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FISH PRODUCTS

By: B.P. Nikitin

Author's handwritten note:

To my dear friend Mr. Dempsey, as a token of my respect and in remembrance of our pleasant meeting and conversations in Moscow.

(signed) B.P. Nikitin
Moscow IV-1968

Survey of Contents

1. The fishing industry as a supplier of raw materials and food products.
2. Indices of consumer value and specific character of the raw materials.

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3. Species of fish used and their characteristics.
4. Survey of market products.
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6. Shipping containers and consumer packaging. Processing and packaging fish.
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Author's Foreword

This work contains information about new, and still relatively little-known, fish in domestic industry and trade.

The book contains a description of several hundred fish species found in no less than 70 families (if the 24 families of eels are considered as a single family) at a time when no more than 30 families of fish have been described in any previous book on the science of commodities. The information is presented with regard for its industrial and market importance and immediate prospects for utilizing certain kinds of fish.

In preparing this book the author has drawn on his personal experience in the fishing industry, where he specialized in marketing, in government agencies for control of product quality, experience in the field of commodities and commercial work in organizations exporting and importing fish products, as well as consultant and arbitration experience. The book includes observations and conclusions that are based on many years of teaching and work in standardization of fish and fish products. This, however, did not prevent him from making wide use of data

provided in the literature.

The scope and contents of the section on sharks in the Chapter "Species of Fish Used and their Characteristics" goes far beyond the limits of the solutions accepted in the description of all the other fish in connection with the given task, which is to quickly organize large-scale catch and proper utilization of sharks, a fish which we have unduly disregarded and about which we still know very little.

In order to obtain a more complete and coordinated picture of commodities it is recommended that this book be used simultaneously with two other books that were published earlier: "Organoleptic Method in Evaluating Quality of Fish and Fish Products"¹ and "Prevention and Removal of Spoilage in Fish Products"².

¹

Published by "Rybnoe Khozyaystvo", M., 1962.

²

Published by "Pishchevaya Promyshlennost'", M., 1964.

Introduction

The world-wide harvest of fish and non-fish products on the open seas began to develop in the middle of the last century. In 1850, the fish catch was 1.5-2.0 million tons. By 1900 it had increased to 4 million tons, by 1929 it exceeded 10 million tons, in 1958 it was 32.6 million tons, and in 1965 it had reached 46.6 million tons. Recently, fishing has been developing particularly rapidly. This is going on in spite of the fact that, on many old fishing grounds, some of the traditional objects of fishery are showing signs of depleted reserves.

Many experts are of the opinion that, judging from the fish reserves in the oceans of the world, the yearly catch could be increased to 100 million tons, i.e., doubled, without harm to the reserves. In the past few years, the world-wide harvest of aquatic products has been about 85-90% fish.

Of the world harvest of fish and non-fish products, about 90% presently comes from the open seas and oceans, while fresh water yields about 10%. The Atlantic ocean (including the Arctic ocean) presently produces about 40% of the world harvest

of fish and other marine animals. The main catch here is made up of herrings, cods, mackerels, tunas, and flounders.

About 56% of the world fish harvest comes from the Pacific ocean. The catch consists mainly of herrings, tunas, cods, salmon and flounders.

The Indian ocean produces about 4% of the world catch. Tunas, sharks, mackerels, sardines and some other fish are taken in this region.

The requirement for fish per person of population in a country depends, evidently, mainly on its geographic position, the catch per person of population, the national taste and traditions, the economic and technical level, the extent to which the population is supplied with meat of warm-blooded animals, animal protein of other types, the possible scale and extent to which it is able to export and import fish and fish products.

According to data provided by FAO, the yearly requirement for fish and non-fish products by weight of edible portion, per person of population, in some countries is characterized by the figures in Table 1.

Table 1

Legend: a- continents, countries; b- period, years;
c- quantity of fish and non-fish products, kgm.

(a)	(b)	(c)
Europe		
Austria	1963/64	3.7
Belgium Luxemburg	1962/63	4.8
Great Britain	1963/64	9.2
Greece	1962	9.1
Denmark	1962	16.0
Spain	1962/63	14.8
Italy	1963/64	5.5
Netherlands	1963/64	5.3
Norway	1963/64	20.4
Portugal	1963	20.0
Yugoslavia	1962	1.1
Finland	1962/63	9.1
France	1957/59	5.7
West Germany	1963/64	6.7
Switzerland	1962/63	4.0
Sweden	1963/64	20.6
America		
Argentina	1962	2.0
Brazil	1962	2.8
Venezuela	1962	6.4
Canada	1960/63	5.6
Columbia	1961	1.5
Mexico	1962	2.6
Peru	1962	7.2
USA	1964	5.0
Uruguay	1961	1.5
Ecuador	1961	5.0
Chile	1962	6.8
Jamaica	1958	11.4

Table 1 (continued)

(a)	(b)	(c)
Asia		
India	1962/63	1.0
Pakistan	1962/63	1.6
Turkey	1960/61	2.5
Philippines	1962	9.7
Ceylon	1963	6.2
Japan	1963	28.8
Africa		
UAR	1962/63	4.9
South Africa	1960/61	8.5
Australia		
Australia	1962/63	5.0
New Zealand	1963	6.7

THE FISHING INDUSTRY AS A SUPPLIER OF RAW
MATERIALS AND FOOD PRODUCTS

Since 1957, Soviet fishermen have been mastering the waters of the Northwest Atlantic and the equatorial waters of Africa. Fishing in the unrestricted regions of the Northern Pacific and in the Indian Ocean has been under development since 1960. Fishery on the open seas and oceans has become a definitive factor in the development of our fishing industry.

The Soviet marine fishing fleet is the material and technical foundation of our fish industry. During the past ten years the fishing fleet has been almost tripled. This fleet has been strengthened mainly by the introduction of large ships which possess a high level of independent operation.

Because the majority of the new ships are equipped with modern refrigeration facilities, all the international fishing waters of the Pacific Ocean are now accessible to our fishery.

The USSR applies scientifically founded physiological norms to the consumption of food products per person of population, including fish, which were developed and

recommended by the Institute of Nutrition of the Academy of Medical Sciences USSR. The total food ration per person of population in the USSR requires an average of 15.7 kgm of fish and fish products per year.

In 1965, consumption of fish products in the country amounted to an average of about 12.5 kgm per person and the planned consumption is 20 kgm per person by 1970.

The physiological norm for consumption of fish and fish products cannot be considered and evaluated without taking into account the norm and size of the actual consumption of meat from warm-blooded animals, their by-products, and other products which are sources of full-value animal protein (dairy products for example).

In terms of wealth and variety, the species composition of the fish caught in the USSR continues to occupy the foremost place in the world, while in terms of catch it is in fourth place.

Growing ocean fishery is characteristic of the development of the Soviet fishing industry during the past 15 years, and is accompanied by a larger catch in more remote regions. The catch in inland waters has not decreased, but the ratio in the total USSR catch has been

sharply decreased and continues to drop. This is precisely the reason why there have been such large changes in the species and technological assortment of products. There have been sharp and continuing changes in the species composition of the catches and in the predominating methods of processing the raw materials.

The fishing fleet includes factory ships that are equipped with highly efficient fishing gear, industrial machinery and mechanized fish-processing lines. By 1965, the fishing fleet had 65% of its total hold capacity refrigerated.

While afloat, these ships carry out a complete production cycle, bringing to shore the fully-packed and ready frozen fish (in blocks), canned products, fish meal and oil, and some ships, including large, floating herring factories, deliver lightly and medium salted herring in barrels and specially (sweet) salted herring in 3-5 liter containers, a product which has rightly won great popularity in a short time. However, a significant portion of the barrelled herring is brought to shore as semi-product for further processing.

Finished products are also brought to shore by new floating canning ships such as the ocean-going ships

of the "Andrey Zakharov" type and others.

Continually greater use is being made of refrigerated transport fleets in order to decrease the amount of time lost by ships in hauling their load to ports in the USSR.

The creation of our ocean fishing industry has accelerated the growth of large modern fishing ports (Kaliningrad, Klaypeda, Ventspils, Liepaya, Riga, Tallin, Murmansk, Nakhodka and others).

The practice of off-loading product directly from the ship to the railroad car, i.e., without off-loading the goods on the wharf at the fishing port, is steadily increasing.

Most of the ocean-going ships on which fish are processed have a much greater production capacity than do shore fish-processing plants. Thus, there has been considerable concentration and modernization of fish processing in our country.

During 1965 more than 60% of the fish were processed on ships at sea. One of the main features of the fish industry, which distinguish it from other branches of the food industry, is the fact that it uses primarily its own resources and raw materials.

The period from 1966 through 1970 will be characterized by the establishment of a system of enterprises which will provide a rational fish economy on the Caspian, in the Sea of Azov and Black Sea, on the Baltic, in the Sea of Aral, on the lakes and rivers of European USSR, in Central Asia, in the better developed regions of Siberia and the Far East, and also on water reservoirs.

At the present time, the greatest volume of landed fish and greatest prospects for development of fishery consists of the following: argentine, batterfish, Azov-Black Sea goby, roach, pink salmon, Far East flounder, gilthead, keta, Caspian kilka, bream, walleye pollock, ocean perch, sturgeon, haddock, Pacific saury, Baltic herring, sevriuga, Atlantic herring, Pacific herring, mackerel, scad, zander, cod, anchovy and hake. 9

Of the large number of species in the assortment of fish having nutritional value, the 25 names given above make up 82-83%, while the remaining numerous species comprise only 17-18%.

The catch of some kinds of fish of certain of these 25 species is determined, at the present time, by the ratio in percent of total catch (for example, argentine, pink salmon,

keta and mackerel), whereas the catch of other fish amounts to 10-12%.

Landings of 7 species made up more than 52% of the total catch in 1966 (Far East flounder - 2.7%, ocean perch - 5.5%, Atlantic herring - 11.5%, Pacific herring - 6.2%, cod - 8.5%, hake - 9.6% and walleye pollock - 8.2%).

The importance and scale of the break-through during the past 15-20 years in our fishing industry can be seen from the fact that, of the 25 major species caught by the USSR, more than 1/3 are those which previously had been almost or completely absent from the harvest. There are scores of other fish species that could be added to this list, but the catch, by the USSR, is somewhat more limited or less frequent.

The volume, assortment and quality of the fish products of our industry still do not fully satisfy consumer demand.

Our technology for producing fish food products has its own peculiarities.

The domestic assortment has, for example, traditional varieties that are in great demand by the Russian population,

even though these are very plain in appearance, such as salt-dried smelt, dried fish (taran, roach, bream), unique cured fillets of salmon and sturgeon fishes, lightly salted salmon, as well as salmon and Amur river autumn keta prepared like salmon. Delicacies in the assortment are soft and pressed sturgeon caviar, as well as soft caviar of Pacific salmon. There are also many unique fish and fish-plant preserves.

In variety and originality of assortment, / 10
our fishing industry is quite different from that of many large countries having a well-developed fishing industry.

However, the major technological advance by the USSR fish industry is in further increasing the production of live, iced and frozen fish, including frozen fillets.

Herring and sardines are going to be used both in the production of hors d'oeuvre goods and as raw material for basic food products to be processed both at fishing industry enterprises and at centers of demand (in the retail trade, community feeding and in the home).

Our fishing industry output of fish products by main categories is characterized by the data given in Table 2:

Table 2

Product	Output, thous. tons			
	1963 r.	1964 r.	1965 r.	1966 r.
Fish, live				
iced				
frozen (excl. filleting) . .	23,3	28,2	30,7	39,3
salted (excl. herring) . .	125,4	128,9	125,6	116,5
	989,7	1176,0	1442,8	1604,7
	372,9	242,5	232,0	165,8
Salted herring	631,3	733,4	550,7	523,0
	64,4	72,7	79,1	81,0
Fish, smoked	15,2	16,7	14,6	15,1
dried	87,7	96,0	85,4	127,5
spice-brined and marinated .	7,8	10,3	11,1	10,3
	5,6	6,5	7,9	8,5
Cooked fish products	2335,8	—	2604,3	2712,0
	761,1	—	709,9	704,6
Cured fillets and semi-products .				
Total commercial output of food products, excl. canned . . .				
Herring of all types				

Production of canned and preserved fish is growing considerably and, in 1966, it was 1032 million standard cans, including: canned product in oil - 222, in tomato sauce - 357, au naturel - 104, fish-vegetable - 133, other fish - 3, whale - 8, other sea products - 2 and preserves - 175 million standard cans. Output of preserves made from uncut, fat herring sweet salted in large tins (3-5 kgm each) was 118 million standard cans.

The products from fish-processing enterprises made from the iced, frozen and salted fish shown above will, in the retail network, significantly change the ratio in the assortment of fish products received by the consumer.

In 1966, the RSFSR Trade Ministry enterprises produced the following quantities of fish food products:

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Product	Output, thous. tons
Fish, hot smoked	19.1
cold smoked	47.3
Fillets	8.1
Spiced and marinated fish products	41.3
Cooked products	14.1
Cooked fish semi-products . .	19.4

Thus, those retail enterprises which are in the Russian Federation alone, produce almost as much smoked fish and filleted products as do all the enterprises in the Soviet Union that are included in the fishing industry system, and about three times as much cooked fish products and semi-products as do all the enterprises in the fishing industry. If we take into account the production of smoked

fish at retail enterprises in the remaining 14 Republics of the Union, then the output of smoked fish in the Soviet Union will be at least 170,000 tons per year. Production of spiced and marinated barrelled fish products has been accelerated only recently and has been tripled in the retail system. Presently, the task of organizing large scale production of cooked semi-products at fish industry enterprises is being considered. The best cooked fish semi-product are fillets which are prepared and frozen at sea from fresh-caught fish.

Of course, it would be expedient to definitely increase production of pond fish. This very high quality fish is the cheapest. Increase production of pond fish is accomplished by developing new reservoirs and increasing productivity by means of intense application of mineral fertilizers and foods, enriching the food mixtures, and changing from a single crop of carp to a multi-crop system in order that such vegetarian fish as, for example, grass and silver carp fish could feed on the grass left by the other carp in the same reservoir.

Commercial production of fish is now being organized in worked-out peat beds, as well as in irrigation systems.

While developing pelagic fishery near and far from home, one should not discount the necessity for continuously and seriously improving the fishing economy within the country by rejuvenating and increasing reserves of nutritionally valuable anadromous, diadromous and fresh-water fish for which our country has always been famous.

INDICES OF CONSUMER VALUE AND SPECIFIC CHARACTER
OF THE RAW MATERIALS

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In the Soviet Union, hygienists are guided in their research and practical work by prophylactic considerations for protection of health and in developing rational diets directed towards prevention of disease, increasing the work capacity of man and extending his lifespan. They study and develop hygienic norms of nutrition and quality of products with regard for the physiological value, as well as the qualitative and quantitative dietary norms (taking into account the age, sex, work, climate, state of health and other factors and conditions in human life).

The hygienists make use of data and the research methods of physiologists, chemists, microbiologists and biochemists when preparing a hygienic description of food products and determining their value for the human organism. Collaboration among hygienists, technologists and retailers is very useful for this purpose.

Sanitation measures for providing the population with good quality and nutritious food, which are applied in accordance with physiological and hygienic regulations, as well as the practical application of scientifically

based sanitary norms in feeding are properly the domain of food sanitation.

The results of hygienic research, which are the basis for developing the norms, rules and instructions for food sanitation, and issued by the Soviet Government, as well as by the sanitation Departments of the USSR and Member Republics, are utilized by hygienists.

A distinction is made between the elementary chemical and molecular chemical composition of fish. The elementary composition is characterized by the quantity of individual chemical elements in the whole fish, as well as in the various organs and in the fish meat. The body of a fish contains about 60 chemical elements.

The molecular chemical composition of fish stock and fish products (earlier this was rather unprecisely called the bulk chemical composition) is the amount of individual chemical compounds (or groups of related substances, for example, protein), it specifies the nutritive, hygienic, protective-medicinal or technical value of the fish stock or ready product, as well as the degree of its overall and sanitary level of quality.

The commercial food and hygienic evaluation of fish and fish products, as well as their utilization, without indicating the molecular chemical composition, is impossible under modern conditions. This composition is basically defined by the amount of water, the total quantity of nitrogenous substances, which is conventionally known as albumen (or raw protein), fat, as well as the total amount of mineral substances (ash).

The protein content in the meat¹ of the great majority of commercial fish, if one ignores the period of spawning emaciation, normally varies between 14.5-21.0%. Mineral content is 0.9-2.0%, water 56-85% and fat 0.1-33.0%.

The most constant value is normally the total percent content of water and fat in the meat of various species of fish. It is almost always about 79% (variation + 2%), and therefore the total quantity of water and fat in fish meat is conventionally taken to be a constant value.

¹

The fish body muscles with the included friable connecting and fat tissue, blood and lymphatic vessels, as well as tiny inter-muscle bones are called meat.

The commercial nutritional value of fish meat depends on its fat content, and the fluctuations in fat content can be very large (from 0.1 to 33%). In this respect it is convenient to divide all commercial fish into categories on the basis of this very important property. Fish are most often divided into four categories (in relation to the average fat content in the meat of raw fish from the commercial catch):

Fish	% Fat Content of Meat
lean	less than 2
medium fatness	2-5
fat	from over 5 to 15
very fat	over 15

The bulk of fish in the pelagic catch are characterized by fat content in the meat of up to 2% and an increased amount of protein (about 20% and higher). Exceptions are some species of ocean fish which display lower protein content or greater fatness. There are ocean fish which are poor in protein, but at the same time very fat, but these are few.

Fish products include vitamins, enzymes and other organic compounds. Because of their composition or insignificant

amount, some substances do not improve the nutritional value of the product, but they give it a specific aroma, taste, colour and other properties which have a positive effect on the nervous system and digestive organs and enhance the products.

During the life of a fish, the chemical composition of the tissues in its body changes continually. Depending on the species and the biological condition of the fish, these changes are sometimes very significant. Study of the chemical composition of fish is of scientific interest and is absolutely necessary for trade and commerce.

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The nutritional value of fish and fish products changes in relation to the changes in their chemical composition. The nutritional value of any food product is the most important index used to determine its commercial value.

The chemical composition of fish meat depends on the time and place of catch, on the age and sex of the fish, as well as on environmental conditions.

In contrast to warm-blooded animals, whose body temperature is always maintained at the same level, the body

temperature of fish changes in association with temperature changes of the environment. When the water in which the fish live becomes very cold, many of the fish become semi-rigid and stop feeding. At this time the fat accumulated in the body of the fish is consumed, and there also are changes in the composition and total amount of nitrogenous substances. There is a significant decrease in the fat content and partly of protein in the fish meat towards the spawning period, during spawning and immediately after it. An important part of the catch is made up of anadromous fishes, i.e., those which ascend the rivers from the sea for breeding. The fat and protein content changes abruptly in the meat of salmon entering fresh water from the sea for breeding. In its travels to the spawning grounds, which normally lie at the headwaters of rivers, the salmon sometimes covers distances of up 2,000 km, fighting the current along the entire route. The fish is in constant motion all this time, it does not feed at all and finds itself in fresh waters that are unnatural to it after its lengthy stay in the ocean. For some salmon, this complete fasting period lasts for a year and even more. Having expended an enormous amount of energy covering the route to the spawning grounds, and having consumed a large amount of

protein and fat in the production of roe and milt (the mass of which, in relation to the total mass of the salmon, is, at the moment of spawning, up to 15-20% for females and a little less for males), the fish is in a state of deep exhaustion at spawning time.

Some species of fish are so emaciated after spawning that they immediately die (black-backed shad, Far Eastern salmon and other fish).

Spawning is the main factor causing emaciation of fish. The pre-spawning condition of fish does not effect the commercial value of the products. Fish taken at spawning time (running sexual products) or immediately after spawning (downstream-migrant) is, in the majority of cases, commercially and nutritionally unsatisfactory.

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Following spawning, the fish meat becomes not only less nutritious, but also flaccid, unstable, its colour becomes dull, the aroma and normal taste disappear, there is a sharp drop in its nutritional value because of the enormous loss of fat, considerable loss of protein, and pronounced hydration of the meat.

Postspawning fish, greatly depleted of nutritional substances, yields a product of much lower assimilability.

Some authors suggest that, because of spawning, the fish meat loses a considerable amount of irreplaceable amino acids.

Most fish have unique features. The chemical composition of cod fish meat during the growing period or emaciation changes very little, but there is an increase or decrease in the size and weight of the liver. Some fish, having been depleted in association with cessation of feeding and low temperature conditions of the benthos (for example some flounders and other flounder-like fishes), lose fat and protein, while their muscles become structureless.

Postspawning fish is considered to be a low-value object of fishery and is not recommended for food.

Restoration of fatty and protein substances in the body of the fish requires from 20 to 60 days, depending on the species of fish, the conditions in which it lives and other factors. (Its overall food value is restored in about the same period).

A sure sign of possible spawning emaciation of fish is the condition known in ichthyology as the breeding color. The female in breeding color has small white or whitish protuberances on the head or body (carp fishes), and its fins become elongated; the male takes on bright coloration, a hump appears on its back, and the jaws become curved (many salmon fishes).

Enormous national economic importance is attached to the organization of fishery in such a way that the fishing places for any particular species of fish are intelligently selected and utilized. Whereas, earlier, the fish was landed in any biological condition whatsoever, in recent years a farsighted approach has been taken to this vital problem. For example, until recently Atlantic cod was landed in any state (even immediately after spawning with meat fatness of 1-3%), and Pacific ocean cod was taken almost exclusively during the spring when it made its spawning approach to the shores. Nowadays, fat ocean cod predominate in our catch.

Whereas, earlier, Pacific Ocean salmon were taken not only at sea, but in great numbers in the estuaries (as well as along the middle and upper reaches) of rivers,

nowadays the catch is concentrated almost exclusively at sea.

If, in the future, fewer downstream-migrant fish are taken in Siberia, considering them to be unsuitable, and, for example, lesser quantities of spring herring and kilka are taken and the effort is concentrated on the autumn, fatter herring and kilka then, in the final analysis, there will be great benefit to the consumer, to the industry, to the national budget and to the fish reserves.

During spawning the fish loses about $1/3$ of the total amount of nutritive substances, together with the roe and milt, taking into account only the edible parts of the fish prior to spawning. During this process the fish loses about 30% of its proteins.

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The caloricity of Atlantic herring caught in April and May is 2.5-3.0 times lower than the caloricity of the same herring when caught during the period of greatest fatness.

If the cost of both kinds of herring is the same, and the same kind of products are prepared from these herrings, while the difference in the commercial-nutritive

and consumer value is enormous (not only according to indices of caloricity), it would then become obvious that fishing for lean ocean herring to be used for food purposes cannot be profitable and expedient from any point of view. Nor does the consumer require such herring. Therefore, such catch is curtailed as much as possible.

Goods managers and technologists make use of accepted indices for determining the stage of development of the sexual glands (roe, milt) of fish. Six stages of development of the gonads (sex glands) are known:

Features	Stage
Glands not developed (immature fish)	I
Glands in the initial stage of development; there are signs of sex (roe, milt). The stage is characteristic of sexually maturing fish or mature fish soon after spawning	II
Glands not mature but fairly well developed (fish is preparing for spawning)	III
Glands fully matured, they have reached full development	IV
Roe or milt easily forced out of the anal aperture (running sexual products, spawning period)	V
Roe and milt expended (deposited), sex glands are sagged, flaccid, inflamed (red), fish through spawning	VI

In mature specimens (those species which do not perish after spawning) there is a change directly from stage VI to stage II.

Individual specimens of fish of the same species and even of the same size, caught at the same time of the year, but in different water bodies, frequently differ greatly in their commercial-food value (the amount of food and other conditions of the environment cause a difference).

The smaller the specimens of certain families and species of fish, the less valuable they are. This is explained, not only by the different ratio of unedible parts (small specimens have more waste), but also by the lower fattiness with greater amount of water in small specimens, particularly immature ones. However, this does not apply to all species of fish. There are inverse ratios also, the older and larger fish being less valuable.

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Given the same age and environmental conditions, the females of the species in a majority of cases are larger than the males. During the period of intensive development of the sexual products and immediately after spawning, the females normally become more emaciated than the males.

Frequently the same reservoir during the same fishing season will contain certain species of fish which, in different years, have different weight and fattiness. This is connected normally with changes in the amount of food in the reservoir or some other factor.

It must be remembered that the composition of the meat from different parts of the fish will be different, particularly for large fish. For example, in many fish there is observed a regular increase in fat and meatiness of the body farther away from the head parts and near the anal aperture; along the back the amount of fat in the meat normally decreases from the head towards the tail. The fat humps of some whitefish and ide, as well as the dark (brown) meat of fish have greater fat content than the meat from the other parts of the body. Dark meat is found along the lateral line the entire length of the body; this meat is distinguished by its excellent taste and contains up to 30-45% fat even in many fish of medium fattiness. Exceptions are tunas and some mackerels whose dark meat is less valuable than the light meat both in fat content and consistency.

The nutritional value of the product is determined on the basis of its good qualities, i.e., the absence of

unnatural or unpleasant odours, aftertaste, abnormal external appearance, consistency, as well as foreign inclusions and harmful substances (salts of heavy metals, the products of protein decay, oxidation spoilage of fat etc.).

For a universal evaluation of the food value of the edible part of the product it is important to know the degree of assimilability (digestibility) of the fat and protein by the human body. When food is brought into the human body, a part of it is absorbed by the intestinal villi and is taken up in the blood, i.e., it is digested by the body, and part of it leaves the body together with the liquid and solid excretions. By taking as 100% the amount of food entering a healthy body and taking into account the amount that is excreted from the body, it is possible to determine the percentage assimilation of food by the body. The level of assimilability /18 mainly depends on the extent to which the process of preparation had preserved the full value of the fat and, particularly, the proteins in the meat.

Fish fats have very high assimilability in comparison with other fats. This is explained by the liquid consistency of fish fats and the nature of the main fatty acids in the composition of fish fat. The assimilability of good quality fish fat normally varies between 96.4 and 97.0%. The fat in dried and smoked fish, cured fillets, lean and fat salted fish, and also sturgeon caviar, are characterized by high assimilability (96.7-97.2%). The indices cited refer to high-quality fat. If the fish fat has undergone oxidation spoilage its assimilability and physiological value will have been essentially changed, and the accumulated decay products in the fat can be toxic or have other undesirable properties that are harmful to the organism.

The assimilability of food also depends on the ratio of the amount of proteins, fats and carbohydrates. When there is a surplus of fat the assimilability of protein and all other food is lowered.

Food qualities such as taste, aroma, nutrition, as well as the ability to satisfy, are not dependent merely

on the amount of fat, protein and other substances in the fish meat. These qualities largely depend on the method of preparing the food product. For example the assimilability of proteins that have undergone prolonged action of large amounts of salt (strong salting) or lengthy exposure to high temperatures (hot drying, sterilization of canned products), will be essentially lowered. It is therefore important that during all commercial and cooking processes the fish should not be over-exposed to the action of salt and heat.

The best method of preserving all the natural food properties of fish is to cook the prepared fish on a screen above boiling water (steaming), bake or hot smoke it. The next best method is to cook the fish in water.

The assimilability of fish food (as all other food) is strongly influenced by the aromatic and gustatory substances contained in fish meat. They induce abundant flow of digestive juices and at the same time make it easier to digest and assimilate the food. Aromatic and gustatory substances are not sources of energy and are

not a building material, but their importance in food preparation is enormous. Practical experience and scientific study of the digestive processes both show that food which is not good to the taste and has an unpleasant odour or simply is toneless in both taste and odour is poorly digested and assimilated. This is explained by the fact that the organism does not react to the presence of such food in the digestive system by secreting the necessary amount of digestive juices.

Assimilability of protein depends on the mineral composition and vitamin C content of the food. Consequently, to insure high assimilability of fish it is very helpful to have it with a garnish of fresh vegetables. Having fish with a variety of vegetables is a necessary condition both for excellent assimilability and for the best physiological effect overall.

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The assimilability of the eaten product is strongly influenced by the presence of a normal appetite and the degree of satisfaction with which the food is eaten.

Normal organoleptic properties of the product corresponding to the habitual impressions the consumer has of them are of great importance to the digestion.

When the food product satisfies the consumer in its external appearance, odour, taste and consistency it arouses those favourable emotions that are necessary to stimulate the appetite and at the same time it ensures that the food will be fully assimilated. Because of this it is absolutely necessary to have an organoleptic evaluation when determining the food value of the product.

The most widely used indices of quality of foods, including fish products, are organoleptic data. Man daily organoleptically evaluates his food, as well as the raw material and semi-product.

However, those properties of food which have a decisive effect on its physiological value, but cannot be organoleptically evaluated, i.e., the organic composition of the food, is much more difficult to control and is therefore not often the subject of evaluation and discussion.

At the same time the physiological requirements in the composition of food products (mainly in relation to the

amount of full-value protein, mineral salts and vitamins) in combination with its organoleptic qualities must be the basis for standards of quality of the products and selection of methods of technological and consumer utilization of the raw materials (including fish).

Modern nutritional science has recently been significantly developed, which is quite proper because the complex tasks in correctly organizing nutrition are inseparably associated with the problem of health, work capacity and longevity of man.

It has been proven that fish fare is healthier and more hygienic. It is very beneficial to alternate the meat of warm-blooded animals with fish meat in the food ration. It is also certain that people who eat mainly fish live longer, have fewer illnesses and do not have the deficiencies of old age that affect people who have misused the meat of warm-blooded animals.

The level of secretion by the digestive organs in old age is significantly lower, and it is therefore specially recommended that elderly people eat products and foods that are most easily digested by enzymes, particularly fish products.

The value of fish food products depends mainly

on the following factors:

- 1) the ratio of edible to non-edible parts;
- 2) the amount of protein and fat in the edible part (in relation to the standard calorificity of that part);
- 3) condition and assimilability of the proteins and fats;
- 4) amount of other substances that are of value to the human organism (vitamins, amino acids and mineral substances);
- 5) the appetite aroused by the appearance and odour of the product, as well as from subsequent sensations aroused when the fish product or course is eaten;
- 6) the standards and indices of quality for the product (variety, category of fat, salinity, sometimes the size of the fish, and also the sanitary condition of the packaging).

The meat of most commercial marine fish has a specific aroma of the sea, while the meat of some fish has a pleasant acetic aftertaste. This gives the product

a special piquancy which is fully appreciated not only by the epicures, but also by the majority of consumers who have a taste for marine fish. Commonly, after eating marine fish for a long time, the aromatic and taste qualities of fresh-water, diadromous and many anadromous fish are found to be inadequately expressed, and such fish frequently no longer meet the taste requirements of consumers who have become accustomed to the incomparable features of marine fish meat.

Some people think that food prepared from fish products is less nutritious, since the consumer feels less satiated than he does after eating the meat of warm-blooded animals. This is possible, since the feeling of satiation following eating various foods is in direct relation to the time taken for digestion of the food by the digestive juices in the stomach, and also on the amount of juices secreted. The meat of warm-blooded animals is digested more slowly than fish meat and therefore, after eating the meat of warm-blooded animals, a great feeling of satiation is experienced, but this does not mean that fish meat is less nutritive and good.

Heavily salted fish or cold-smoked products give a greater sensation of satiation than fresh fish that has been cooked, baked or fried, even though the organism more poorly assimilates protein of cold-smoked or salted fish, which is explained by the denaturation of protein and thickening of the meat. This feature of fish products cannot be ignored if it is remembered that man reacts to the sensation of hunger more in relation to the condition of the entire digestive system than to the real need of the organism for nutrition.

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In order to prolong the sensation of satiation, it is necessary to have fish in combination with an abundant amount of vegetables and sufficient (but not excessive) amount of fat in the food.

When determining the quality of fish products it is important to distinguish between first, second and third degree properties. For example, frozen, glazed sturgeon in one lot which has been stored at lower temperature may have a commercial defect resulting from fins having been broken off, whereas frozen sturgeon of another lot may have the fins on, but the fish had not been glazed and as a result of a long period of storage at -8 to -12°C had acquired distinct

traces of fat oxidation spoilage. Naturally, the first qualitative feature is of a third degree, whereas the second is a first degree qualitative feature and a decisive one. Evidently, the consumer will not suffer if the cooked fish has its fins broken off, but if the fish meat smells of oxidizing fat and has a bitter taste it is without doubt of poor quality.

Standards normally establish only the main qualitative properties. If the other properties are mentioned at all, then it is only when there is discussion concerning the permissibility of comparatively insignificant or practically unavoidable defects.

A food product should be not only harmless, but also as nutritious as possible. Technologists are duty-bound to produce products that have the highest level of assimilability, caloricity, vitamin content, have the best external appearance, taste, aroma, which have preserved, emphasized and even developed all the natural valuable properties of the raw material in both the hygienic-nutritional and in the gastronomic, medicinal, protective and dietetic senses. Each of these factors is vitally essential.

In the gastrointestinal tract the food proteins

decompose into various amino acids, the number of which depends on the composition of the protein. Even the smallest arteries in the vascular system perform very complex work in reducing protein molecules. Each amino acid has its special purpose in the nutrition of man. Some amino acids are not synthesized by the organism. These are called irreplaceable amino acids.

Proteins which do not contain at least one vitally necessary amino acid are inferior in the physiological sense, particularly for a growing organism.

If the organism does not receive a sufficient amount of full-value proteins from food to cover expenditure of energy, for regeneration and to stimulate the functioning of the endocrine glands, then it must use the protein in its own tissues.

Fish contains all the irreplaceable amino acids: arginine, valine, histidine, isoleucine, leucine, lysine, methionine, threonine, tryptophan, and phenylalanine. This also determines the special value of fish as one of the highest quality sources of protein food.

The absence or deficiency of irreplaceable amino acids

in food products leads to growth arrest, reduction in body weight, and also causes various illnesses. Every amino acid has its minimum which is necessary for the proper development, growth and nutrition of the human or animal organism.

For example, deficiency of the leucine and isoleucine causes skin diseases, the absence of valine is one of the causes of poor coordination.

Since the identification and determination of the amount of separate nitrogenous substances is a very complex matter, a general description of the chemical composition of fish and the separate parts of its body, as well as the fish products, is normally limited to determining its total nitrogen content. The total amount of all the nitrogenous substances commonly known as crude protein is found by multiplying the amount of total nitrogen (in percent) by the coefficient 6.25. Nevertheless, the organization of the most advanced and reliable research on the edible part of the fish and fish products for determining and studying the various amino acids and nitrogenous extractive substances is a very important task which has recently been successfully approached with the help

of specialized equipment.

A summary composed on the basis of available data shows that the content of irreplaceable amino acids in the meat of various fish was found during research to have the following very significant fluctuations:

Amino Acid	% in relation to protein in the meat
arginine	1.7-12.8
valine	0.6- 9.4
histidine	0.6- 5.7
isoleucine	1.4- 8.5
leucine	1.4-18.0
lysine	1.3-14.4
methionine	0.6-14.8
threonine	0.5- 6.2
tryptophan	0.1- 1.8
phenylalanine	0.6-14.8

Table 3 shows the average amount of irreplaceable amino acid in the meat of five large object of ocean fishery, Atlantic herring, sardines, haddock, ocean perch and mackerel.

Table 3

Fish	Amino acid in % of protein in the meat									
	аргинина	валина	гистидина	изолей- цина	лейцина	лизина	метио- нина	треонина	трипто- фана	фенилала- нина
Atlantic herring	a	b	c	d	e	f	g	h	i	j
Sardines	5,5	5,0	2,4	4,9	7,1	7,8	2,7	4,4	0,8	3,4
Haddock	5,1	5,2	4,7	4,6	7,2	8,4	2,8	4,3	1,0	3,7
Ocean perch	6,1	5,3	2,1	5,5	8,1	8,8	3,0	4,9	1,0	3,9
Mackerel	4,3	5,0	1,6	6,8	11,4	14,4	2,6	5,1	0,1	4,4
	5,5	5,2	5,4	5,0	7,4	8,5	2,8	4,5	1,0	3,8

a- arginine; b- valine; c- histidine; d- isoleucine;
 e- leucine; f- lysine; g- methionine; h- threonine;
 i- tryptophan; j- phenylalanine.

Fish meat protein, if it has not been denatured by improper processing, is no less assimilable than the protein in the meat of terrestrial animals. The nutritional value in terms of amino acid composition is no less than that of meat of warm-blooded animals, and sometimes is greatly superior to it.

The time is now gone when the consumer value of any kind of fish can be determined without taking into account the indices showing the amino acid composition of the meat, and the amount of certain mineral salts and vitamins.

This detailed evaluation is of great importance in determining the correct technological utilization of any kind of fish, for establishing the proper rates when determining the prices, for timely, complete and correct information directly to the consumer, as well as for wholesale and retail trading networks, organizations and enterprises concerned with mass feeding.

Commodity descriptions of fish and fish products are necessary particularly for fully understanding and foreseeing the behaviour of a product under certain conditions of packaging, shipment and storage.

The preparation of commodity descriptions of fish that are new objects of our fishery is sometimes confined to the study of only a few, and sometimes only one specimen of the fish. Also, it is not always known where and when the fish had been caught. Even if the fish is represented by a considerable number of specimens taken at a known time and in a known place this is still not enough for a final food commodity description.

Fish can be reliably described from this point of view only after the most basic indices have been determined

on the basis of a study of the raw material from the moment the fish is caught, taking into account the season of catch, the fishing ground, as well as length differences (age differences) typical for the catch. If the description / 24 is based on the first, random specimen obtained and, on the basis of such fragmentary materials, hasty decisions are made concerning processing, then this can only result in gross errors. Special care and a sense of responsibility are also necessary when prices are being fixed, and in no way less than when selecting technological methods of processing.

The study of the properties of new objects of our fishery require special attention, since these studies serve as the basis for determining both the consumer cost of the finished product and the technological method of processing the fish. This approach is fully applicable also to the study of the most commercial fishes.

Because fat is the main source of energy its amount varies greatly with age, in relation to the season of the year, changes in feeding associated with lengthy migrations, spawning etc.

Every species of fish deposits fat on parts of the body in a unique fashion. On sturgeon and salmon fish the

main accumulations of fat are found between the muscles, between the skin and the muscles and also in the abdominal cavity; in the cod fishes it is found in the liver; in the percid fishes it is found in the abdominal cavity. In many carps very important deposits of fat form on the stomach and intestine during the pasturing period.

Fish fats and vegetable oils liquify at temperatures below 37°C . A large part of fish fats contains from 20 to 30% saturated and from 70 to 80% unsaturated fatty acids. Polyunsaturated fatty acids contain more than one double bond in each fatty acid molecule. Edible vegetable oil contains not over 3 double bonds, while molecules of fatty acids of fish fat contain 4, 5 and even 6 double bonds. This is precisely the reason for the high degree of polyunsaturation of fish fat in comparison even with vegetable oils. The highest amount of polyunsaturated fatty acids was found in pink salmon by American scientists.

Many cardio-vascular illnesses are associated with the quality and the properties of fats consumed by man. Consumption of surplus amounts of fat, as well as fats containing mainly saturated fatty acids, is conducive to the deposition of cholesterol in the vessels, which results in atherosclerosis at a certain age and under

certain conditions, as well as in the formation of thrombi.

The increase in cardio-vascular illnesses is usually associated with an insufficiency of polyunsaturated fatty acids in the diet and a preponderance of saturated fatty acids.

Until recently, dietitians felt that it was better for elderly people to eat the lean meat of fish, and stressed the easier assimilability of lean fish meat. One should not discount the favourable effect of fish fat on an organism as well, particularly to elderly people.

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U. Notervap, on the basis of multilateral and detailed research carried out by him, came to the conclusion that the food ration of people suffering from atherosclerosis should contain a sufficient amount of polyunsaturated fatty acids.

Professor Notervap noted the following interesting regularity. When, in Norway, they used natural, unhydrogenated fish fat in their food, coronary heart ailments were a rare exception. With increasing use, in that country, of hydrogenated fish fat (poor in polyunsaturated fatty acids) there has been a significant increase in the occurrence of

coronary heart ailments and atherosclerosis.

Natural fish fat can and should have a positive effect in the normalization of human diet.

Highly unsaturated fat is particularly effective as a means of lowering the cholesterol level in the blood. In this case its effectiveness is proportional to the degree of unsaturation of the fat. The unsaturation of fish fats is more than twice that of unsaturated vegetable oils. This is precisely why fish fat is so effective as a substance for lowering the level of cholesterol in the blood.

Taking 30 grams of fish fat lowers the amount of cholesterol contained in the blood of a man by 7%. It is therefore recommended that both adults and children take some form of fish fat daily, preferably in medicinal preparation.

There are highly unsaturated fatty acids which are so important to the human organism that they are considered to be absolutely necessary. These acids cannot be synthesized in the human organism and therefore must be a part of the diet.

The most biologically active polyunsaturated fatty acids are linoleic, linolenic and arachidonic acids. Food containing these three acids is particularly valuable. The absence or deficiency of these fatty acids results, in part, in a vitamin deficiency in the organism.

Fish is a source of vitamins A₁, A₂, B₁, B₂, B₆, B₁₂, C, D, E, PP. Fat-soluble vitamins of the groups A and D are contained mainly in the internal organs of fish (very small amounts in muscle tissue), while vitamins of the B group (water-soluble) are found in almost all the parts of the body including the meat.

The amount of vitamin A in fish liver varies within 30 - 8400 i.u. per 1 gm of liver. One gram of liver fat contains from 70 to 216 i.u. vitamins of the D group. In addition, fish fat contains a large amount of provitamin D. After irradiation with a mercury-quartz lamp PRK-4, the amount of vitamin D in cod liver fat reaches 3,000-7,000 i.u. per one gm of fat.

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Fish have the biological ability to accumulate enormous amounts of fat-soluble vitamins A and D in their internal organs.

In addition to the fat-soluble vitamins in the various tissues and organs of fish and marine mammals there are also water-soluble vitamins such as B₁ (thiamine, aneurine), B₂ (riboflavin), B₁₂ (antianemic factor) and PP (nicotinic acid).

As a rule, the amount of vitamin A in fish liver increases with increasing size or age. The vitamin A content in almost all the fish studied changes according to the season of the year. During the spring and summer period, the livers of fish of the same species are found to contain more vitamin than during the fall and winter period. The vitamin A content of fish liver fluctuates more during the spring than in the fall.

Vitamin A is a cure and preventative for eye ailments (antixerophthalmic effect), it improves the eyesight, increases the organism's resistance to infectious diseases and encourages growth. One gm of crystalline vitamin A = 4.3-4.5 million i.u.

Vitamin D is the collective name for fat-soluble vitamins which prevent rickets and other bone ailments. Vitamins D₁, D₂, D₃, D₄, D₅, D₆, and D₇ are known. Vitamins D₁ and D₂ have the same biological effect in the pure state,

but preparations of D_1 contain a biologically inactive part.

Undoubtedly, fat takes part in the maturing process of salted, dried, cold-smoked and canned fish meat. We are speaking of all the phenomena involved in maturation.

Fish meat is also very valuable for its content of physiologically important mineral substances. They have a most important biological and physiological role in the organism. Therefore, when evaluating the physiological superiority of one or another kind of food, serious attention is given to the presence of macro and ¹microelements .

In spite of their small amounts, microelements have a very important physiological function. Of the macroelements contained in fish meat the most valuable are the compounds of phosphorus, calcium, magnesium, iron and potassium.

¹

Elements which are found in fish in amounts greater than 0.5 mgm per 100 gm of raw material are called macroelements, those found in lesser quantities are called microelements.

Fish meat contains such microelements as iodine, copper, arsenic, cobalt, manganese, zinc, lead and a number of others. Arsenic is mainly found in fat-rich fish tissues in the form of fat-soluble compounds. Ocean fish, particularly their fatty tissue, contain much iodine.

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The amount of microelements in fish meat changes essentially in relation to the species and environment. Microelements are distributed very irregularly in the various parts of the body and organs of the fish.

Mineral substances have a significant influence on the colloidal properties of cellular proteins, they counteract changes in the pH of the blood while, at the same time, they maintain the normal course of the vital processes and constant osmotic pressure in the cells and tissues of the organism.

Some elements are included in the composition of complex organic substances; for example, iron is included in haemoglobin, and therefore iron salts are necessary for haemopoiesis and respiration in man. An iron deficiency in the organism results in anaemia.

Potassium salts play a particularly important role in cardiac activity.

Manganese, magnesium and copper are found in a number of enzymes. Calcium and sodium ions affect the excitability of the cerebral cortex.

Calcium salts are needed for formation of teeth and bones, they encourage assimilation of food and normal blood coagulation, and they improve the functioning of the heart and nervous system. Calcium, magnesium and phosphorus salts take part in the formation of bony tissue. Calcium and magnesium are very important for ensuring normal functioning of the cardiac and skeletal muscles.

Phosphorus is required for building and feeding nervous tissue. Phosphorus salts are required for bone formation, they are part of the nervous system and they regulate carbohydrate metabolism.

In order for calcium to be best assimilated by the organism it must be taken in definite ratios with phosphorus. The required ratios of calcium and phosphorus are found in the meat of most fish, in carrots, beets, onion, cabbage, tomato paste, but this valuable feature

is not found in potatoes and grits. As a result, it is not desirable to replace the above-named vegetables with grits or potatoes in fish-plant preserves.

Copper and cobalt are needed for haemopoiesis processes, manganese takes part in bone formation, iodine is required for normal functioning of the thyroid gland.

It is natural for fish to accumulate iodine in enormous quantities from the environment.

The bulk of the mineral (ash) substances consists of potassium, sodium, calcium, magnesium, phosphorus, chlorine and sulfur. They are found in the fish organism in various quantities, having entered from the environment with food and accumulating by way of osmosis in the body of the fish. Consequently, the chemical composition of the ash substances in the fish body depends both on the environment (sea or fresh water) and on specific features of the fish which are associated with its systematic position and the selective capabilities of the organism.

Ocean fish concentrate more boron, iron, lithium, copper, calcium, potassium, cobalt, magnesium, manganese, strontium, bromine, phosphorus, fluorine and iodine in their bodies than do fresh-water fish.

The wealth of mineral substances in the meat of ocean fish places it among the products which best provide for the metabolism in the human organism, while among the widely-used animal proteins it is undoubtedly foremost.

Fish in general, and ocean fish in particular, is very useful for feeding people, particularly those over 40 years of age. From this age onward the chemical processes associated with the metabolism begin to gradually break down to some extent in the majority of people, and this breakdown tends to increase, particularly when normal health rules are not observed.

Fish and marine invertebrates are the best sources of biologically first-class protein including all the vitally necessary macro and microelements and amino acids in the required proportions.

The assimilation of fish by the human organism is made considerably easier by the absence, from fish meat, of coarse cellulose and the various films of connecting tissue of which there are so many in the meat of warm-blooded animals.

Small fry, which is often eaten together with its bones, is a food which is particularly rich in calcium and phosphorus.

This small fry also contains fluorine which protects the teeth from spoilage.

The small intestine in the majority of commercial fish has from one to two hundred and more blind processes or pyloric appendages. Ocean fish have particularly many pyloric appendages. These are auxiliary organs for digestion and absorption of food. The number of these appendages greatly influences the ability of meat of some fish to mature very well in the uneviscerated state and under certain other conditions.

Of the internal organs, the liver is very important and is often very large in size. The liver deposits vitamins of the A and D groups and protects the blood from noxious substances. The liver is located near the oesophagus and the stomach. During life, the colour of fish liver differs and depends on the species (in cod it is creamy coloured, in haddock it is greyish, in most carps it is dark brown, and in sturgeon fishes it is dark grey). The average weight of the liver in the fattest cods may reach 9% of the total weight of the ungutted fish, and in some specimens it may go up to 15%. The gall bladder and contents is most frequently amber-yellow,

bright green or brownish in colour. It is situated behind the heart. Its position necessitates particular care during cutting and draining the blood of the fish. The bile of many fish is not bitter. For example, preserves and conserves of whole Baltic species kilka do not arouse complaints, since the bile is not bitter, whereas the bile of anchovies has a sharply bitter taste.

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Deep within the muscles of many fish are a multitude of straight and tine-like, tiny intermuscular bones. During cooking and industrial processing these intermuscular bones are not removed. They are very highly developed in carp, salmon and herring fishes, particularly in the carp where they are normally hard and prickly. This considerably lowers the food quality of cooked carp fishes. But if such fish is dried, cold-smoked or sterilized (canned), the bones become unnoticeable.

Rigor in fish begins at the head: initially the mouth muscles stiffen, then the occipital muscles, after that the trunk muscles and, finally, the caudal part stiffens and the entire fish enters a period of rigor mortis. Decline of rigor proceeds in the same sequence, initially the mouth muscles relax, followed by the body muscles and

later by the caudal part. If the jaws of the fish firmly close the mouth, but the caudal stem has not stiffened, this means that rigor has only begun to set in and the product, in terms of freshness, is in excellent condition. If the caudal muscles have stiffened, and the mouth is closed (it can easily be opened and closed), this means the process of rigor is approaching termination. The quality of such fish is still quite excellent.

Large and fat fish undergo autolysis slower than small lean fish of the same species.

Autolysis of fresh fish meat should not be fully identified with the same process in the meat of warm-blooded animals. Whereas the meat of warm-blooded animals which has not been sufficiently exposed to the action of enzymes is not the best for human consumption, fresh fish meat is all the more aromatic, tastier and more succulent the less it has undergone the action of enzymes, i.e., autolysis processes. This is the main essential difference between the two kinds of meat. This is precisely the reason why fresh fish meat stock must be provided with rapid and dependable conservation.

The signs of rigor given above are sure indications of the freshness of raw fish.

The rate of development of the post-mortem changes in fish associated with the conditions of its death and are in direct relation to the temperature of the air or water surrounding the dead fish, as well as to its particular species.

During the life of the fish, the slime /30
exuded by the cutaneous glands is constantly washed off by the water, rubbed off on the bottom and on plants. After the fish is pulled from the water the production of slime is not stopped, and even intensifies, and therefore the body of the dead fish is gradually covered with a lot of slime. Much slime is produced by fish that have died of asphyxiation. On perfectly fresh fish, like the live ones, the slime is clear, transparent, and its consistency suggests the white of a fresh, raw, chicken egg. The amount of slime also depends on the species of the fish and the season of the year.

In the majority of cases, the meat of live or dead fresh fish is translucent, whitish, or seemingly colourless, it frequently has greyish tones and sometimes shows opaline, mother-of-pearl tints (seen in cross-section). The interlayers of fat are colourless in the majority of fish. In some fish, such as sturgeon, sevriuga and sterlet

these layers are most frequently yellowish to orange in colour, and in the great sturgeon they are white or greyish-green; in tench, large ide and the Siberian whitefish they are often creamy-yellow in colour. Such fat layers preserve their initial colour after heat treatment. The meat of some live fish, as well as raw meat or that which has been cooked, has a colour similar to that of beef (it is more or less reddish, and after processing it turns greyish-brown), as, for example, the meat of wild carp, carp, pelamids and some other scombrids. The meat of almost all the true (Atlantic) salmon, as well as Pacific Ocean salmon, trout and taimen have a very pleasant colour in the raw and preserved states, varying from pinkish to intense red of various, unique shades.

The peritoneum, the membrane lining the abdominal cavity, is most often colourless, white or silvery mother-of-pearl. Certain fish, as, for example, cods, Pacific herrings, marinka, have black or almost black membrane.

Both the shape and the size of the scales vary for different fish. For example, on the eel the scales are microscopically small, while on some carp fishes they

are extremely large and go up to 2 cm and more in diameter. (for example the enormous scales of the mirror carp).

The chemical composition of this scale is a strongly mineralized albumen substance. When scales are boiled in water, organic substances pass from them into the water, yielding collagen.

All the colourful variety of the cutaneous-scale covering of the fish is caused by the presence of special cells (chromatophores) located in the skin and containing grains of pigment. The most durable of these pigments is the black (melanine). It will not dissolve in either indifferent solutions or in acids and is stable during physiological changes in the condition of the fish.

The red and yellow pigments are chemically associated with fat. This is also why they are called lypophores. Lypophoric pigment is soluble in alcohol, it fades in light and usually disappears relatively quickly. During fasting periods, the fat component in the pigment grains takes part in the general metabolism and as a result of this the bright colours disappear. Pigmentation in red shades is particularly characteristic of the meat of the true and Pacific salmons (from the silvery

stage with most highly coloured meat to the postspawning condition when the meat becomes a dirty-grey pallid colour).

Some fish, such as the eel, sterlet, catfish and tench excrete a great deal of slime through their skin; others, such as, for example, the salmon and fresh water perch, excrete very little. The lamprey excretes a particularly large amount. As a rule, those fish which have well-developed scales excrete small amounts of slime, whereas fish whose scales are poorly developed or are entirely absent are capable of excreting great quantities of slime. The slime of fish consists mainly of nucleoproteins.

Among the various species of fish the different parts of the body have dissimilar value and purpose. When determining the weight ratio of the main organs and tissues of fish (meat, head, bone, roe, liver), this property is used to determine the value of the fish for production, trade and generally as a food source.

Particularly strong emphasis must be placed on the necessity to systematically use the data of science, practice and experience accumulated in some countries on the

toxicity of certain new fish in our catch. Utilization of new objects of fishery requires absolutely reliable expertise, consultation, instruction and sanitary control.

Information about certain species of fish is given in the following chapter.

SPECIES OF FISH AND THEIR CHARACTERISTICS/32

Fish are classified according to their way of life into marine, anadromous, diadromous and fresh-water fish.

Marine fish live exclusively in salt water.

Anadromous fish live most of their lives in the sea and only ascend the rivers and lakes to spawn. The eel, on the contrary, is catadromous and leaves fresh water for the sea for spawning.

Diadromous fish live in the estuaries and near-estuary, freshened sectors of the ocean.

Fresh-water fish are found only in fresh water.

At the present time, Soviet scientists are successfully augmenting the fauna of certain water bodies by acclimatizing new, fairly numerous objects of fishery.

The most complete system of fishes was established by the Academician L.S. Berg. The basic unit of zoological systematics is the species.

A species is the whole lot of specimens living within a definite geographical area and having a number of inherent properties which always distinguish that species from other, similar species.

The scientific name of a species is always signified by two words. The first word is the generic signification, and the second word the species. It is customary to give the name of the author who first described a certain species after the name of that species. For example, fish of the family Salmonidae, genus Salmo, known as the common salmon or semga, is called Salmo salar Linné, while another salmon of the same genus, the sea trout, is named Salmo trutta Linné.

A sub-species is the whole lot of specimens which are related to the species by the presence of transitional forms but which occupy a definite geographical area.

Sub-species, or geographical races, are given a triple name consisting of the name of the genus, species to which the given sub-species belongs, and the name of the sub-species proper. For example, the Caspian salmon is

called Salmo trutta caspius Kessleri.

Species are combined into genera, genera into sub-families, sub-families into families, families into superfamilies, superfamilies into sub-orders. Orders are composed of sub-orders, orders, classes and sub-classes.

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All fish belong to two classes which are very irregular in number and definition: the cyclostomes (eels) and fishes (all other fish).

In ichthyology, the units up to and including order bare the name of the first-named genus, but each unit has its own definite termination. The names of sub-families end in inae, families end in idae, superfamilies in oidae, sub-orders end in oidei and orders end in formes. For example, in the order of carp fishes the following five taxonomic units have the common root taken from the name of the wild carp Cyprinus.

Systematic Unit	Name
Sub-family	Cyprininae
Family	Cyprinidae
Superfamily	Cyprinoidae
Sub-order	Cyprinoidei
Order	Cyprinoformes

The specific names of fish are frequently associated with definite external properties of that species. Often the association between the species and the features of a certain fish are obvious and easily recognizable. For example, it is a known fact that the scales on an adult, live "shemaia" are coppertoned. This is exactly how the species got its name *chalcoides* (*chalcos*-coppery; *eidos*-species).

The largest gray mullet is called in Russian "loban" because of its massive head and very broad forehead. The Latin specific name is *cephalus* and is derived from the Greek kephales meaning head (the mullet with the prominent head).

The "sharp-nosed mullet" is a swift fish that easily leaps out of the water. This is the reason for its specific name of *saliens* (leaping).

The eelpout is a live-born fish which distinguishes it from the majority of other commercial fishes.

The specific name of the Baltic eelpout is viviparus (vivus-live, pario-bear).

The gray wolffish has a relatively broad forehead. Its specific name is latifrons (latus-broad, frons-forehead).

The true halibut has a considerably elongated, tongue-like body. Its specific name is hippoglossus (hippos-horse, glossa-tongue, horse tongue).

Furthermore, the plaices include a whole family of soles (soleidae). These species of flounder are slightly different, but they also have the elongated, tongue-like body shape.

The surmullet or goatfish, which has two large whiskers under its chin, bears the specific name of bearded, from the Latin barba-beard.

In ichthyology, the scientific names of fish are also taken from the literal meaning of Latin and Greek words signifying the live color of the fish, their habits, carriage, characteristic features of the shape of the body or individual parts of it, and occasionally even from the gustatory qualities of the fish, for example, leucos (white), albulus (albino), lucidus (light), argentatus

(silvery), aureus (gold), virens (green), percus (dark),
lugens (mourning), rostrum (beak), stoma (mouth),
vente (belly), rhynchos (snout), physos (bladder),
taenia (ribbon, strip), cyclos (circle), petra (stone),
sfen (wedge), stellatus (stellar), nudus (naked),
leptos (fin), artios (whole), volitans (flying),
sebastos (majestic), amarus (unpalatable).

Frequently the specific name of fish indicates the area of its occurrence or distribution, therefore the technologist and goods manager must comprehend such concepts as, for example, marinus - marine, caspicus - Caspian, ussuriensis - Ussurian, fluviatilis - fluvial, borealis - northern, tanaicus - Don River (Tanais - Don), euxinus - Black Sea, maeoticus - Azov.

The examples have been given for the purpose of satisfying the wide range of workers who must or should become acquainted with species of fish that are new to them, and for the purpose of showing the literal meaning of the specific names of these fish in Latin or Greek. This will make it easier to familiarize oneself with the scientific names of commercial fishes and their zoological classification.

given in reference texts and to learn and remember these names.

In standards, price lists, industry, statistics and trade the fish are divided into types, but not always in full agreement with the system of zoological units. The consumer also distinguishes fish by type. For example, in the Far East there are about 25 commercial species of flounder, but all these flounders are known under the general typical name of Far East flounder. In the Caspian Sea, about 15 species of herring are caught, but the standards and price lists give us only 2 typical units, Caspian herring and Black Sea herring. The herring known in science as Atlantic herring goes by the trade names of Atlantic, Atlantic fat, Norwegian, Holland, Iceland, farerskaya, yarmutskaya and Scottish herring.

In connection with this, in the science of commodities we must use the conventional meaning of the type.

At the present time, about 16,000 species of fish are known.

Our catch consists mainly of fish of the following 20 families: sturgeons, herrings, anchovies, salmon, smelts,

piques, carps, catfishes, mullets, mackerels, scads, perches, scorpionfishes, gobies, sauries, cods, giltheads, rock basses, drums and flounders.

In addition to the fish named, this work contains descriptions of fish that are of less importance and which belong to other families. However, this, too, does not exhaust the generic composition of the fish in our catch, which is being enriched literally every day.

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LAMPREYS

The lamprey has a snake-like body, is covered with slime and has no scales. It has seven gill apertures on each side behind the eyes.

The lamprey is found in commercial quantities in the Caspian, Baltic, Barents, Kara, White, Bering and Japan Seas. However, the Caspian and Baltic lampreys are mainly caught. Lampreys are taken during the fall and in the early winter along the lower reaches of the Volga, Kura, Neva, and many other Baltic and White Sea Rivers.

In spite of the fact that the lamprey is a very large, fat and tasty fish, its reserves have hardly been utilized to the present time.

The average chemical composition at the edible part of the raw eel is given in Table 4:

Table 4

Lamprey	% content			
	moisture	protein	fat	ash
Caspian	55,1	13,2	30,3	1,4
Neva (river)	66,7	15,9	16,6	0,8
	67,7—71,5	14,0—15,3	12,8—16,3	1,2—1,4
Other Baltic Arctic, or Pacific	52,1—53,5	12,6—13,7	32,6—33,1	1,0—1,1

The meat of fried Caspian lamprey contains, on the average, (in %): moisture - 45.1; protein - 21.9; fat - 26.6; ash - 6.4.

The length of the lamprey¹ taken commercially is characterized by the data given in Table 5.

1

The length of fish in this work is given in standard measurements.

The lamprey averages about 85% (sometimes up to 93%) of edible portion. Lamprey meat has a consistency that is peculiar only to it. The cartilaginous skeleton is soft.

The commercial harvest of lamprey for food purposes was first developed to a considerable extent on the Baltic coast.

Over 100 years ago, lamprey was being caught along the lower reaches of the Volga for rendering down to obtain the fat, and the Kura fisherman utilized dry lamprey in place of candles and torches. It took the efforts of Academician K.M. Ber to get the Kura lamprey fried and marketed like the Baltic species during the 70's and 80's of the last century.

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Table 5

Lamprey	Length, cm			Weight gm		
	min.	max.	av.	min.	max.	av.
Volga						
Kura						
Northern Dvina	19	55	37-41	—	—	60-70
	24	45	26-31	—	—	120-170
Arctic brook	35	43	—	23	95	—
	42	58	48	—	—	150-185
	35	51	—	—	—	80-90
Pacific (Suchan)	—	41	31-34	—	—	57-65
Pacific (Amur)						
Baltic						

At the moment, lamprey is produced fried or in gelatine almost exclusively, it is rarely prepared in marinade. It is a generally recognized rare delicacy.

The total amount of fried lamprey retailed in the country varies approximately from 200 to 300 tons.

It is known that the slime so abundantly excreted by the lamprey is harmful to the human organism and therefore it is necessary to insure the complete post-mortem excretion of slime on the surface of the skin and to completely remove it, after which it can be used as the raw material for frying.

SHARKS

The shark has a cartilaginous skeleton, broad low mouth, sac-like gills with 5-7 gill slits on each side (without gill covers) and normally large pectoral and pelvic fins.

Nineteen families of sharks have been described, these consist of about 300 species.

Mature sharks vary in size. Sharks are known whose length does not exceed 0.2 m, and also sharks that reach a length of 20 m.

The zoological systematics of sharks presents particular difficulties for specialists and raises differences in opinion.

In this work we have made use of the systematics of sharks according to G.U. Lindberg, and more often than is customary we resort to the scientific names of orders, families, genera and species.

Sharks are divided into five orders:

Heterodontiformes, Hexanchiformes, Lamniformes, Squaliformes and Pristiophoriformes. Only one family, Heterodontus, is known for the order Heterodontiformes. The order Hexanchiformes consists of two families, the comb-toothed sharks and the frilled sharks. The order Lamniformes is the largest and consists of 11 families, these are the nurse, whale, sand, goblin, mackerel, basking, thresher, cat, pseudo smooth hound, requiem and hammerhead sharks. Of the order Squaliformes, the spiny dogfishes and, to an incomparably lesser extent, the straight-mouth, stellate and flat-body sharks are of commercial importance.

The order Pristiophoriforme consists of but one family, the saw-nosed sharks.

The sharks of greatest commercial importance are the mackerel, grey and spiny sharks (among the latter the spiny dogfish and Greenland sharks are the most important). The USSR has only now begun to organize systematic large scale fishery for sharks with processing of the meat for food purposes (up to the present mainly for export) and more rational utilization of fat, skin, fins, head, endocrine glands and other usable material.

The necessity for serious and dependable organization of fishery, processing and utilization for food purposes of shark meat is due not only to the large reserves of shark in many parts of the open seas that have been and are being developed by the Soviet fishing fleet and the fact that these fish are first class when properly processed into food, fodder and technical purposes, but also ^{by the fact} that practically all the sharks inflict an enormous loss on the fishing economy, by destroying very large numbers of valuable fish, and frequently on commercial fishery.

ORDER HETERODONTIFORMES - THE HORN SHARKS

This order is represented by sharks measuring up to 4 m in length, having frontally thickened, smooth, powerful and short body and with five narrow gill apertures on each side. Each of the two dorsal fins have a massive spine. The caudal fin is short and its lower lobe is well developed. The pectoral fins are large and there is an anal fin. Propagation is by oviposition. They are virtually unknown to eat fish. The order contains only one family Heterodontus.

The species H. japonicus (Dumeril) is utilized by the Japanese in the production of a cooked meat paste¹ called kamaboko.

The commercial value of the zebra-like shark H. Zebra (Gray) is not great.

ORDER HEXANCHIFORMES - THE MULTI-GILLED SHARKS

The order consists of two families, the frilled and the

¹

Kamaboko - see page 51.

multi-gilled sharks. Only the multi-gilled sharks are of commercial importance. These fish reach a length of 8 metres. There is one, spineless dorsal fin.

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There is an anal fin and six or seven gill apertures on both sides of the head. The fish is viviparous.

The meat of multi-gilled sharks of the genus Hexanchus (7-gilled) is of high food quality. The length of commercial fishes of this genus normally runs from 0.7 to 2 m.

One species of this genus of sharks, the H. perlo (Bonnaterre), the narrow-headed comb-tooth, is utilized in Japan mainly for making kamaboko. This genus also includes the flat-headed comb-tooth shark.

The comb-toothed sharks of other genera (6-gilled) evidently do not have commercial significance.

ORDER LAMNIFORMES - PORBEAGLES

The order consists of the following 11 families:

Orectolobidae - nurse sharks

Rhincodontidae - whale sharks

Odontaspidae - sand sharks

Scapanorhynchidae - goblin sharks

Lamnidae - mackerel sharks

Cetorhinidae - basking sharks
Alopiidae - thresher sharks (not edible)
Scyliorhinidae - cat sharks
Pseudotretanidae - pseudo smoothhound sharks
Carcharhinidae - requiem sharks
Sphyrnidae - hammerhead sharks

FAMILY ORECTOLOBIDAE - nurse sharks

The sharks in this family measure from 0.4 to 3.5 m (there are at least 12 genera). The nurse sharks have 2 dorsal fins situated near the tail. The fish normally is bright-coloured (like a carpet).

FAMILY RHINCODONTIDAE - whale sharks

Three species are known in this family. The Rhincodon typus (Smith), the whale shark, is of particular interest. It differs from all other sharks by its enormous size (length up to 20 m), terminal mouth and particularly large gill apertures.

FAMILY LAMNIDAE - the porbeagles or mackerel sharks, these are the dolphin sharks.

The fish of this family are viviparous. The mackerel

sharks are the most important object of shark fishery. They are large and medium-sized sharks (fish of different species and genera measure from 4 to 15 m in length.

Three genera are known:

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Carcharodon - white shark, Mokoy;

Isurus - gray-blue, Mako;

Lamna - mackerel sharks.

The members of the genus of white sharks, or Mokoy sharks, are distinguished by a conical snout which is thickened at the top and uniformly tapered. They are large sharks measuring up to 12 m in length and body weight of up to 3.5 tons.

One member of the genus is widely known, this is the man-eater Carharodon Carcharias (L). This shark is a great hunter (its body length reaches 12 m), it attacks other sharks, sea lions, bathers and castaways, and even small boats.

This shark is blue on top and white underneath.

As a food, the meat of this shark is highly esteemed in Eastern countries.

The genus of gray-blue sharks or Mako sharks.

Trim body. Caudal fin lacks auxiliary caudal keel.

A viviparous fish that reaches a length of 7 m.

The best known is Isurus glaucus (Müller et Henle), the blue or Mako shark. The meat is of average food quality. According to the data provided by AzcherNIRO (Koval'chuk and others), the blue shark yields meat of excellent external appearance and satisfactory food qualities even though the amount of fat in the raw meat is 0.41% and in the prepared meat it is 0.42%, according to this data. The fins of the Isurus shark are particularly highly prized.

Genus of mackerel sharks. Snout pointed, conical in shape. Body massive, thick and relatively short. Two species are known, the Lamna nasus (L. cornubica Risso), found in the Atlantic - the Atlantic mackerel shark (fig. 1), and the L. ditropis - the Pacific mackerel shark.

Sub-species or similar species exist.

The L. nasus is up to 4 m in length. Body weight exceeds 350 kgm. It has a pointed snout, thin caudal peduncle with transverse keels, and large tail. Fins are reddish.

The mackerel sharks are a valuable object of fishery. Their high quality meat is reddish in colour, tasty, fat, and suggests veal. This shark, because of the fatness of its meat, is prepared as imitation sturgeon (like dogfish), and also salted as imitation semga. Mackerel shark is excellent when cooked in various ways. It is particularly highly valued along the Meditarrenean and Atlantic coasts of France and in many other West European countries.

The L. ditropis achieves a length of up to 3 m. It inflicts a significant amount of damage to the reserves of Pacific Ocean salmon. It occurs only in the Pacific Ocean and is distinguished from the Atlantic variety by dark spots on the abdominal part of the body. The meat is eaten as food.

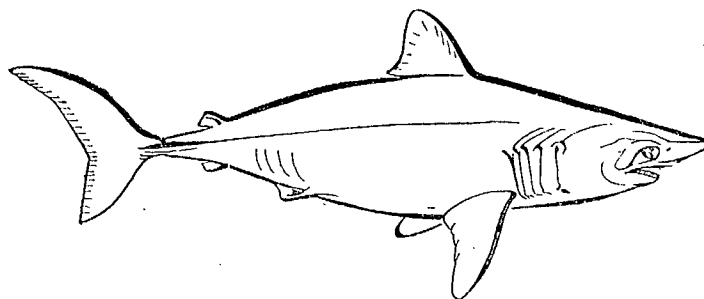


Figure 1. Atlantic mackerel shark.

Norway and Denmark export mackerel shark mainly to Italy. Large international markets for mackerel shark are located in Italy and FRG. In Italy they make canned products of this fish which are exported to the USA.

Mackerel shark meat in steaks is sold in the USA under the name of swordfish steaks.

Much of the Pacific Ocean mackerel shark meat is utilized in the fresh and dried state in China and in Japan.

In the German Democratic Republic, meat of the mackerel and some other sharks is used under its own name (there is even a standard for it).

FAMILY CETORHINIDAE - BASKING SHARKS

The fish of this family have their gill apertures greatly enlarged. It is a viviparous fish. The sole species in the family, Cetorhinus maximus (Gunner), the giant or basking shark, attains a length of 15 m. It feeds on crustacean plankton. The meat is utilized mainly in the smoked state.

FAMILY ALOPIIDAE - THRESHER SHARKS

The meat of this family of fish is not edible.

FAMILY SCYLIORHINIDAE - CAT SHARKS

The representatives of this family are small fish measuring up to 1 m in length. The dorsal fins (one or two) are situated far to the rear (always behind the base of the ventral fins). The snout is short, angled upward ("feline"), mouth slightly curved. The fish is oviparous.

The sharks are numerous in the tropics and are the main object of catch for the local population. The most important genera are Galeus, Parmaturus, Cephaloscyllium, and Scyliorhinus.

The best known of the cat sharks are G. japonicus (Müller et Henle), the Japanese soup shark of the genus Scyliorhinus, S. caniculus (L), the cat shark or seacat with brown spots on a yellow background, and the S. toruzame (Tanaka), from which kamaboko is made in Japan.

FAMILY CARCHARHINIDAE - REQUIEM SHARKS

Characteristic features of this family are two dorsal fins, the length of the caudal fin is less than $\frac{1}{2}$ the length of the body, lateral keels are absent, and the upper

lobe is much larger than the lower. The caudal pedicle is only slightly tapered. The head is of the usual shape without lateral protruberances. It is the most extensive family of sharks and is represented by 26 genera (Mustelus, Triakis, Galeocordo, Negogaleus, Galeorhinus, Prionace Scoliodon - Hypoprion, Carcharhinus, etc.).

The most numerous of these genera, and the most widely distributed and most important as an object of catch (current and future) is the genus Carcharhinus.

Genus Mustelus. This includes the species M. canius (Mitchell) - the smooth hound, M. griseus - gray smooth hound, M. manazo - Japanese smooth hound, widely known in Japan where it is used to make kamaboko.

Genus Galeocerdo. It includes the species G. cuvieri (Risso), the tiger or leopard shark having the characteristic external appearance and measuring up to 5.5 m in length (fig. 2).

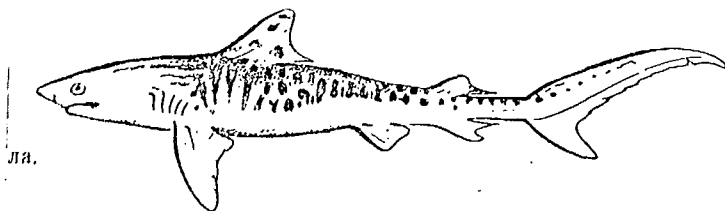


Figure 2. Tiger shark.

According to data provided by AtlantNIRO,
a tiger shark weighing 215 kgm had the following composition
by weight:

Body part	Weight, percent
carcass	23.0
head	34.4
liver	23.5
fins	9.7

Genus Prionace. This includes P. glauca (L),
the blue, gray shark or Mokoy. Length up to 6 m.
The meat is the main ingredient of the Japanese product
called hamren.

Genus Carcharhinus. The size of the sharks
in this genus is extremely variable depending on the
species. Some species are no more than 0.9 m in length
and others reach a length of 7.5 m.

Most of the raw meat is normally white in colour,
after cooking it acquires a light gray colour and is
distinguished by firm consistency. The taste of cooked
meat, which is not given special treatment (soaking in water
or solutions), of the gray shark Carcharhinus Melanopterus
according to AzcherNIRO data, is bitter. The meat contains
the following:

Substance	Content in percent
moisture	74.56
fat	0.44
protein	23.59
ash	1.31

This genus includes C. brachyurus (Günther), the bronze whaler, measuring up to 3 m. Fresh meat of the young shark is delicious. This shark has commercial importance.

This genus also includes the C. johnson (Smith), the gray shark; and C. grandeticus (Müller), the gray Indian shark (identical with the Japanese white-eyed shark) measuring up to 1.6 m, as well as the C. carharias (L), the white shark; and also such species as C. taurus (Rafinesque) up to 6 m in length, C. ablimarginatus (Ruppel), the white-finned shark, C. longimanus (Poey) and C. milberti (Müller et Henle) the bull shark. The latter is usually caught when it reaches a length of 150-250 cm and weight of 50-60 kgm (rarely up to 3 m and weight to 200 kgm). The bull shark, according to AtlantNIRO data, has the following composition by weight:

Body part	Weight in percent
carcass	51.7
head	20.0
liver	5.3
fins	9.8

The meat of the bull shark contained:

Substance	Content in percent
moisture	75.8
fat	0.3
protein	21.1
ash	1.4

The meat of the white-finned shark is completely edible.

Genus Galeorhinus. This genus includes, in particular, G. japonicus (Müller) the soup fin shark measuring up to 2 m.

The blue shark of the family of gray sharks, genus Carcharhinus and called C. glaucus (L), is also sometimes called a man-eater shark. It is the largest shark by weight, 315 kgm, and measures up to 5 m. It has a long snout, very large sharp teeth and a white belly. The meat is mushroomy but it is utilized for food

purposes in Africa, South America and in Asia.

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The C. meniosrrah (Müller et Henle), the Malay (reef) shark, has frequently been the cause of mass poisoning among the populations of the Polynesian and Galapagos Islands who had eaten its meat. Research has shown that the liver and gonads of this shark are also toxic.

Genus Scoliodon. The species S. walbeehmi (Bleeker) is known commercially as a source of raw material for kamaboko.

The S. terraenovae (Richardson) has both its spinal and anal fins trimmed with a black band. Its length is up to 1 m. It is normally caught in trawler nets. The commercial name for it is dog shark.

Genus Triakis. The Japanese catch one of the smallest commercially-taken sharks, T. scyllium (Müller) for making kamaboko.

FAMILY SPHYRNIDAE - HAMMERHEAD SHARKS

These fish are called hammerheads because of the unique shape of their heads which are flattened in the middle and have large protruberances ("hammers") on the sides.

Six species are known. Some reach a length of 6.5 m and a body weight of 0.5 tons. They are a viviparous fish.

Of commercial importance are such species of hammerheads as the S. zygaena (L) and S. diplana, with very high first dorsal fin. The meat of the hammerhead shark is of such low quality that it is used as a food only rarely and in very few countries of Africa and Asia. Generally speaking, the meat of the hammerhead shark is considered unsuitable as a food in most countries, and with justification.

According to AtlantNIRO, the weight composition of the hammerhead shark was (in percent): carcass, 46. , head, 24.7, liver, 6.2, fins, 12.1. The composition of its fresh meat is as follows:

Substance	Content in percent
moisture	73.2
fat	0.4
protein	24.9
ash	1.6

The liver fat of the hammerhead shark is richer in vitamin A than the liver fat of other sharks and fish in general.

ORDER SQUALIFORMES - THE DOGFISHES

The sharks in this order either have spines on the two dorsal fins or they are without them. The anal fin is absent.

FAMILY SQUALIDAE - THE SPINY DOGFISHES

The spiny dogfishes have an elongated body and pointed snout. Each of the two dorsal fins is equipped with a spine. Surface colouring is most frequently greyish-brown, brownish or greyish-green, in some species the sides are covered with white mottling, and in others there are white spots, the belly is greenish-white.

The spiny dogfishes are of great interest for our fishery.

Twelve genera of spiny dogfishes are known:

Centroscyllium, Etmopterus, Deania, Squalus, Cirrhigaleus,
Centroscymnus, Scymnodon, Centrophorus, Somniosus,
Dalatis, Oxynotus, Isistius.

The genera Squalus and Somniosus are of fundamental importance for fishery.

The most characteristic and important in fishery is the Squalus acanthas (L), the spiny or spring dogfish (figure 3). The maximum length of its body is 2 m and it weighs up to 15 kgm. Most frequently, specimens measuring 60-150 cm and weighing an average of 1.8 kgm are found in the nets. In the Northern Atlantic specimens are found with maximum length up to 1.3 m, most often up to 0.9 m. In Norway the minimum size that may be taken is 0.7 m.

Soviet fishery has been taking spiny dogfish from the Black Sea since 1949, but utilization of this fish for food purposes is still far from satisfactory. In ocean fishery, the spiny dogfish has only recently been given serious attention.

The largest and almost year-round catch of spiny dogfishes is carried on by Norway and England (North sea), as well as in the region of the Eastern Shelf of the USA and Canada.

About 8-10,000 tons of spiny dogfish is brought into the English ports yearly.

The reserves of spiny dogfish are very large and the meat is of high quality. After cooking or canning it is

characterized by its whiteness, excellent consistency, pleasant taste and aroma and complete absence of acidity or the tartness common to many marine fishes.

Spiny dogfish meat does not have the specific "sharkey" odour common to some shark meat, but during cold storage in cans it may develop an odour of ammonia.

At highly authoritative tasters' meetings they invariably note the excellent external appearance and high gustatory qualities of cooked, fried or canned spiny dogfish meat prepared from selected fresh and fat dogfish.

In Japan, many national dishes are made from spiny dogfish meat. Spiny dogfish meat is used abroad as a cheap substitute for salmon (it is passed off as salmon).

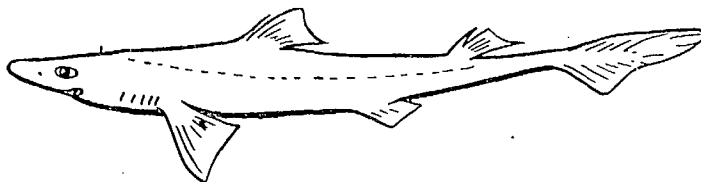


Figure 3. Spiny or spring dogfish.

According to AtlantNIRO the meat of dogfish taken along the Georges Banks had the chemical composition given in Table 6:

Table 6

Substance	Content in % of Meat		
	Fresh	salted	balyk
Moisture	69.5	53.0	43
Fat	11.5	10.5	20
Protein	18.0	20.0	26
Ash	1.0	1.2	1.1
Salt	No info.	15.3	No info.

Dogfish meat is of such high quality in the gastronomic sense that it normally does not require special soaking or maturation; it is not recommended that this meat be canned or stored for long periods.

Temporary norms for waste and yield of cut fish for processing of dogfish sharks (spiny and spring dogfish) have been established at the following levels (in %): head - 20, liver - 7, dorsal and ventral fins - 5, caudal fin - 2, skin - 7, viscera - 19, vertebrae - 6, losses during cutting - 2, carcass or pieces

of it - 45, fillet with skin - 39, skinless fillet - 32.

Dogfish has been used since ancient times in the preparation of balyk by the drying or cold smoking methods (similar to the method of preparing sturgeon backs). In Turkey, Germany and some other countries, dogfish is widely used as a substitute in the processing of balyk (backs) under the names of sturgeon and sevriuga.

At the beginning of this century, the "sturgeon" dried and smoked balyks brought to the Russian Black Sea resorts by Turkish feluccas attracted attention because of their cheapness.

In Sweden, fresh and hot-smoked dogfish meat is very popular.

Marinated dogfish meat is sold on the market in Sweden under the name of congor eel.

Judging from foreign literature, production of frozen dogfish meat fillets is not advisable because the fat contained in the meat very quickly undergoes oxidation spoilage.

Under our conditions it is best to prepare dogfish backs in the frozen state (in blocks), and if this is not possible then it should be put on shore salted for reprocessing

into balyks.

The skin of the dogfish is used for polishing valuable wood species and in making felt velour.

Ever since a method was found for removing its spines, dogfish skin has been used in the haberdashery trade.

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Dogfish liver-fat is rated above cod liver fat, particularly for its vitamin A value.

Dogfish roe is utilized in food and also in the manufacture of natural chamois. Pepsin is extracted from the stomachs.

According to data published in the literature the yield of liver (in percent of weight of whole shark) of Greenland shark varies from 4.5 to 13.8 (average 9.5), while for dogfish it is from 5.5 to 29.9 (average 12.0).

In the VNIRO Standards Laboratory early in 1966 a liver from one specimen of frozen dogfish taken during the first trip of the NPS "Akademik Knipovich" amounted to 24.8%. A dogfish liver suggests the ovaries and their membranes in external appearance, it is light fawn in colour and fills the entire abdominal cavity.

The amount of fat in dogfish liver normally varies within broad limits, from 22.5 to 73.5%.

According to G.U. Lindberg, the Greenland shark also belongs to the family of dogfishes (genus Somniosus).

The second important representative of the dogfish family of sharks, Somniosus microcephalus (B.) is the polar or Greenland shark.

This large oviparous shark achieves a length of 8 m and weighs a ton. Normally, specimens measuring 2.5-4.5 m are caught. These sharks have a blunt snout, gray skin and relatively small fins (figure 4). The meat is fatty (normally contains over 10% fat), and is of a very attractive white colour. An excellent hot-smoked product is obtained from the sharks.

The meat of the Greenland shark is used more for production of canned goods than is the meat of other sharks. The fried meat suggests beluga.

It is necessary for the meat of the Greenland shark to be kept for an adequate period to mature after it has been skinned and before it is processed by any method. This significantly improves the consistency and aromatic-gustatory

properties of the meat.

Data concerning low nutritional properties of Greenland shark meat are frequently based on improperly matured meat.

It is quite possible that the same applies to the meat of other sharks.

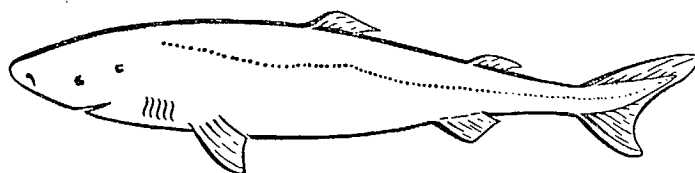


Figure 4. Greenland shark.

Research carried out by G.K. Koval'chuk and others (AzcherNIRO) has demonstrated that shark meat can also be matured in the salted state¹.

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The Greenland shark species found in the Pacific Ocean is mainly the Somniosus pacificus (Bigelow et Schroeder). The skin of the Greenland shark is particularly massive, strong and is an excellent source of material for special purposes.

¹

"Rybnoe Khozyaystvo", 1966, No. 6, pp 58-60.

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The numerous shark species have been studied and described very inadequately. Also, the species composition is extremely variable.

For general information, the temporary approximate commercial data concerning the proportions of the various parts of the shark body have been confirmed.

No other fish deposits fat in its liver in such enormous quantities as does the shark. It is characteristic of sharks, in contrast to cod, for example, that they can maintain considerable quantities of fat simultaneously in the liver and in the meat. The amount of fat in shark liver averages over 50%; for example, the dog shark contains 52.4%, the hammerhead - 50.6%, and the Greenland shark 52.0%.

Fresh shark meat that has been heat-treated usually remains milky white in colour, sometimes more or less pinkish; in some species following sterilization in hermetic containers it acquires an unpleasant greyish-green tinge.

The liver is the only organ in which amino acids are deaminated and ammonia converted to urea.

One of the best methods of neutralizing ammonia is to synthesize urea. As a result of such synthesis, the ammonia, which possesses toxic properties, is converted to urea, a substance that is harmless to the organism. As is known, urea is the main product of nitrogenous exchange. During straight disintegration the amino acids are not able to convert to urea. Urea can be formed from amino acids as a result of synthesis. Although urea is considered the end product of nitrogenous exchange, the animal organism is able to utilize it for the synthesis of proteins. Evidently, the large amount of urea in shark meat is associated with the enormous volume of its liver (it contains about 3 times as much urea as there is found in other fish). The total amount of nitrogen in shark meat is significantly higher than in the meat of bony fish (3.5-4.0% and over as compared with 2.4-3.3% in bony fishes). However, more than $\frac{1}{2}$ (up to $\frac{2}{3}$) of all the nitrogen in the shark is found in the proteins. The remaining nitrogen is found in non-protein compounds (extractive nitrogenous substances). The meat of bony fishes contains 81-91% protein nitrogen.

The large amount of extractive nitrogenous substances /48 in the meat of sharks and skates is dependent on the higher

urea content in it (normally from 1.3 to 2.1%).

Of 13 species of shark, the greatest amount of urea (1.8-2.1%) was found in the angel sharks (Squatina japonica) and in some other species of the family of sharks (Galeorhinus japonicus, Mustelus griseus).

Smaller amounts of urea (1.3-1.7) were found in members of the gray shark family such as Prionace glauca, Mustelus monazo, Sriakis scyllia, the mackerel family Isurus glaucus, and all species of dogfishes including the commercially very important species Squalus acanthias.

Experience in Japan, Norway, USA and many other countries has shown that the entire body of the shark can be utilized with great economic effect.

In the countries of Asia, Africa, South America and Europe, shark meat of many species is utilized for food and a ready market is always available. Shark meat is used as food in those countries of Africa that are situated north of the Republic of South Africa.

The mackerel shark and the spiny (spring) dogfish are certainly first-class food material and their meat does not require special processing to remove undesirable aftertaste, odour or bleaching.

The meat of the gray and blue sharks, in contrast to that of the mackerel sharks and dogfish, is normally soaked in water, soda or other solutions in order to make it a first-class food.

Trial treatments carried out by Engineer-technologist V.G. Tishin on shark meat using a 2% bicarbonate of soda solution and lasting one hour confirmed the possibility of removing the "sharkey" odour, all undesirable aftertaste, and also excessive toughness of the meat.

Among the most difficult to utilize as a food are the adult whale sharks.

The hammerhead sharks, as has been stated above, in most cases are either totally unsuitable for food or they are marginal food, while the thresher sharks are certainly not fit to eat.

A very interesting problem has been raised by G.K. Koval'chuk regarding the use of the amount of volatile nitrogen in shark meat as an index of quality for determining whether shark of a certain species is to be considered a food fish or not¹. At the same

¹ Koval'chuk G.K. Technology for primary processing of shark. Compendium of scientific-technical information, VNIRO. Issue 6, 1966.

time it is absolutely necessary to carry out wide research on meat of commercial sharks of all species using this index in regular and systematic comparison with organoleptic evaluation.

It would be worthwhile to make a more complete study of world practice in processing and sale of shark meat of the various species.

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Shark meat for food is sold mainly in the iced, frozen, smoked (hot smoking) state, in the form of balyks (similar to sturgeon), salt-dried, fresh-salted (to the consistency of petrified wood) and in marinade. Dogfish meat is widely used in Canada in the manufacture of fish sticks. Many special national dishes are prepared in Japan from shark meat.

The importance of shark meat as a food product has been steadily increasing in the recent past.

Japanese specialists believe that the meat of young sharks is quite suitable for use in the baked, stewed, fried, cooked, smoked and salted states.

The belief exists that the best food properties are found in the meat of small sharks (length up to 1.0-1.5 m). This is evidently accounted for by the fact that most of the saleable shark meat comes from the dogfishes

which really do have first-class edible meat and are thus distinguished from most of the other, larger sharks. The meat of very old sharks of the large species is, as a rule, tough, stringy and unpalatable. However there are exceptions to this rule and the meat of large shark specimens can be of high quality.

A characteristic feature of the meat of most sharks is its more or less detectable sweetness, which is normally more noticeable than that of the "sweetest" meat of other fish. This property of shark meat should not be considered negatively, since, in the first place, the consumer fairly quickly and easily becomes accustomed to it, and then even likes this taste feature, and, secondly, such "sweetness" can be easily dissipated by various methods of preparation.

According to the standard in effect in the GDR, fresh food shark, like other marine fish, is classified in two grades: class A and class B.

Characteristic indices are the consistency (density) of shark meat: in class A meat the consistency must be firm and elastic, while in class B meat the consistency must be hard.

According to the GDR standard, food sharks are the basking, mackerel and smooth hound, and one of the

species of lesser spotted dogfishes (Galeorhinus galeus L), and, of the spiny dogfishes, the spiny or spring dogfish and the Greenland shark.

In the USSR, the harvest of shark for food purposes is only now being established, but it is fairly promising.

Only the meat of freshly-caught sharks is used for freezing, and the processing is done directly on site.

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Sharks intended for food purposes must be skinned.

Sharks that have died before processing has begun and also sharks with injuries, but which are accepted by us as technically suitable for food, are not used (they are utilized in the production of fish meal).

The period before the onset of rigor mortis and the period of rigor mortis is considerably shorter in sharks than it is in other fish under similar conditions.

In Norway, sharks are frequently frozen in alginic jelly after gutting.

Up to 10,000 tons of cut iced shark is exported from Norway yearly.

In Japan, since antiquity shark has been prepared in the salted-dried state mainly for export to certain Asian

countries. To obtain this product the shark, depending on species and size, is slit open, sometimes beheaded, and sometimes cut into two fillets. Shark is also cut into oblong rectangular pieces.

After cutting, the meat is bleached in water, salted in dry salt and then dried either immediately after salting or, depending on the weather, season, catch and market, sometime later (after which it is kept as a salted semi-product).

Comparatively recently the shark was used only for production of liver fat, fins and skin. Japan is one of the few countries where shark meat has been successfully used since antiquity for food.

The meat of almost all sharks is edible, although, like the meat of other fish, it can be of higher or lower quality and is evaluated in relation to this.

The belief exists that the cooking water of dog sharks is toxic. The meat is eaten, but only after it has been boiled in water which has been changed several times (the cooking water is thrown out).

In many countries the meat of hammerhead and whale sharks is not used as food (an exception is the meat of sexually immature animals).

Dark shark meat is also not used as food, only the light-coloured meat is used for this purpose.

Attempts to use shark meat for canning purposes have not yielded satisfactory results up to this time, if canning smoked meat of certain sharks in oil is discounted. When canned au naturel, the urea decomposes into ammonia and carbon dioxide during heating in the vacuum-packing process. The colour, consistency and 51 odour of natural canned shark meat is, as a rule, unsatisfactory.

Canning in tomato sauce and other sauces are also not particularly satisfactory due to the very intensive absorption of the liquid by the meat (consistency and colour of the meat suffer).

In Japan, they successfully can smoked shark meat in various soya sauces and also in a very wide assortment of cooked preparations.

In Japan, the traditional and the largest cooked product made of white shark meat and fish of the drum family (croakers) is kamaboko, which is made from crushed or ground fish meat.

For kamaboko, the meat is finely ground, mixed with spices, other special Japanese flavourings, sauces and food additives. Then the meat is carefully and very thoroughly

pulverized, beautifully shaped into long loaves and cooked over steam (steamed kamaboko) or baked to form a crust on it or without it (baked). The kamaboko loaves are decorated in the Japanese style, colouring the meat layers in various colours, and sometimes a gold colour is applied to the meat.

Kamaboko has long been produced on a large scale in Japan. All the operations are very well mechanized at all stages of production.

National tastes, on which the Japanese cuisine is based, is very unique and there is no question of adapting the Japanese recipes. The principle of multicoloured pulverized shark meat would be unacceptable to us. At the same time, the organization of large-scale production of kamaboko, utilizing shark meat, is of interest and could be successfully used in the manufacture, in our country, using highly mechanized production lines at the consumer points, of such appetizing and attractive-looking items as fish cakes ~~made of shark meat~~ or fish sausage. Vegetables could be added to either pulverized-meat product. It is namely the pulverized (very finely ground) fish meat which provides a very high gastronomic

effect.

Shark skin is used in the production of shagreen, smooth types of leather and various haberdashery; the internal organs are used in the pharmaceutical industry; the dried fins and cephalic cartilages are in continual demand as gastronomic delights in Japan, China and some other parts of Asia, as well as in many parts of West Africa.

The cartilages of shark heads and the bases of the fins, as well as the jaw and gill bones, are used in the manufacture of an export food product that is called transparent cartilage (for use in making delicacy soups). This material is produced by repeated cooking and drying. Proper cutting and subsequent cleaning of the cartilages is very important. Very high value is placed on the transparency and pale-yellow colour of the finished product. Semi-transparent cartilages that are white in colour are considered to be a relatively low quality product. Transparent shark cartilages are processed mainly in Japan. The other cartilages are used in the manufacture of gelatine and technical glue.

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Shark liver is particularly valuable. The liver fat is every bit as good, and sometimes even better, than cod liver.

Shark meat is also converted to fodder flour.

The most important aspect of shark fishery is production of vitamin A from shark liver. Shark liver fat, as a vitamin A concentrate, is the largest source of income to shark fishery.

To evaluate shark liver, not as a source of fat, but as a source of definite amounts of vitamin A, it should be realized that the concentration of vitamin A in the fat of shark liver increases as the amount of fat decreases. Also, the amount of vitamin A varies in relation to the biological condition of the shark when caught (season of catch). In females, the amount of fat in the liver is higher the less-developed are the embryos. The yield of fat decreases with the advancement of pregnancy in sharks.

As a rule, shark liver is not used as a food because of the possibility of hypervitaminosis.

STURGEON FAMILY

In sturgeon fishes, the body is spindle-shaped and has five rows of bony shields. In the sturgeon, ship's sturgeon and sevriuga, there are small plates and

spines scattered among these shields. The mouth is transversally-ovate or crescent-shaped. The internal skeleton is cartilaginous.

The main commercial species are the sturgeon, sevriuga and great sturgeon. The ship sturgeon, sterlet and particularly the kaluga are much less important.

The sturgeons are among the most valuable fish. The sturgeon, sevriuga, great sturgeon and ship sturgeon are used for black caviar, which is in great demand on the world market.

Besides the USSR, only Iran is a source of commercial quantities of sturgeon caviar. The production of caviar in Bulgaria, Romania, the USA and some other countries is insignificant. Even the natural American black roe (not artificially dyed) is of comparatively low quality.

About $2/3$ of the world harvest of sturgeon fishes comes from the Caspian Basin.

The national sturgeon catch has averaged about 90% in the Caspian Basin in recent years and about 5-6% in the Black Sea-Azov Basin.

The basins of the Aral, Baltic, and White Seas, Lake Balkhash, the water reservoirs of Siberia and elsewhere produce the remaining 4-6% of the sturgeon taken. Thus, in 1963, the Caspian Basin produced 18.2 thousand tons of sturgeon fishes, whereas the Black Sea-Azov Basin produced 1.1 thousand tons. During the past 25 years the sturgeon catch in the Caspian Basin has fluctuated between 3.5 and 23.0 thousand tons.

The Caspian sturgeon harvest during individual years (or average for five-year periods) is as follows (in thousands of tons per year):

1931-1935	16.2
1936-1940	14.1
1946-1950	10.4
1951-1955	12.2
1956-1960	11.5
1961	13.0
1962	19.4
1963	18.3
1964	15.1

The dynamics of sturgeon harvest during the past few years in the country as a whole is characterized by the following data (thousands of tons):

1952	17.5
1953	16.7
1954	16.6
1955	13.8
1956	15.8
1957	13.7
1958	13.5
1959	14.2
1960	12.3
1961	15.4
1962	22.1
1963	20.0
1964	17.8
1965	16.8
1966	15.0

Great Sturgeon. This fish inhabits the basins of the Caspian, Black and Azov Seas. It is not found in other basins (the kaluga, a similar species to the great sturgeon, is now found very rarely in the Amur River).

Of the rivers flowing into the Caspian Sea, the largest numbers of great sturgeon enter the Volga, to a lesser extent into the Ural River and very little indeed into the other rivers.

The snout on the great sturgeon is short, soft, pliant, and the upper and lower parts are cartilaginous. The mouth is crescent-shaped, very large, and covers the entire lower surface of the snout. The barbels are flattened on the sides and have leaf-like appendages. The rows of shields run, without fusing, to the end of the body. Of the dorsal plates, the first is the smallest. The dorsal fin has at least 60 rays (fig. 5). During the

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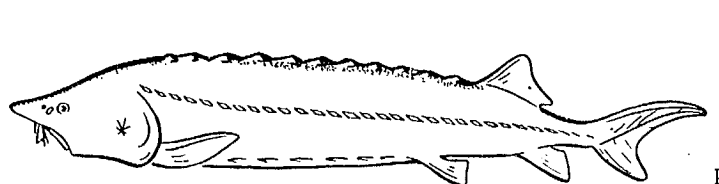


Figure 5. Great sturgeon.

previous century, great sturgeon weighing up to 2 tons were sometimes landed; during the first third of the 20th century they weighed up to 1.2-1.3 tons. Subsequently, and nowadays, great sturgeon weighing 600-800 kgm have become exceptionally rare. The usual landed weight for a great sturgeon is 35-200 kgm.

The minimum length limits for great sturgeon taken from rivers flowing into the Caspian Sea is 165 cm, for those flowing into the Sea of Azov the minimum is 150 cm and into the Black Sea 140 cm.

Caspian great sturgeon meat has the following chemical composition:

Substance	Percent Content	
	spring	fall
Moisture	68.7-71.2	69.0-69.5
Protein	16.6-17.1	16.0-17.2
Fat	11.3-13.3	12.3-14.9

Great sturgeon meat is white and slightly coarser than that of other sturgeon fishes. The larger the great sturgeon, the coarser its meat. The colour of the fat ranges from perfectly white to a greyish-green, and sometimes dark-gray (almost black). Great sturgeon is processed mainly as balyks by the cold-smoked method (fillets) and as cooked fish. A small quantity of the great sturgeon is utilized for canning, hot-smoking and frozen fish.

The roe is used almost exclusively for soft caviar.

The great sturgeon yields the largest roe, and it is therefore preferred on the world market over roe obtained from other sturgeon fishes. The largest, light-gray great sturgeon roe is the most desirable.

Sturgeon. The Russian sturgeon (fig. 6) is caught mainly in the Caspian Sea, much less is taken from the Azov and Black Seas. The Siberian sturgeon catch is very small. Amur, Sakhalin and Atlantic sturgeon are landed in insignificant numbers.

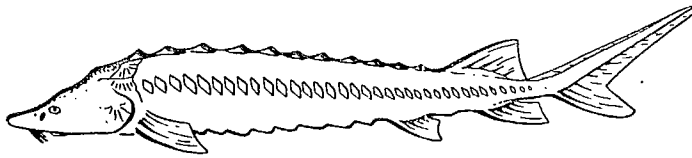


Figure 6. Russian sturgeon.

The mouth aperture on the sturgeon is transverse, and of moderate length. The snout is conical or sword-like. The barbels are cylindrical in cross-section.

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There are three types of sturgeon in the Caspian Sea: the North Caspian, the Kura river and the Iranian. The best sturgeon from the point of view of marketable quality of the meat is the North Caspian sturgeon, and the poorest is the Iranian. The best quality sturgeon roe (on the basis of natural properties) comes from the Iranian and Kura river sturgeon.

The maximum length of the sturgeon is 3 m at a weight of 200 kgm, but usually the landed Caspian sturgeon runs from

0.5 to 160 cm, with a weight of 8-25 kgm (average 14-16 kgm). The sturgeon in the Azov and Black Seas is considerably smaller. The Siberian sturgeon is a comparatively small fish but its meat is distinguished by its fattiness, tenderness and bright aroma.

The sturgeon makes up the largest part of the sturgeon fish catch (in 1964 about 9,000 tons were landed).

The smallest permissible length of sturgeon which can be taken is : Caspian - 105 cm, Azov - 90 cm, Black Sea - 80 cm, Ob' river - 82 cm.

Caspian Sea sturgeon meat averages about 70-72% moisture, 16% protein and 10-12% fat.

The white meat of the sturgeon after heat processing is slightly more friable than the meat of the great sturgeon or the sevriuga. It is a gastronomic winner because it has interlayers of fat that range from a bright yellow to orange in colour. Sturgeon in which the fat is brightly coloured is particularly excellent.

Sturgeon is converted mainly to the frozen state and into balyks for cold-smoking. A good deal of the

sturgeon is boiled and processed by hot-smoking. Sturgeon canned au naturel is very good, as is "fisherman's Siberian cisco" made from sturgeon heads and cartilages.

Sevriuga. The sevriuga has a long and flattened snout the length of which comprises 62-65% of the entire head. The body is considerably thicker than that of the sturgeon (fig. 7).

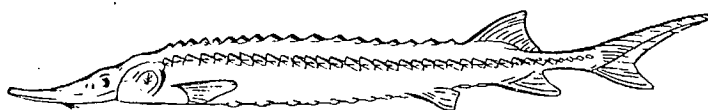


Figure 7. Sevriuga.

The minimum permissible length of sevriuga which may be taken in the Caspian is 110 cm, the Sea of Azov 80 cm, and in the Black Sea 75 cm.

The sevriuga reaches a maximum length of 220 cm, and a weight of 68 kgm. The average weight of the landed sevriuga normally varies between 7.5 and 9.5 kgm (depending on the region in which it is caught).

The sevriuga is caught only in the Caspian and Black Sea - Azov Basins. Landings in 1964 amounted to 6.6, thou. tons, of which 6.35 thousand tons came from the Caspian Basin.

Commercially the North Caspian sevriuga / 56
is better than the South Caspian, but the roe of the
South Caspian is better. The Kuban sevriuga is
the best.

The interlayers of fat within the meat are
most frequently yellow, orange and dark-green.
Sevriuga meat normally contains 67-70% moisture,
16-18% protein and 6-13% fat.

Sevriuga meat is much more tender and aromatic
than the meat of sturgeon, and the more so the great
sturgeon. One of its shortcomings is its tendency
to divide into layers (particularly during processing
into balyks for cold-smoking, and also during indiscrete
cooking). However, the meat does acquire excellent
consistency during hot-smoking.

The main and the most suitable process for
sevriuga is hot-smoking. Sevriuga balyks are very
aromatic and tender, but they require special care in
storage since their tender meat easily divides into layers.
An excellent dish is expertly-prepared boiled sevriuga,
as well as celyanka (a thick fish soup) and fish soup made
with fresh sevriuga.

Sevriuga roe is more tender, tasty, fatter and more aromatic than the roe of other sturgeon fishes, but the roe casings are thinner and less durable (they weaken and burst particularly easily). Sevriuga caviar is finer and has a dark colouring, it is therefore less attractive in external appearance than the caviar of other sturgeon fishes (ship sturgeon is slightly larger, but much lighter coloured).

Ship Sturgeon. The lower lip is not broken as it is in the sturgeon. Barbels are fringed. There are no plates on the body between the five rows of shields. Snout conical (fig. 8).

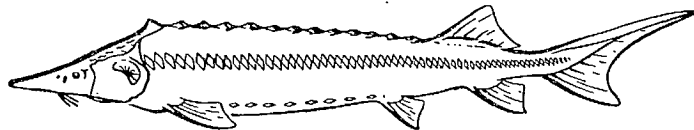


Figure 8. Ship sturgeon.

The ship sturgeon inhabits the Caspian and Aral Seas. Solitary specimens are rarely found in the Black Sea-Azov Basin. The meat of the ship sturgeon has slightly lower commercial value than that of the Russian sturgeon. The fat interlayers are white. The roe is much smaller, but much brighter coloured than that of the sturgeon. Ship sturgeon roe does not have

the golden yellow, brownish, black and protective coloring natural to the Russian sturgeon roe.

The commercial value of the ship sturgeon is very small (in 1964 about 100 tons was landed). Fishermen frequently erroneously call hybrids of various sturgeon fishes ship sturgeon.

Sterlet. This fish is smaller than the other sturgeons. It is distinguished for its very tasty, tender meat. It is perfectly suitable as a whole fish dish. The barbels are fringed, the lateral shields vary from 57 to 76. The back and sides are of brownish tones.

Most of the sterlet is taken from the following rivers: Northern Dvina, Pechora, Ob', Irtysh, Yenisei, Volga, Kama and Danube. In 1964, 180 tons of sterlet was landed, including 170 tons from the Siberian rivers.

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The smallest commercial length for Ob' river sterlet is 31 cm, while that for Archangel sterlet is 36 cm. The usual commercial weight of the fish varies from 0.2 to 0.6 kgm, but once in a while sterlet weighing up to 4 kgm is landed.

The fat content in the meat of sterlet caught in the Yenisei estuary varies very significantly and averages 24.5% (for females 33.5%) for large fish weighing 1.1-1.2 kgm, or for small sterlet weighing 0.2-0.3 kgm it averages about 7%.

Ob' river sterlet specimens caught in the vicinity of Samarovo, having an average weight of 530 gm for males and 690 gm for females and measuring 37-43 cm in length, were found to have meat of the following chemical composition:

Substance	Content in percent
Moisture	66.8-69.4
Protein	16.5-16.7
Fat	11.9-15.3
Ash	1.1- 1.8

As usual, the females were considerably fatter than the males. Sterlet is realized in the fresh-caught, iced and, mainly, in the frozen state. It is also sold in the round. Sterlet roe is not processed commercially.

FAMILY CLUPEIDAE

This family includes the fish of the following kinds: kilka, sprat, marine or ocean herring, sardinella,

sardinops, sardine, tiulka, Caspian and Black Sea-Azov herring (in the genus of marine herrings is included, according to zoological classification, both the Baltic herring and the White Sea herring).

About 200 species of fish are known in this family. They include marine, anadromous and even freshwater fishes.

The clupeid fishes are distinguished from the commercial fishes of other families by the almost complete absence of the lateral line, by silvery, thin, comparatively easily-removed scales (scales are absent from the head), the presence of a single dorsal fin and a prominently forked tail.

In volume of catch the herrings, like the cods, are the main domestic and world commercial fish.

As a food product, the fish of the clupeid family caught by our fisherman are divided into herrings, sardines and small herring (Baltic herring, kilka, tiulka).

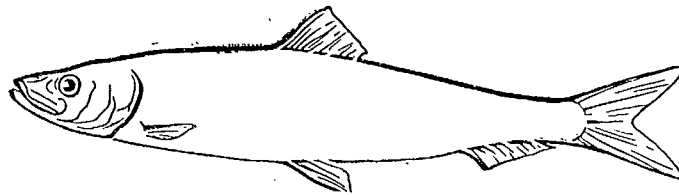


Figure 9. Atlantic herring.

As a product, the herrings themselves are divided into Atlantic (including North Sea), Pacific, Caspian to include the black-backed shad, Black Sea-Azov and White Sea herring. Among the newest possible objects for our herring fishery are such species as the pomolobus, menhaden and shad.

Marine herring make up over 95% of our herring catch.

The marine herring is an ocean shoaling fish found in the Atlantic and Pacific Ocean Basins. It forms several sub-species and geographical races or forms: Atlantic herring, Baltic herring, White Sea herring and Kanin-Pechora (arctic) herring, as well as the Pacific Ocean herring.

The Atlantic and Pacific herring are of chief commercial importance. Baltic herring is not grouped with

herring for commercial purposes, but is placed with sardines. The White Sea herring catch is very small. The Arctic herring fishery is still very poorly developed.

All these marine herring forms compose, in their own turn, local schools which are distinguished by growth rate, place and time of spawning, pasturing regions and systematic properties.

Marine herring, more properly two of its sub-species, the Atlantic and the Pacific, yield the second largest catch of commercial fish. Recently it has comprised $1/4$ of the total USSR catch.

Atlantic herring is delivered to the consumer points mainly through the ports of the Murmansk, Leningrad and Kaliningrad Oblasts, Lithuania, Latvia and Estonia, while Pacific herring is delivered mainly through Vladivostok and Nakhodka.

The population of the USSR is presently fully supplied with herring caught by their own fisherman, and most of which is of high quality.

In 1966, fat ocean herring accounted for about 75% of the total salt herring produced by our industry.

Atlantic herring (fig. 9). Soviet ships mainly fish for Atlantic herring in the international waters of the Norway, Greenland and North Seas, in the vicinity of the Faroe Islands, Iceland and the Nova Scotia shelf. According to the data of N.N. Rulev, the usual commercial length of the Atlantic herring is 28-31 cm, and the weight of raw material varies from 200 to 500 gm (average 330 gm). The yield of carcasses during April through November fluctuates from 72.4 to 75.2%, while from December through to March it runs from 65.9 to 69.5%.

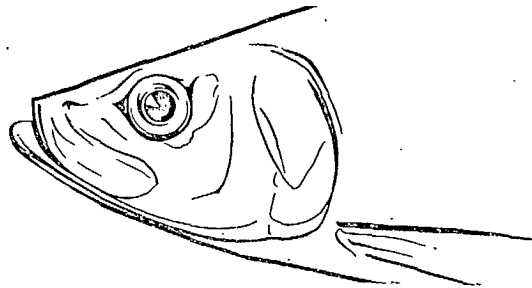


Figure 10. Head of an Atlantic herring.

The Pacific Ocean sub-species of the ocean herring differs from the Atlantic sub-species by several features (number of vertebrae, scales), of which the most obvious for commerce are the following: darker (almost black) peritoneal membrane lining the abdominal cavity, whereas in the Atlantic sub-species it is gray; in the Pacific Ocean herring there are powerful teeth developed on the vomer, while the Atlantic herring has barely noticeable teeth.

It is enough to run your finger over the vomer of a herring to determine whether it is of the Pacific or Atlantic species.

Figure 10 shows the head of an Atlantic herring with the protruding lower jaw characteristic of ocean herring.

The Pacific Ocean herring has a special, unique "Pacific Ocean" odour to its meat.

Our national harvest of Atlantic herring is reported by geographic and ecological groups (tribes), each of which has its distinctive properties and features.

The main groups of herring are as follows:
Norway-Scandinavian, North Sea, Nova Scotia and, to a lesser extent Icelandic.

Landings of Atlantic, North Sea, Barents Sea and Kanin-Pechora herring during the period from 1955 through 1965 were as follows (in thousands of tons):

1955	224.2	1960	523.4
1956	277.0	1963	569.4
1957	346.4	1964	698.0
1958	432.2	1965	620.7
1959	464.3	1966	611.7

The meat of fresh Atlantic herring (except North Sea and Nova Scotia) is characterized by the following fat content by months (in %):

January-February	15.0-17.5
March	7.0-15.0
April	4.4- 7.5
May	4.6- 5.8
June	6.5-13.8
July	19.0-20.0
September	19.0-22.0
December	16.0-19.0

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Herring taken in the regions of the Nova Scotia shelf (Georges Bank, Sable Island and others), had the following average chemical composition (Table 7).

Table 7

Date and place of catch	% content			
	Moisture	Fat	Protein	Ash
1 May, Nova Scotia shelf . .	72.87	5.7	19.06	1.94
20 May, " " " . .	69.58	12.08	17.18	1.35
June-July, Georges Bank . .	71.5	8.7	18.75	1.05

Herring caught on Georges Bank, according to V.N. Podsevalov, had an average weight of 130-160 gm, and length of 24-27 cm. Fattiness varies greatly even among fish of the same catch. Analyses carried out by AtlantNIRO (207 analyses) showed the following fluctuations in fattiness of meat of Atlantic herring landed on Georges

Bank (Table 8).

Table 8

Catch period	% fat content of herring meat for number of analyses (%)					
	2-6	6-9	9-12	12-15	15-18	более 18
January-June						
July	55,0	35,0	6,0	2,0	2,0	—
August	—	14,3	2,8	28,6	25,7	28,6
September-December	7,5	25,0	25,0	25,0	7,5	10,0
	38,5	54,2	6,1	1,2	—	—

The data and experience with large numbers of herring on Georges Bank show that all the herring taken there from September through June inclusive are graded commercially as lean, while in July mainly fat herring are caught, in which however, there is about 15-20% of lean herring, whereas in August approximately equal amounts of fat and lean herring are landed (if the present standard is applied). This shows that Atlantic herring from this particular region does not come under the currently-used divisions for fattiness and it requires special treatment.

When ocean herring reaches its maximum fattiness it no longer feeds. This is precisely the time when it is the best consumer product since it is the most nutritive, tasty, aromatic, fat, tender and, in addition, it still

does not contain developed sexual products. At this time the digestive tract is almost or completely empty, which facilitates processing particularly during salting.

Of the isolated races of Atlantic herring, the most numerous and intensively caught are the Atlantic-Scandinavian and North Sea (on shoals) herring. The Atlantic-Scandinavian herring are, in their own turn, divided into three basic schools: the Norway spring-spawning, Iceland spring-spawning (spawning in March and April) and the Iceland summer-spawning (June-August). Of these, the largest is the Icelandic spring-spawning herring (fish measuring 32-34 cm are found in the nets, while from other schools they run from 27-28 to 32 cm).

The basic types in the national catch are both the spring-spawning school and, in certain years, the summer-spawning school of Iceland herring.

The fattiness of Iceland herring meat of the summer catch normally fluctuates monthly within the following limits (in %):

134.

June	7.3-14.0
July	14.0-20.0
August	18.0-21.0
September	17.5-20.0

The meat of strongly salted Atlantic herring caught in the Norway Sea during the period from 13 July through 8 of August had the following chemical composition:

Substance	% Content
Moisture	$\frac{49.28-52.15}{51.02}$
Fat	$\frac{11.10-15.45}{13.38}$
Protein	$\frac{18.42-21.06}{19.82}$
Ash	$\frac{15.67-16.80}{16.25}$
NaCl	$\frac{15.05-16.20}{15.59}$

Note: the numerator gives the limits of % content, the denominator shows the average.

The average weight of the salted, round herring during this period was 289 gm. The average yield (in %) was: meat- 58, head- 16, viscera- 11.9, skin and fins- 4.9, bones- 4.9.

North Sea herring includes the herring found normally in the North Sea, along the northwestern coast of Scotland,

Northern Ireland and in the English channel.

The bulk of the catch consists of North Sea Bank herring measuring 18-24 cm (most frequently 22 cm), as well as herring from the northern part of the sea and normally measuring 25-27 cm (sometimes up to 30 cm). The amount of fat in the meat of North Sea herring between June and October varies from 14 to 28%, and is greatest during August.

North Sea herring makes up a significant amount of the national catch and has long been known in our country as an imported product under the names of Holland, Scotland and Yarmut salted herring.

Since 1961, the USSR fishing fleet has been taking herring on both Georges Bank and Bank Bankero in the vicinity of the Nova Scotia shelf. Georges Bank herring spawns during the spring (March-April) and in the summer.

The best fishing is to be had on Georges Bank from April through October. In November the fleet normally moves to Bank Banquereau. This herring spawns from October through December and stays on the Bank mainly from December through March. The length of commercial fish here is 20-29 cm.

Atlantic herring (except North Sea and Murmansk) may be taken to a length of 20 cm.

Pacific Ocean herring. The national catch of Pacific Ocean herring during an 18-year period has fluctuated from 102.8 thou. tons in 1947 to 460.5 thou. tons in 1964. In 1966 323.3 thou. tons of fish were landed. Several local forms or schools of this fish are known.

The most important in the national catch are the Okhotsk-Tauyskoe, Gizhiginskoe-Kamchatka (Western Kamchatka), Karaginskoe-Olyutorskoe (Eastern Kamchatka), Sakhalin-Hokkaido schools of Pacific Ocean herring as well as the Alaska, Bristol and the winter Bering Sea herring.

Pacific Ocean herring taken in 1959 in the region of Western Kamchatka and the Northern Kuril Islands (Gizhiginskoe-Kamchatka school), had average fat content of 22.3% during August, and 26.0% during September, whereas the Olyutorskoe herring had average fat content of 21.2% during July and August (TINRO data).

Pacific herring from the Okhotsk-Tauyskoe school had highest fat content in the meat during August and September (19.3-19.5%).

According to TINRO data, the meat of male Pacific Ocean herring was somewhat fatter during all periods of catch

than the meat of females, although this does contradict the generally-accepted notion held by consumers concerning the greater fattiness of herring with milt in comparison with herring with roe.

The Sakhalin-Hokkaido herring reaches a length of 50 cm and a weight of 725 gm, but its average length (not including a special group of young Anivskoe herring) is 30-32 cm and its weight averages about 300 gm.

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Okhotsk herring is considerably smaller. The average length is 25-28 cm and the weight varies from 140-250 gm. Gizhiginskoe-Kamchatka herring is caught mainly in the Penzhinskiy Bay and along the coast of Western and Southeastern Kamchatka to Avachinskiy Bay. The average length of commercial herring is 26 cm at weight of 200 gm.

Karaginskoe-Olyutorskoe herring is caught mainly in the Bering Sea along the northeastern coast of Kamchatka and in the Olyutorskoe-Navarrinskiy region. This herring measures from 24 to 38 cm in length at a weight of 175 to 675 gm.

The minimum permissible length of Pacific Ocean herring that may be caught (in cm) is:

ocean - 20, Dekastrinskaya - 19; from the bays and lagoons of the Sea of Okhotsk and Sea of Japan - 16.

During the past 8-10 years, large scale fishery has been organized in the Far East to catch excellent fat herring (instead of the passive fishery for leaner pre-spawning herring) under difficult conditions of sharply reduced reserves of herring in the regions close to the traditional fishing grounds.

Pacific Ocean fat herring is fatter, more tender and more aromatic (more gastronomic) than Atlantic fat herring.

Caspian herring. Herrings of the genus Alosa form several species and sub-species in the Basins of the Caspian, Black and Azov Seas. Figure 11 shows the features which distinguish them from other herring. There are several species and sub-species of Alosa of commercial importance along the European and American coast of the Atlantic Ocean.

The Alosa is an anadromous herring.

All the herring in the Caspian and Black Sea-Azov Basins are included in the genus Alosa Caspialosa.

All the Caspian herring, except the black-back shad, is given in the price list and standards under the commercial name of Caspian herring.

The usual commercial length of the black-back is 35-44 cm (maximum 50 cm and weight about 2 kgm). It is not permissible to take fish less than 35 cm long.

Caspian shad may be taken down to length of 14 cm and at an average commercial length of 14-20 cm it weighs 100-120 gm. Fat content in the meat of shad and Volga herring is normally within the limits of 7-10%, and only the black-back shad runs from 16 to 21%, while the dolginka herrings are around 2-5%.

Commercially important in the Caspian are the diadromous northeastern and Astrabad herring shads, the anadromous Caspian shad, Volga herring and black-back shad, and also the marine (brashnikov) dolginka, Astrakhan, redwater, whitehead (Astrakhan), sarinka, eastern, bigeye and gasankulinka herrings and the bigeye and Agrakhan shads.

The minimum commercial length for Caspian herring, except the black-back shad and the shad, has been set at 20 cm.

For the Caspian and Black Sea Azov herrings the following regularity is known: the higher up the river

herring of a certain species travels, the fatter it becomes during the pasturing season. The black-back normally has meat fat content within the limits of 16-21%. The marine species and sub-species are the leanest, the diadromous varieties occupy an intermediate position between the marine and anadromous (this could be catadromous- translator's note) herrings.

The length of the Volga herring in the catch normally runs from 25 to 35 cm (but it does go up to 40 cm).

The shads make up a very large part of the Caspian herring catch (in Dagestan and Azerbaydzhan these are the main species of herring caught).

The dolginka, being a purely marine herring like the other brashnikovii Caspian herrings, does not become fat but it does reach a length of 48 cm.

The basis of the greatly undermined Caspian herring fishery now consists of North Caspian and big-eyed shad (these predominate in the herring catch in Dagestan and Azerbaydzhan) and the least fattened brashnikovii herrings. The main fishing grounds are the Volga-Caspian Basin, Dagestan and Azerbaydzhan. Herring is caught almost exclusively during the spring from March to May.

The two most valuable commercial anadromous (catadromous??) Caspian herrings, the black-back and the Volga, have formed a hybrid which ichthyologists call oligrandrous Volga herring.

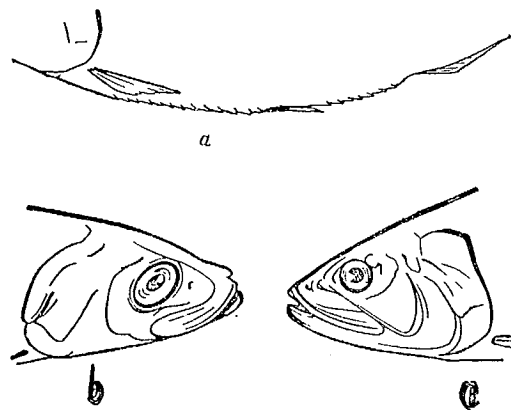


Figure 11. Features of Caspian-Black Sea-Azov herrings: a- serrated scalar keel along the entire abdomen; b- mid-jaw notch on the upper jaw; c- the jaws do not project forward.

Black Sea-Azov herring. Of these herrings, the following are handled in the trade: Azov and Paleostomes shad (diadromous), Black Sea herring and Danube shad (anadromous or catadromous-trans.), and the marine Azov herring.

Black Sea herring spawns in the Danube, Dnester, Dnieper, Bug and Don rivers. It reaches a length of 40 cm.

The commercial importance of this herring is very small at the present time, since the fattiness and meat content of the Kerch and Azov herring has deteriorated.

The following minimum length for commercial herring have been established (in cm):

Black Sea-Azov shad	11
Danube herring	16
Other Black Sea-Azov herring (Kerch, Don, Dnieperpetrovsk)	14

Danube herring is very distinctive for its gastronomic properties among the other Black Sea-Azov herrings. It is now being marketed in large tin cans (specially salted).

All the Black Sea-Azov herring is sold at the same price, although it normally has regional names (Dnieper, Don, Danube, Kerch).

White Sea herring. Zoologically this herring is very similar to the Pacific Ocean herring; in the commercial and food sense the small White Sea herring is closest of all to Baltic herring.

The small-sized White Sea herring (11-20 cm) spawns early in the spring, while the large-sized (20-32 cm)

spawns at the beginning of summer.

The minimum takeable length for White Sea herring is (in cm): in the region of Archangel 11, in the Murmansk region and the Karelian ASSR 13.

A considerable amount of the White Sea herring serves as an excellent raw material for hot-smoking, as well as for the production of canned goods of the type "Sprats in Oil" or "Sardines in Oil". The large herring is excellent when salted. The fat content in the meat of White Sea herring is 3-7% in the spring and 10-15% in the fall and winter. The Solovets herring caught in the fall is the fattest and tastiest of the White Sea herrings.

Fish of the herring family have made up about 1/3 of the total national catch during the past few years. In 1966, herring yielded about 30% of the total catch, of which Atlantic herring made up 11.5%, Pacific Ocean herring 6.2%, actual herring total 18.0%, all types of sardines were a little over 1%, Baltic herring 1.7%, Baltic kilka 1.1% and Caspian kilka almost 3.4%.

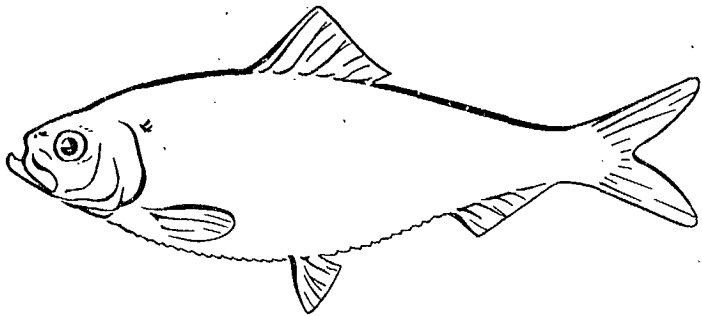


Figure 12. Pomolobus.

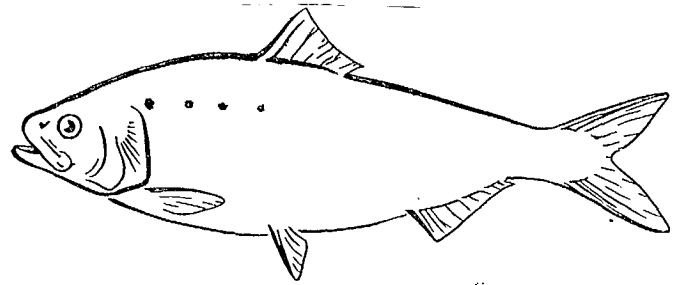


Figure 13. Shad.

The herring in each school has biological, morphological and commercial peculiarities. As a result of this, regardless of the one price on all Pacific Ocean fat herring, it would be convenient to separately designate, for the retail trade, using distinct labels and even special illustrations and descriptions, distinct Pacific Ocean herring by 3-5 geographic names and perhaps more.

It is recommended that the same principle be applied to have the workers engaged in retailing various other types of herring in this way (North Sea herring should be distinguished from Atlantic herring for example, and among the Caspian herring the shad and the Volga should be distinguished, while the latter should be distinguished from dolginka and South Caspian herring, Danube or Kerch herring from the other Black Sea-Azov herrings).

This will make it possible to formulate the required consumer evaluations on the various herrings, and the variety of salted herring will be made greater and more interesting by such practice.

New species of herring. The pomolobus is found as a rare fish among Atlantic herring. In external appearance it suggests our large southern shads (fig. 12). Its gastronomic qualities are somewhat lower than the main types of herring (Atlantic). There are several species of this fish found in the Atlantic Ocean along the shores of North and Central America. Minimum length of 20 cm is permitted for this herring.

Shad is found in the Atlantic Ocean along the American coast (fig. 13). This anadromous fish sometimes forms fresh-water forms, morphologically it is very similar to our Caspian and Black Sea-Azov herrings (shad of the genus Alosa). The shad spawns during the spring in the rivers, and at the present time it has become acclimatized to the Pacific Ocean coast of the USA. Specimens of shad have been found very recently in the catch taken along the eastern shores of Kamchatka (Korfa Bay). The commercial length taken is mainly 20-30 cm, more rarely it is from 16 to 65 cm.

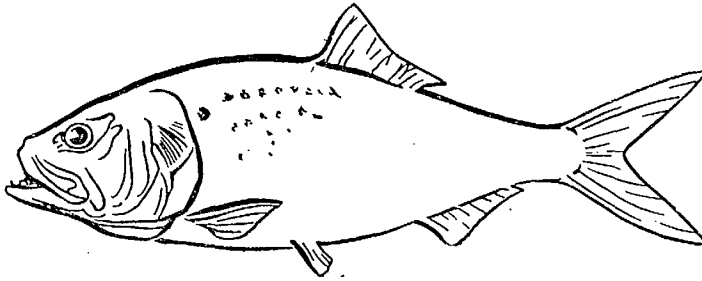


Figure 14. Menhaden.

Menhaden is a large fish with very high body, it is a marine herring (fig. 14). At least four species of menhaden are known. The commercial length is 30-38 cm, the amount of meat in one specimen normally varies between 300 and 450 gm, and its length averages 30-37.5 cm. Average fat content is 17%. The menhaden has a large head ($1/3$ length of the body), there is one distinct black spot on each side immediately behind the gill covers, and small spots are scattered over the body.

The menhaden is a heat-loving fish, its approach to the shore is associated with the warm-up of the coastal waters to a temperature of 10°C , and its departure into the ocean depths is associated with cooling of the water. On warm sunny days this fish is found at the surface, and it seeks the depths during bad weather. It is distributed throughout the Atlantic Ocean along the coast of America and Nova Scotia down to the shores of Brazil and Northern Argentina. It leaves the coastal regions

in the fall and remains until spring in the open sea.

In 1966, the National Fish Industry had determined the following basic technological processing methods for herring (in % of finished product):

Frozen	12
Salted	83
Of which lightly and medium salted comprised	55
In boxes	11
Spiced	1.5
Smoked	3.5

Sardines. Sardines are heat-loving fish.

They are part of the herring family and are represented by 3 genera: Sardines, Sardinella and Sardinops.

In the composition of our national sardine catch there is a preponderance of sardinops, sardinella is 5-6 times less, while there are practically no true sardines.

Genus of true sardines. There is a row of dark spots on the body, while the gill covers have radial grooves. The base of the caudal fin has elongated scalar protuberances on the lobes. The scales are large and easily removed.

Genus Sardinella. There are no dark spots on the body and no radial grooves on the gill covers. There are several gold-coloured stripes along the body (the central one is the most distinct). Sixteen species of sardinella are known. One of these species, the Sardinella aurita, is called the West African sardine.

The fish of this basic sardinella species has two leathery outgrowths on the back under the gill covers.

The scales are more firmly attached on the sardinella than on other sardines. The usual commercial length is 14-19 cm and weight of 13 to 105 gm. Specimens do occur measuring up to 35 cm and weighing up to 500 gm. The mass of the carcass (including scales) is 64-70%, and that of the head is 20-24%. The fat content in the whole fish varies from 2.4 to 18.3%, and in the carcass from 2.3 to 17.0%. The most widely distributed sardinella in the trade is the aurita (round) and eba (flat). The aurita sardinella has a black spot on the edge of each of the gill covers. The meat of this fish is very tender, succulent, with a piquant sour aftertaste which the consumer who has a well developed taste prizes highly. The eba sardinella has a very high body that is not typical of sardines (its like that of the

vobla or taran).

Genus Sardinops. This genus consists of one species which includes several sub-species. This includes the Pacific Ocean sardine (known in the national trade during the period from 1925 through 1941 as ivasi), California, South American, Australian and South African sardines. Recently our fishery has been utilizing mainly South African sardines.

The South African sardines has easily removal scales (normally do not adhere at all to the landed fish). Along the sides, near the back, can be seen 6-9 black or gray round spots situated in a row on each side of the body (their colour varies in intensity). It has a scaly keel, with distinct clearly expressed serrations on the part between the anal and ventral fins. Fish measuring 16-24 cm are usually caught, but it can reach a length of 30 cm. The usual weight of the sardinops is from 50 to 110 gm. The body weight averages 64%. The weight of the head averages 24%.

The sardinops normally deposits fat under the skin. There is more fat on the head than in the meat.

Meat of sardinops taken along the coast of Angola and South Western Africa contains 5.4-8.2% fat and 18.6-21.2%

protein during June and July.

According to data provided by the Sevastopol office for ocean fishery (SUOR), the fat content in the meat of South African sardines (sardinops) taken by its ships is as shown in the Table below for monthly averages:

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Month	Fat Content in Percent
January	2.4
February	6.3
March	16.1
April	18.4
May	17.0
June	11.1-16.7
July	10.6
August	10.7
September	6.8
October	6.8
November	2.1
December	2.7

The tissue fat of South African sardine very quickly undergoes oxidation spoilage. Within 1-1.5 months after freezing and storage at low temperature the sardine shows all the features of oxidation spoilage

of the fat under the glazing layer in the block.

The main and most expedient method of processing fish of this genus is universally accepted to be canning in oil with preliminary drying, blanching of the raw material (or by using other methods of partially dehydrating the raw material).

All the species and sub-species of sardines caught by our fishing fleets contain from 1 to 17% fat in the meat depending on the period and month of catch.

Normally a slightly greenish tinge to the fat is natural to the raw fish and is associated with the frequent presence of chlorophyl in the fish fat.

The most tender, succulent meat with bright "sardine" aroma and particularly pleasant piquantly-sour aftertaste is found in the true sardines and in *sardinella aurita* (during the periods when the fish is sufficiently fattened).

Nevertheless, fat sardinops are tastier than lean sardines or *sardinella*.

The canned product that is sold on the world market and within many countries under the name of sardines

is made from fish of all three genera. They all deserve to be classified as true sardines.

The world catch of sardines is about 2 million tons. The development by Soviet specialists of methods of sardine fishery with the help of a light has provided prospects for continuing considerable trade in this very valuable fish, but one which is very unstable when stored in the frozen state. The development of its harvest will undoubtedly facilitate organization of mass processing of the raw material into canned product at sea using specialized canning ships equipped with the necessary devices and modern equipment. Smoked and frozen sardines should not be less than 15-16 cm in length. Smaller sardines are used for canning.

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Baltic herring. This is the main commercial fish taken in the Baltic Sea. This is a Baltic sub-species of the Atlantic herring, but in the commercial sense it is not considered a herring. In the Leningrad Oblast and Estonia a smaller herring is found (9-16 cm), however individual specimens reach a length of 37.5 cm. The Latvian Baltic herring averages a size intermediate between the Leningrad and Kaliningrad varieties.

Baltic herring is caught mainly in the spring (average fattiness about 3%).

On the whole the Baltic herring caught during the spring and summer (April-June) is considerably less fat than the fall and winter catch. As a rule, whole fish contains no more than 6.5% fat from April through July. In the fall and beginning of winter the Baltic herring is much fatter (from October through December in Estonia the catch Baltic herring whose fattiness averages 10.5-13.5%).

Baltic herring consists of two biological groups: the spring-spawning (May-June) and fall-spawning (August-September). The spring-spawning Baltic herring makes up no less than 80% of the total catch.

The average yield of cleaned and gutted carcasses of spring Baltic herring equals 61.6%, and fall catch is 68.9% of the weight of the uncut raw material.

The weight of sexual products averages 14% in the spring and 2.7% in the fall, while the weight of viscera is respectively 3.6 and 5.1%.

Uncut Baltic herring has the following chemical composition:

Substance	Content in %
Moisture	$\frac{72.3-80.8}{78}$
Protein	$\frac{13.2-18.6}{15}$
Ash	$\frac{1.8-2.7}{2}$
Fat	2.1-9.0

Note: Here and further on the numerator gives the limit of content, while the denominator gives the average value.

The amount of fat in the meat of the Baltic herring is normally slightly lower than in the whole fish. The weight of the uncut Baltic herring varies from 6 to 90 gm.

The largest Baltic herring is caught in the Baltic Sea around Kaliningrad, the length is usually 15-19 cm and the average weight of a specimen is about 50 gm. The harvest is taken normally from mid-April upto the beginning of June. The average size of the Baltic herring in the catch gradually diminishes from the beginning towards the end of the harvest.

On the average, the carcasses of Kaliningrad Baltic herring (without viscera) contain 77.0% moisture, 3.3% fat, 17.7% protein and 2.0% ash. The roe of Baltic herring contains very little fat (2-3%). The head is relatively fat (6-7% fat).

Baltic herring is an excellent universal raw material for production of smoked, salted-spiced products (in barrels, as well as preserves in small and large containers), conserves in tomato sauce, in marinade, and conserves of smoked fish in oil. A very tasty and popular dish is hot-smoked Baltic herring.

The most fattened and freshest Baltic herring is used in production of "Sprats in Oil", as well as the high quality gastronomic preserves made of Baltic herring fillets "anchovies" (still in small amounts), and in "Baltic herring specially salted" (sweet salting without spices).

Iced and frozen Baltic herring is an excellent semi-product for cooking (fish-cooking plants, communal feeding enterprises and home kitchens can be used to prepare a variety of excellent snacks and first and second courses).

Frozen Baltic herring is not sufficiently stable for storage, and therefore it is necessary to maintain strict control over quality of frozen Baltic herring up to the time it is used for further processing.

Unfortunately, much Baltic herring is being straight salted because of insufficient technical support. Salted spring Baltic herring undergoes summer storage very poorly without chilling and results in an unpalatable and unprofitable product.

Although refrigeration trains have been in use since 1954 for shipping iced Baltic herring to the large centers, this method has met with poor results. The possibilities for delivery of frozen Baltic herring (in small and large frozen blocks) are increasing. The near future will see intensified development of mass production of smoked Baltic herring using mechanized processes.

Baltic kilka (Sprat) excels over all the species of Caspian kilka in gastronomic qualities, as well as over the Black Sea-Azov tiulka, Black Sea sprat and Baltic herring, the latter is frequently caught at the same time.

Baltic kilka and herring frequently come in the same

catch, and often in equal quantities, and this creates particular difficulties in fishery and fish processing when sorting the raw material.

In order to distinguish tiulka from the Baltic herring, it is necessary to know that the herring has the base of the dorsal fin directed forward in relation to the base of the ventral fin, whereas the kilka has the base of the dorsal fin directed to the rear. The herring has a slightly rounded belly and a poorly expressed keel, whereas the kilka has a sharply protruding serrated keel. The kilka head and mouth are considerably smaller than those of the herring (for fish of the same length).

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Baltic kilka is the best raw material for making two types of classical product which enjoy great demand both at home and abroad; i.e., spice salted kilka in large and small containers and the canned product "Sprats in Oil".

The Baltic kilka is a true sprat which inhabits the Atlantic coast of Western Europe from the Straits of Gibraltar to the Lofoten Islands. It is particularly numerous in the Baltic Sea and its bays.

The national catch of Baltic kilka is very significant and recent years has amounted to 50-60 thousand tons. The average length of the fish in the catch is 11.7 cm, and the weight is 13.3 gm. It reaches a length of 15-16 cm and sometimes even 17 cm. Spawning takes place from the middle of May to August (partial roe deposition). The fattest and best fed kilka is caught in October and November. It has managed to fatten by this time, after spawning, and has acquired an average of 11.5-14.0% fat in the body (individual specimens reach fattiness of 18%).

A particularly praiseworthy preserve is "Tallin kilka in spiced brine". This preserve is made of the very best raw materials using a special, strictly observed recipe and technology. The Tallin kilka (preserves) brand is maintained at such a high level that it deserves the widest study and distribution.

The noted shortcomings in large-scale technological and consumer utilization of Baltic herring apply also to Baltic kilka.

Establishing single prices for Baltic kilka and herring in the raw, iced, frozen, salted (including spiced in barrels) would decisively influence the increase in catch and quality of products made from kilka and herring

(it would then be unnecessary to sort the raw material according to kind).

Black Sea kilka (sprat) goes by the trade name of Black Sea sprat. Morphologically, the Black Sea sprat-kilka is similar to the Baltic sprat-kilka. The Black Sea sprat is smaller, on the average, than the Baltic kilka (~~its~~ commercial length is 8-11 cm and has an average weight of 9 gm). It spawns from September to June (intensive spawning occurs from December through April). It is caught mainly during the summer. The trade is very small and unstable, from 0.5 to 4.0 thousand tons per year. The reserves allow a catch of up to 20-30 thousand tons, but this is made impractical by insufficient concentration and unstable schools of fish.

Typical chemical composition in percent of catchable Black Sea sprat is as follows: moisture- from 68.8 to 72.2, protein from 15.8 to 17.8, fat from 10.7 to 14.3%. During the spawning period the fat content in the Black Sea sprat body drops to an average of 2.3%.

Because of its extreme instability in storage the Black Sea sprat is mainly used for heavy salting and in the manufacture of fodder flour and fat. Very small amounts of Black Sea sprat ~~are~~ used for spiced salting.

The Black Sea sprat, where the catch and processing had been properly organized, would undoubtedly yield a first-class canned and spiced product.

Caspian kilka in the fishery consists of three species: the common, the anchovy-like kilka and the bigeye kilka. The anchovy-like kilka is of chief importance in fishery. It has a roundish, low body, the belly is rounded, the keel is weakly expressed, and the back is thick and dark. The anchovy-like kilka in external appearance suggests the anchovy. Its length goes up to 15.5 cm, and the weight to 26.4 gm. The average takeable length until recently was 11.5-12.7 cm, with an average weight of 10.5-16.5 gm. Large scale spawning takes place from May through November. It is caught mainly by the light fishing method. The kilka is attracted to an electric light and is taken by fish pumps at depths where the young are absent. By this method the young of kilka and more valuable fish are preserved. The anchovy-like kilka lives in the open sea and does not approach the shore. It is caught mainly in the Middle and Southern Caspian, as well as in the southern part of the Northern Caspian Sea.

The fat content of kilka normally is 2.5-3.0%.

The common kilka is found throughout the Caspian and it enters the lower regions of the Volga and the Ural

rivers. Its average length is 9.8-10.7 cm, and has an average weight of 10.5-13.3 gm. It spawns mainly in April and May. During the summer and fall it fattens very well. It is caught mainly along the shores of Kazakhstan, Dagestan and in the south of Azerbaydzhan by means of an electric light (light fishing).

The fat content is 5-12%.

The bigeye kilka remains in the open parts of the Southern and Middle Caspian Sea. Its average takeable length is 10.6-11.2 cm, and weight is 7.1-10.9 gm.

It spawns from January through September.

Kilka has become the main object of Caspian fishery.

Caspian kilka is used in the preparation of canned product in tomato sauce and in oil (using smoked and dried fish of the sprat and sardine type), in fish-vegetable canned products, spiced preserves and barrel spiced products. It is prepared in the frozen state for cooking establishment situated at consumer points.

The development of a gutting machine for mass production and its further improvement has made it possible to significantly expand and improve the variety of canned products made from Caspian kilka, in comparison with the variety produced mainly from whole fish.

The older type of straight salting has been sharply reduced because of the lack of demand for low quality salted product. At the same time, there has been organized large scale production of fodder fish flour and fodder kilka by special preserving methods. Two new technological methods are indicated: processing of food fish flour and finely pulverized raw frozen paste.

About $3/4$ of the Caspian fish catch at the present time is kilka, mainly the anchovy-like.

In 1966, the industry planned to produce, from Caspian kilka, 120 thousand tons of cooked products, 500 thousand tons of smoked product, 25 thousand tons of frozen product, 17 thousand tons of spiced and 15 thousand tons of salted fish. The remainder of the kilka was used mainly for production of fodder products.

Tiulka, in the systematic and morphological sense, is very similar to the Caspian kilkas and particularly to the common Caspian kilka. The tiulka body is higher, flatter and shorter than the comparatively shaft-like body of the low and rounded kilka.

During the pre-war years, 50-90 thousand tons of tiulka were caught annually. After that the catch was

almost completely stopped for a long time to preserve the reserves of other, more valuable species of fish.

Tiulka is caught in the Sea of Azov and in small quantities in the freshened parts of the Black Sea. It is caught mainly in Taganrog Bay.

The tiulka is the smallest commercial fish. Its takeable length normally is 5-8 cm, with an average weight of 2-3 gm. From October until the start of the spring, when the spawning migration begins, the tiulka is very fat (15-20% fat) and rapidly loses its fattiness as the spawning event approaches (down to 4.5%).

Tiulka is fairly good in the fried, stewed, salted, dried and smoked states, however the production process for dried and smoked tiulka is unsatisfactory because of poor use of mechanization.

As summer approaches and the tiulka begins losing its fat, and large amounts of unedible percarina appear in the catch, the tiulka fishery is stopped, and if it is caught then the fish is used for manufacture of fodder flour.

FAMILY ALBULIDAE

This family, which is very similar to the herring family of fishes, includes the albula (or ladyfish).

It is a very beautiful, large fish, in shape of its body it resembles the herring. The weight of individual specimens caught normally goes from 1.2 to 4.0 kgm. The average chemical composition of albula fish meat caught in the Indian Ocean has been (in %): moisture 77.2, fat 0.6, protein 20.9 and ash 1.3.

Analyses carried out at the VNIRO Standards Laboratory (Borisochkina and Dubrovskaya) have shown that the albula caught during September in the Indian Ocean, measuring 65 cm in length and weighing 4 kgm, had the following chemical composition of the meat:

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Substance	Percent Content
Moisture	73.1
Fat	1.7
Protein	24.0
Ash	1.2

The composition by weight of the albula body (in %) is given below:

Body Part	Percent Content
Meat	56.0
Head	20.2
Skin	2.6
Bone	6.2
Scale	4.0

Body Part	Percent Content
Fins	1.0
Viscera (including milt)	9.2 3.2
Liver	0.7

Albula meat is rather dry and of low gustatory properties.

FAMILY ENGRAULIDAE

The anchovies make up about 1/4 of the world catch of fish. The Peru anchovy is foremost in terms of catch among the anchovies (93% of the world anchovy harvest), and is used in the production of fish flour. The Japan anchovy comprises about 4% of the world anchovy harvest. The Atlantic anchovy comprises 2.9% of the catch and, finally, the Canada anchovy totals 0.1%.

The anchovies differ from herring by their very large mouth and rounded belly. Seventeen genera and about 40 species of anchovy are known. An objective of our large scale fishery is the Black Sea-Azov anchovy (Atlantic anchovy). In addition, the Japan anchovy is taken in the northern part of the Pacific Ocean, but the national fishery for this species is not large at the present time, although the reserves are considerable. In terms of size, the

Japan anchovy is much larger than the Black Sea-Azov anchovy and reaches a length of 14-18 cm. and weight from 15 to 42 gm.

Considerable amounts of anchovy are caught by Mediterranean countries in the southern part of the Mediterranean Sea, as well as by Japan, Korea, China and Australia. The anchovy catch in Peru is 7-8 million tons per year (this is the basis of the world's largest fish meal industry established in Peru).

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The leanest anchovy is found in our country in the spring when it passes into the Sea of Azov for spawning following the winter fasting period in the Black Sea, while the fattest anchovy is found during the period of the fall migration through the Kerch Strait from the Sea of Azov into the Black Sea for wintering.

Whereas ~~the~~ spring anchovy will contain from 6 to 9% fat, the fall anchovy will contain up to 25%, and the carcasses will have up to 28% fat content. Large anchovy is considerably fatter than the small one. Thus, the fall anchovy measuring 90-100 mm contains 24-25% fat, and that measuring 63 mm contains only 18.5%.

In the spring the fat content in anchovy measuring 90-100 mm amounts to 8-10%, whereas in anchovy measuring 70-80 mm it is only 6-7%.

The protein content in the body of anchovy of various sizes and seasons is fairly constant. On the average a whole anchovy contains about 14% protein.

Anchovies are a very important factor in world fishery, and the world catch of this fish has sharply increased during the past ten years (up to 1965 inclusive).

Anchovy is caught mainly during the fall in the region of the Kerch Strait when it leaves its pasturing grounds in the Sea of Azov and goes to its wintering places along the Crimean and Caucasian shores of the Black Sea.

The length taken is from 6.5 to 13.5 cm, and weight from 3 to 20 gm. The yield of carcass is 64.3-74.4% (for Caspian kilka the maximum is 51.8%).

The commercial food properties of anchovy fingerlings or "strings" is extremely low, it is permissible to have up to 60% by numbers in the catch of these "strings". The weight of this admixture in the catch may go as high as 6-9%. The average weight of one "string" specimen is 1-1.5 gm, and that of first-class anchovy (without "strings") 8-12 grams, and with a mixture

of "strings" it is from 5-10 gm.

In Georgia the massive run of anchovy takes place *from* January through March.

Anchovy provides a very tasty product which is mainly salted (including spiced-salted). Anchovy could be used as a very good raw material for canned products when gutted (anchovy gall is very bitter). Canned anchovy production will be possible after a gutting machine has been introduced.

Preserves made from whole anchovy could also be excellent. However, useless and pointless efforts continue to be made to utilize acid and oil fillings in anchovy preserves. Anchovy preserves are excellent when spiced-salted and moderately salted without spices.

It is possible to increase the extent of anchovy fishery in the Black Sea-Azov Basin.

The national catch of anchovy was 89.6 thousand tons in 1963, 74.3 thousand tons in 1964, 65.5 thousand tons in 1965 and 125.7 thousand tons in 1966.

FAMILY SALMONIDAE

The sub-order Salmonoidei consists of twelve families of fishes. Among these families are the Salmonidae,

Thymallidae, Osmeridae, Argentinidae, Salangidae
(small-toothed salangid) and others.

The fish of this sub-order have a common property: they all have an adipose fin which has no rays and is located behind the dorsal fin in the same vertical plane as the anal fin.

The Salmonidae family consists of numerous commercial fishes that are distinguished from one another by size, external appearance, natural gastronomic properties, methods of technological processing, and even methods of consumption.

The salmonids includes such large fishes as the Atlantic salmon, Caspian salmon, chinook salmon and taimen, which reach a weight of 20-30 kgm, and sometimes 50 kgm, as well as such small fishes as the tugun (a cisco) weighing 10-20 gm.

The sub-family Salmonini, the true salmons, consist of the following genera which include our commercial ones: the Atlantic and Pacific salmon, ~~the~~ chars, taimens and lenoks.

This sub-family consists of those fishes which have beautifully-coloured meat when in the silvery stage (i.e., when not in spawning and post-spawning colour).

For example, in chinook and sockeye salmon the meat is an intense red (in the chinook it also has a blueish interplay of colour); the Atlantic, chum, coho and pink salmon have quieter reddish or orangey-red tones; while the Caspian salmon, taimen, char, and trout have pink tones with more or less orangey or sometimes straw-coloured shades. The salmon range of colours is widely known throughout the world under the general name of Somon (salmon colour).

The roe of fish of the main sub-family is very large (from 2 to 7 mm in diameter), reddish-orange or orange in colour.

The second sub-family is Coregonini, and consists of the genus Stenodus (Caspian inconnu and nelma), and the genus Coregonus which consists of the salmon with white meat (the so-called whitefish). All the gastronomic data for the fish of this family are exceptionally excellent and unique.

Anadromous fish predominate among the salmons, there are also fresh-water varieties, but no marine species.

The national fishery includes about 40 species of salmonid fishes, including such large and valuable ones as the Atlantic, Caspian (including the famous "Kura") salmon,

Pacific Ocean salmon such as the pink, chum, sockeye and coho, as well as the Siberian Pechora river nelma and a number of whitefishes (over 10 species of whitefish in the European part of the USSR and the Siberian muksun, broad whitefish ("chir"), peled, "pizhyan", Baikal omul and Siberian cisco).

The salmon, along with the sturgeons, are the best-tasting fish. Fish of the Salmonidae family have such common qualities as amazingly pleasant, outstandingly aromatic, tender meat of the most exquisite taste, with, as a rule, a high degree of fattiness and without tiny intermuscular prickly bones, as well as a large amount of edible part.

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The salmon of greatest importance on the market are the pink, chum, sockeye and coho. The most valuable salmon fishes are the Atlantic (common salmon) and the Caspian salmon.

Salmon that has been processed by salting in the Atlantic salmon fashion, canned au naturel, balyk products, other smoked products and the celebrated soft caviar are all high-class gastronomic delights.

The salmonid fishes, particularly the Atlantic and Pacific salmons, are the most valuable fish resources.

The Pacific salmons in volume of catch and market value are foremost among even the most valuable commercial fishes.

The world harvest of salmon fishes at the present time is 0.7-0.8 million tons per year, of which the main catch (in volume) consists of Pacific Ocean salmon.

The salmon (semga) is the main Atlantic salmon, it is an anadromous fish known on the world market as Atlantic salmon or Somon. In the Baltic Basin it is called salmon, while in the White Sea Basin and the Murmansk region it is called semga. The salmon achieves a length of 150 cm and a weight of 38 kgm (Pechora river), and is usually 130 cm long and weighs up to 24 kgm.

The usual molecular chemical composition of the raw meat of White Sea semga is as follows:

Substance	Content in %
Moisture	59.4-67.0
Protein	16.5-20.0
Fat	11.0-19.4
Ash	1.0- 1.5

In delicacy of aroma, tenderness, beautiful colour of the meat, outer covering and shape of body there is no more valuable and beautiful fish than the semga. The value rests in the fact that the fat in this fish is uniformly distributed throughout all the mass. Semga is particularly excellent when the meat contains up to 4-5% salt.

Kola (Murmansk) semga is slightly lower in natural gastronomic qualities than the White Sea semga.

Small Kola salted semga weighing 1.8-2.2 kgm and salted 8-12 July gave the following average figures (in % of weight of gutted fish): meat 72.8, head 13.5, skin 6.2 and bone 7.0.

The chemical composition of the meat of small salted Kola semga is as follows:

Substance	Content in %
Moisture	$\frac{55.37-59.20}{57.28}$
Fat	$\frac{8.56-13.00}{10.97}$
Protein	$\frac{22.76-22.00}{23.20}$ (sic.)
Ash	$\frac{7.65-10.15}{8.84}$
NaCl	$\frac{7.18-9.70}{8.29}$

Salmon from the Baltic Basin is slightly less fat and tasty than the White Sea or even the Kola (Murmansk) semga (the fat content in the meat is most often 8-12% not counting the fish in spawning colour).

There is a hybrid of salmon and sea trout in some parts of the Baltic. The meat of these fish is leaner and not so tasty.

Caspian salmon is caught mainly on the Western and Southern coast of the Caspian Sea (it enters the Kura, Terek, Sulak and Samur rivers and their tributaries). The Kura salmon was always prized above the other Caspian salmon in both the fishery and the trade. At the present time the Kura and Caspian salmon are combined in the price list. The average weight of the Kura salmon is 13 kgm, and of the more northern, 8 kgm. The maximum weight of Kura salmon registered was 52 kgm. It is the largest salmon.

The minimum takeable length of Kura salmon is 76 cm. Caspian salmon is delivered to the large centers frozen, where it is appropriately salted in the semga fashion until it contains 2-5% salt in the meat, and is also put up in excellent balyks. The meat is yellowish pink in colour.

Average fattiness of Kura salmon meat is about 20% (it goes up to 27%). Salmon from the northern part of the Caspian is not so fat.

The trout includes all the "wild" trout living almost without exception in the headwaters of rivers, mountain streams and brooks (brook trout). The trout will absolutely not tolerate contaminated water.

Many of these fish are found in the rivers and streams of the northwestern part of the USSR and in the Caucasus (Armenia, Georgia and Dagestan).

It is also a fact that the trout is one of the most attractive and complicated objectives of acclimatization, artificial rearing and fishing in general.

The trout^{family} includes a multitude of sub-species, forms, races, mixtures and hybrids. This fish is particularly plastic in the sense of hybridization. Ichthyologists believe that all trout is a local fresh-water form of taimen or sea trout. The trout is sometimes incorrectly called Dolly Varden. The rainbow trout (lake form) is an excellent import to Russia.

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The famous high-mountain Lake Sevan in Armenia has long been known for its beautiful trout ("gegakuni", "ishkhan", "bodzhak"), and these are of some commercial

importance here.

The trout has a very beautiful exterior and skin colouring. This is one of the most beautiful fish.

Trout meat does not have particularly high fat content, but it has an exceptionally pleasant colour, consistency and odour. The colour of the meat after heat processing is milky-white in young trout, while in mature trout it is most often pink, reddish-pink or yellowish-orange.

The weight of the body of pond rainbow commercial trout normally varies from 70 to 250-300 gm, while that of Sevan and other lake trout runs from 150 to 1,000 gm and higher. However, in the mountain lakes of the Caucasus for example, they occasionally land specimens weighing up to 8-10 kgm.

Trout roe is the same as that of all salmon (like chum) in taste, colour and size (4.0-5.5 mm). Trout roe is not marketed. Pan-size trout is highly esteemed (one fish - one helping).

The best method of preparing trout is to cook it over steam and serve it with delicate sauces that have been made with white wine and lemon, along with capers and olives.

Taimen, sea trout and lenok are of

practically no commercial importance.

The char fishes including the lake char, and excluding the Pacific Ocean char, are also of small commercial importance.

Nelma acquired special importance as raw material for balyk processing after white fishery was completely halted in 1960. Nelma and whitefish are very similar fishes although the whitefish is much larger, meatier and fatter. Nelma is taken mainly from the Ob', Yenisei, and Lena river systems and in the White Sea-Pechora region. The molecular chemical composition of Siberian nelma meat is given below:

Substance	Percent Content
Moisture	66.4-78.2
Protein	17.2-19.1
Fat	1.9-13.6
Ash	1.1- 1.3

The fat content of whitefish meat normally fluctuated between 18 and 26%.

The size of the nelma in the catch has recently become very small and the volume of landings has gone down. But generally-speaking there are rare instances of nelma weighing up to 32-40 kgm being landed. The shortest permissible length of takeable nelma is as follows: Ob' 59 cm, and Archangel 65 cm. Nelma weighing 3 kgm and over is used in balyk production.

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The Ob' nelma is being acclimatized in the Caspian; this form is very similar to whitefish.

Pacific Ocean salmon. The Pacific Ocean salmon catch consists mainly of pink and chum salmon followed by coho, sockeye and chinook. The ratio of masu in the catches is insignificant.

The main methods of processing salmon are canning au naturel, light, medium and heavily salted, smoked (including balyk-backs), frozen and soft caviar. The most advanced methods of preparation are light salting (including the semga method), au naturel canned products and first-class soft caviar.

Salmon roe is characterized by very high iodine number values. This is associated with the large amount of highly unsaturated fatty acids in it. This is precisely the reason why the fat in salmon roe is unstable to atmospheric oxygen and spoils quickly.

The fat of salmon roe, which gives it the characteristic colouring, contains various fat-soluble colouring pigments. Salmon roe fat contains the following colouring (according to Kizevetter):

Fat <i>name</i>	Colouring
Chum	Reddish-pink with yellowish tinge
Pink	Pinkish-red
Sockeye	Bright brick-red
Coho	Light red with orange tinge
Chinook	Red with brick-red tinge

The chemical composition of salmon roe is characterized by the data given in Table 9 (according to Kizevetter).

Table 9

Substance	% Content (%) of roe		
	Chum	Pink	Sockeye
Moisture	<u>50.4-56.3</u> 54.4	<u>49.7-59.6</u> 55.7	<u>56.0-68.0</u> 60.4
Fat	<u>11.8-19.7</u> 15.2	<u>9.8-14.7</u> 12.7	<u>10.0-13.2</u> 11.8
Protein	<u>27.4-35.4</u> 29.6	<u>22.9-37.6</u> 28.4	<u>20.1-29.0</u> 25.7
Ash	<u>1.5- 1.7</u> 1.6	<u>1.4- 2.0</u> 1.8	<u>0.7- 1.7</u> 1.4

The data in Table 9 show that the roe richest in fat and protein is that of the chum salmon, the pink salmon is a little behind the chum in this sense, whereas the sockeye has considerably more moisture, is poor in protein and the average fat content in it is less than in either the roe of the pink or the chum salmon.

The composition of the catch according to individual species of Pacific Ocean salmon fluctuates sharply from year to year, particularly in connection with "abundant" and "not abundant" years for pink salmon, but it can be shown approximately in the following manner (in %): pink 42-50, chum 40-45, sockeye 4-6, coho 3-8, chinook 0.5-1.0.

Pacific Ocean salmon fishery is concentrated as far as possible in those areas where the fish has not yet taken on spawning colour (before the fat content and meatiness have decreased, and the colour of the meat has deteriorated), before it has outgrown the silvery stage.

The best-fattened silver salmon is taken on the open seas and during the salmon run at the mouth of spawning rivers.

The difference in the fattiness of fish taken in the sea and even at the very mouth of the river is normally very

significant; in this connection the fattiness drops sharply as the fish progresses up the river.

The average chemical composition of raw Pacific Ocean salmon meat in the national catch is shown in Table 10:

Table 10

Fish	% content in the meat			
	Moisture	Fat	Protein	Ash
Chum: Fall Amur and Rybnovskiy	67.4	13.0	20.7	0.9
Other	70.8	6.4	21.4	1.2
Pink	70.5	7.1	21.0	1.4
Sockeye	70.6	6.9	21.2	1.3
Coho	70.0	7.2	21.1	1.3

Note: Data are for silvers and those fish whose spawning colors are still barely noticeable.

There is a natural law according to which all species of salmon are considerably fatter at the beginning of the run (fishing season) than at the end of the run (fishery) if a comparison is made of fish caught in the same area.

The average phosphorous content (in mgm/kgm) was least in chinook salmon meat (2530), and greatest in coho (2970); the chum salmon has less iodine (mgm/kgm) than other fish (0.22), and the greatest iodine content is found in the sockeye (0.44).

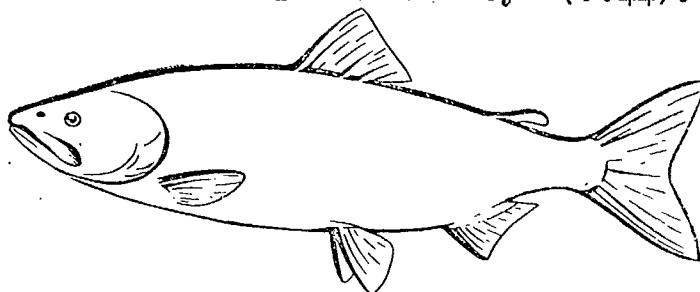


Figure 15. Silver Chum.

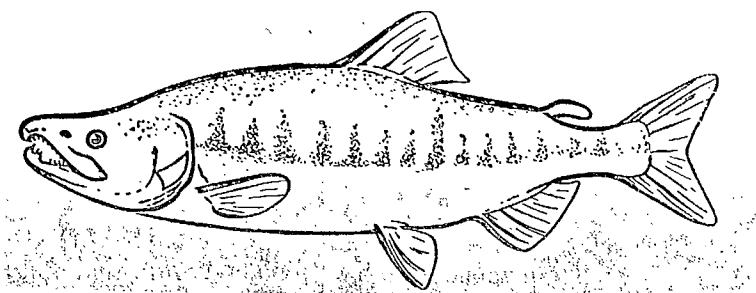


Figure 16. Male Chum in spawning colour.

The Keta (figures 15 and 16) goes by the international trade name of Chum salmon. There are two races of chum salmon known to fishermen, the summer, typical chum measuring up to 80 cm, and weighing up to 5.5 kgm, and the autumn chum measuring up to 100 cm, and weighing 210 kgm. The usual weight of the summer chum is 2-4 kgm, averaging about 2.5 kgm, and fat content of the meat is 6-7%. The autumn chum in the Amur river estuary usually weighs from

3 to 8 kgm, its fat content is between 6 and 20% and the usual protein content is about 21%. Amur-Rybovskiy autumn chum prepared by the semga method of salting and without signs of spawning colour or with the signs only slightly developed is in no way inferior to real semga.

Chum roe is almost as good as the roe of pink salmon and is better than the roe of other species of salmon.

The fish known by the international name of pink salmon is shown in figure 17. It is equally fat and tasty to the chum (if the autumn Amur and Rybovskiy chum is ignored for this purpose), even though the pink salmon is, along with the char, the smallest of the Pacific Ocean salmon. The usual length of running pink salmon is 42-52 cm (average 47), while the average weight is 1.4 kgm. Maximum length is 68 cm and weight 3 kgm.

The roe of the pink salmon is better than the roe of other salmon species.

Canned products au naturel of pink salmon are prized on the world market above those of the chum salmon. A large Pink salmon can be easily distinguished from a small Chum by the more acute angle formed by the end of the Pink salmon snout, and by its smaller scales.

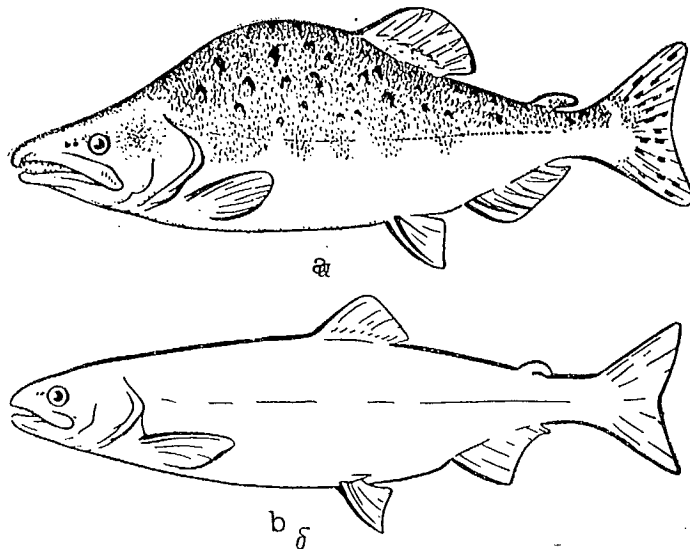


Figure 17. Pink salmon: a- male in spawning color; b- silver female.

The results of work on acclimatization of the Pacific Ocean pink salmon in the Barents Sea has given promising results.

The pink salmon now ascends the Kola Peninsula rivers to spawn by the tens of thousands. Trial catches and processing have shown that in this part of the Arctic Ocean the conditions are excellent for pink salmon.

This has been demonstrated by its size, chemical composition of the meat and the fact that, having been processed by the semga salting method, the Murmansk pink salmon is almost as good as Murmansk semga.

The molecular composition of fresh Pink salmon meat is given in Table 11.

Table 11

Substance	% Content in Pink Salmon	
	Eastern	Murmansk
Moisture	69.3	67.8
Protein	20.8	19.9
Fat	7.5	10.0
Ash	1.3	1.4

The Pink salmon harvest fluctuates very considerably from year to year. Years of abundant pink salmon harvest alternate with lean years.

Work has been carried on since 1962 in order to determine the possibility of acclimatizing chum and pink salmon in the Caspian Sea.

Preliminary promising results have already
¹
 been obtained .

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¹
 Tamarin A.E. Keta in the Caspian Sea "Rybnoe Khozyaystvo", 1965, No. 12, page 6.

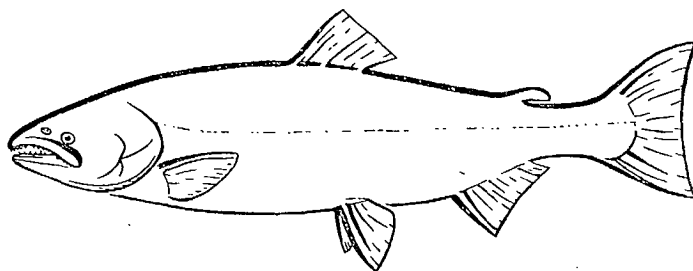


Figure 18. Chinook salmon.

The chinook salmon (fig. 18) or king salmon is the largest Pacific Ocean salmon and achieves a weight of 46 kgm; those caught in our waters normally weigh from 5.5 to 17 kgm, and their length is from 78 to 130 cm. The average length is 90 cm and weight 8.3 kgm. The chinook salmon is the first to enter the rivers. Its meat is fatter than that of other Pacific salmon², it is raspberry red in colour (with a light blueish tinge), and slightly friable. The chinook is usually processed by light salting and made into balyk products. The fat content of the meat averages 11%.

Chinook salmon roe is larger than that of other salmon species, but it is of comparatively low quality.

The sockeye or red salmon meat is a very attractive bright red colour. The average commercial length is

²

Discounting the fattest Amur-Rybnovskiy autumn chum.

56-57 cm, and weighs from 2.0 to 3.5 kgm; maximum length is 80 cm, and weight 5 kgm. Spring and summer sockeye are distinguished in the Bolshaya River. A dwarf lake form of sockeye has developed in the lakes of Kamchatka and along the Okhotsk coast. Sockeye is caught almost exclusively in the waters around Kamchatka.

Sockeye salmon yields the best export canned products au naturel, excellent balyks and lightly salted products.

Sockeye roe has a deep red colour, it is smaller than the pink salmon roe and is usually bitter.

The coho salmon (figures 19 and 20) or silver salmon is caught mainly along the Kamchatka coast. The largest amount of coho enters the Kamchatka river systems Bolshaya and Kikhchik (west coast). The fish reaches a length of 88 cm and weight of 6.5 kgm. Its average length is 60 cm and weight 3.4-3.5 kgm. Meat fattiness varies from 6 to 9%.

The coho is similar to the keta in commercial properties. Its roe strongly suggests sockeye roe.

The Pacific Ocean char or Dolly Varden is caught along the Okhotsk seacoast where it achieves

lengths of from 23 to 52 cm, and an average weight of 0.4 kgm, and on the Anadyr river it weighs over 1 kgm (specimens of up to 5.7 kgm and 80 cm in length occur).

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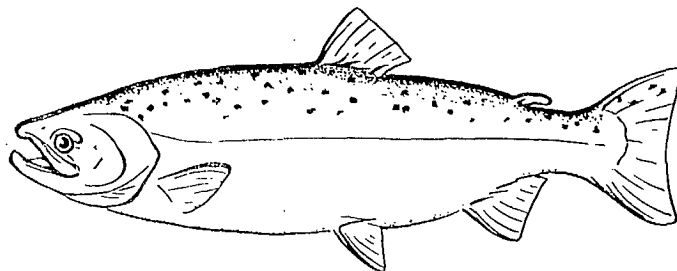


Figure 19. Coho without spawning alterations.

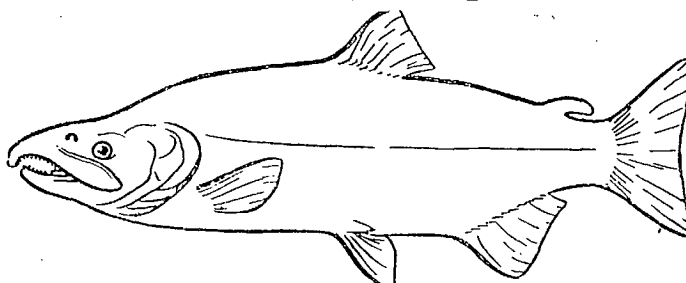


Figure 20. Coho with spawning alterations.

The catch is small but it is carried on along almost all of the Soviet Far East Coast.

Whitefishes. The genus of whitefishes includes the European (Neva), Volkhov, Ladoga, valaamka, lake, sea, Lake Chud, Baikal, Amur, and other whitefishes, the European and Siberian cisco, tugun and the large Siberian whitefish such as muksun, pyzh'yan (Siberian whitefish), chir-shchekur (a broed whitefish), omul, Baikal omul, peled, etc.

The average proportion of meat in the body parts of Lake Ladoga whitefish is given in Table 12.

Table 12

Body part	Weight in %	
	mid-July	mid-October
Meat and skin	68.6	66.5
Head	10.0	11.2
Roe	1.1	6.7
Milt	0.6	2.0
Other viscera	10.2	5.7
Fins	0.9	1.0
Scales	2.4	2.5
Bones	6.0	6.1

The chemical composition of the meat of this whitefish is given in Table 13.

Table 13

Substance	% Content	
	mid-July	mid-October
Moisture	<u>65.00-73.47</u> 70.00	<u>72.05-73.90</u> 72.96
Fat	<u>6.88-12.16</u> 9.61	<u>5.90-7.37</u> 6.97
Protein	<u>18.87-21.50</u> 19.77	<u>18.00-19.62</u> 18.73
Ash	<u>1.01-1.16</u> 1.12	<u>1.29-1.44</u> 1.34

The total whitefish catch in the USSR
in 1966 was 17.8 thousand tons, of which 80-85%
came from Siberia.

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Of the Siberian whitefishes, the bulk of the product is obtained from the Siberian cisco, muksun, peled and Baikal omul. Of these, only the Ob' cisco has comparatively average gastronomic properties, whereas the Yenisei cisco (Turukhanskiy herring), the Lena and Yana river cisco, as well as the muksun, peled and omul are all fish whose natural properties make them delicacies. They normally contain from 9 to 15% fat in the meat and are considerably better than European whitefish. However, the difference in geographic, economic and technological positions of the European and Siberian whitefish fisheries has resulted in the Siberian whitefishes being mainly considered unsatisfactory from the gastronomic point of view and, unfortunately, there is not much demand for them.

The consumer, industry, trade and budget would gain much if, in the future, it would be possible to deliver Siberian whitefish in time and properly frozen and glazed to the large consumer centers in order that they could prepare the classical product such as the Leningrad hot-smoked whitefish (gutted and with scales removed).

It really must be kept in mind that this raw material is much more interesting from the gastronomic point of view than is whitefish from lakes Ladoga, Pskov and Chud, as well as from the Neva, Volkhov, from the water reservoirs in the Baltic Republics, and that the quantity of whitefishes caught in Siberia is tens of times greater than the catch in the European part of the USSR.

The minimum length which may be taken in the Ob' river basin has been set for peled at 26 cm, broad whitefish at 40 cm, for Pyzh'yan at 25, muksun 43, and cisco "Ob' herring" at 17 cm.

Cisco, including European and Siberian cisco, / 88
has long been called herring (Pereyaslavskiy, Teletskiy, Ob', Turukhanskiy, Khatangskiy herring). In the Archangel-Pechora regions it is called "zel'd", while in Yakutiya it is called "kondevka". Tugun from the Sos'va and Igrim rivers is called Sosvinskiy herring.

The only proper technological method of processing tugun is to spice salt it. However it is definitely time to change over from barrels of salted product to canned (large and small cans).

Detailed information concerning Siberian whitefishes can be found in my work entitled "Siberian Fish Products".

FAMILY THYMALLIDAE

Fish of the family Thymallidae have considerable similarity to the whitefishes in both external appearance and commercial-nutritional properties. They differ from the other salmonid fishes by a long and very high (in the males) dorsal fin which has over 17 rays. Two Siberian forms and two Baikal forms of grayling are known. The Baikal graylings are divided into white (lake) and black grayling. The white grayling is considerably meatier, tastier and normally somewhat fatter than the black grayling.

The average fattiness of Baikal grayling meat is 1.5 to 5.0% depending on the season (this fish spawns in the spring). Enormous deposits of fat are found on the viscera of Baikal grayling during its fattest period (on the average up to 47% fat on the viscera).

Only the Lake Baikal graylings are of significant commercial importance (the catch is from 0.2 to 0.8 thousand tons annually), and insignificant amounts from the lower regions of the Ob' and the rivers of Yakutiya. The minimum length caught is 23 cm (Yenisei river) and 26 cm (Baikal), the usual length is between 30 and 32 cm. The average weight is 0.2 to 0.4 kgm.

The Baikal grayling is used in the preparation of canned products, frozen, smoked and salted goods. The grayling gastronomically resembles the whitefish, but it is somewhat inferior.

FAMILY OSMERIDAE

This family includes the commercial fishes of several species of smelt, caplin and stint. They all have an adipose fin. The body is round and shaft-like. The scales are fine, easily removable, without silvery pigment (therefore the fish seem to be semi-transparent).

The smelts are marine, diadromous and fresh-water fish. The stint is a dwarf lake form of smelt.

The smelt has an entirely unique and pleasant taste and aroma. Raw smelt smells like a fresh-picked cucumber. This has also given rise in some areas to the fisherman's name of cucumber-fish for the smelt.

The price list gives smelts regionally. At the same time consideration is given to the average size of the fish (for example, the relatively large Neva, Finnish and White Sea smelt and the much smaller Lake Ladoga smelt), the size of the catch and the remoteness of the fishing ground from consumer centers (Leningrad, Northern Siberia, Far East). The length of the Neva, Finnish and White Sea

smelt normally is 12-25 (sometimes 233) cm, that of Lake Ladoga is 11-25, and Lake Onega up to 16 cm. The fat content varies from 1.5 to 3.0%.

Because of its small size, the Lake Ladoga smelt is used mainly in the salted and dried state (average weight in April is 16.1 gm, while in May it is 8.7 gm - sic) similar to stint.

The average chemical composition of whole fresh Lake Ladoga smelt is given below:

Substance	% Content
Moisture	78.95
Fat	2.64
Protein	15.42
Ash	2.45

The silver smelt, which normally occurs together with the large Arctic or Asia smelt in the Far East and Siberia, is much smaller, but much fatter and tastier (up to 6-8% fat), and is an excellent raw material for drying and smoking.

Fried smelt (including that marinated after frying together with a vegetable garnish), hot-smoked, dried and canned (smoked, in oil) is considered a delicacy. Canned

smelt in tomato sauce is also excellent. An excellent product can be made of small smelt by the hot drying process (it suggests stint).

Stint is caught in lakes Pskov, Chud, Il'men, Beloe, Valday, Seliger and some of the lakes in Latvia. It is caught mainly in Lake Pskov-Chud. Hot drying is the only way to process it. The weight of one raw commercial stint specimen is 1.0-2.5 gm.

The chemical composition of spring salted-dried stint (whole), taken in May, is given below.

Substance	% Content
Moisture	$\frac{40.69-44.62}{42.47}$
Fat	$\frac{2.83-3.48}{3.19}$
Protein	$\frac{29.56-34.30}{32.06}$
Ash	$\frac{21.37-22.83}{22.11}$
NaCl	$\frac{16.42-17.38}{16.82}$

As early as the first quarter of the present century the harvest of stint was 500 thousand tons. At the present time the stint trade has been sharply curtailed. The stint is being acclimatized in many lakes.

Caplin (fig. 21) was caught to be used as bait for cod fishery. However, in some of the western countries it has long been used as a food. The average weight of the males of the coastal caplin is 34 gm, that of females 24 gm. The carcass yield is 66%, weight of the head 25%. The meat contains (in %): moisture 82.2, fat 2.5, protein 14.5%.

Caplin is used mainly in production of fish meal and only partially in food products. Although inferior to smelt in taste, the coastal caplin is fully acceptable in the frozen state, hot-smoked, dried, and in cans (smoked caplin in oil).

All salted osmerid fishes are of very low quality.

Osmerid fishery in many regions of the USSR still requires intensification, and the raw product requires rational technological and consumer utilization. Fishery for exceptionally fat and tasty caplin in the open sea is being organized.

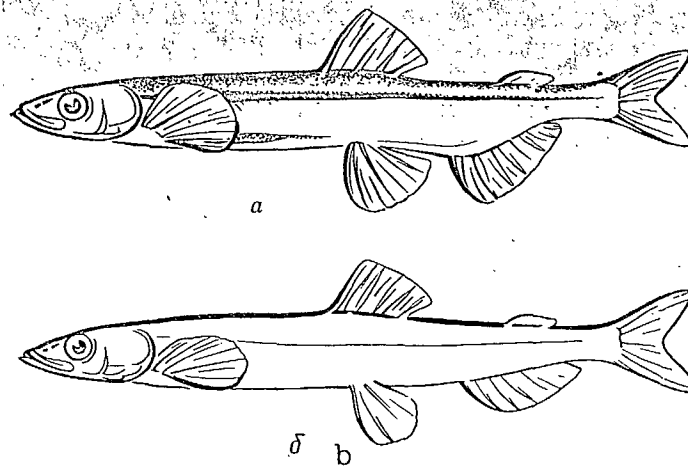


Figure 21. Caplin: a- male; b- female.

FAMILY ARGENTINIDAE

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The argentine (silver fish or golden smelt) strongly resembles the smelt in external appearance but is larger. The scales are fine, large, and easily removable. The eyes are very large. The walls of the swim bladder are silvery. The argentine is an entirely new commercial fish which is very promising.

The minimum commercial length for argentine is 17 cm.

According to PINRO data, the weight of individual argentine specimens taken on Georges Bank and near Sable Island vary between 152 and 628 gm, and average 478 gm with absolute length of 28.3-43.5 and average of 40.2 cm,

weight of carcass averaged 70.9 gm, weight of meat was 64.8%, weight of head 14.8% (with the head cut straight off it was 18%), bone 5%, scale 0.6%, total viscera 11.8%. The maximum weight of roe was 21.0, and that of milt 8.2%. From February through March the gonads develop intensively, and the weight of meat obtained at this time is 60 to 66%; from June through January the amount of meat is 65 to 70%. Fattiness in the meat during the spawning period averages about 1%, and during the remaining periods it is from 2 to 4%.

An analysis of raw argentine meat showed the following fluctuations in molecular chemical composition:

Substance	% Content
Moisture	$\frac{75.4-81.2}{78.6}$
Fat	$\frac{0.4-4.1}{2.0}$
Protein	$\frac{17.2-18.6}{17.6}$
Ash	$\frac{1.3-1.5}{1.3}$

The raw roe contains from 4.8 to 14.0% fat.

The meat is white, tender and very tasty. Argentine is an excellent food fish that can be used in cookery.

It is also excellent after hot-smoking and in canned products.

According to research done by AtlantNIRO (Podsevalov, Pavlova, 1965), argentine meat has the following chemical composition:

Substance	% Content
Protein	18.4
Fat	3.1
Moisture	77.5
Ash	1.0

The weight of the body is between 350 and 900 gm. / 92
The yield is (in %): carcass- 68, head- 16, viscera- 16.

Frozen argentine is sold in the round, while communal feeding enterprises receive it as a semi-product for the kitchen. The yield of such semi-product is 66.7% of frozen argentine. Of the waste and unspecified losses during cutting, which amount to 33.3% total, the weight of the head averages 16.5% of the whole fish.

FAMILY ESOCIDAE

More pike are caught in the USSR than in ^{any} other country in the world. Our fresh-water (and partially

salt water) predator, the true pike, and known in almost any corner of the land, should not be confused with the marine fishes known as ocean pike (ling) (Molva), barracuda and other pikes. These fishes have nothing at all in common, from the commercial-nutritional point of view, with the true pike.

The minimum permissible length of pike which may be taken is: in the Volga Basin 32 cm, in the Ob' Basin 28 cm, and in the northwestern part of the country 30 cm.

The usual weight of the pike caught is 0.3-2.0 kgm. The pike is an extraordinarily long-lived fish. In Siberia even now occasional specimens are caught measuring up to 1 m in length, and weighing up to 16 kgm.

Pike meat is permeated with intermuscular bones, but the consistency and taste of the meat is excellent, provided the fish is not silty and is not very old (large). The molecular composition of the pike meat is given below:

Substance	Percent Content
Moisture	78.4-81.5
Protein	16.9-20.3
Fat	0.4- 0.8
Ash	1.0- 1.9

It is best to utilize pike live, iced or frozen, with subsequent cooking (stuffing, cutlets, quenelle, dumplings).

Freshly-prepared lightly-salted pike roe is extraordinarily good. At the canning plants in Siberia, the Northern Caspian and other enterprises where pike cutting is concentrated during the spring, it would be expedient to organize the preparation of pasteurized pike roe, containing 3-4% salt, as a delicacy.

Salted and smoked pike is a very low quality product. In response to consumer interest, pike should be preserved only as a stuffing. In Siberia such stuffing is, very popular, but it has never been produced in large quantities. It would be very desirable to organize production of so-called "stuffed pike". Fried pike in tomato sauce and even with vegetable garnishing is a totally indifferent product. The gastronomic qualities of the pike become neutralized.

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In the USA the reserves of pike are maintained by artificial rearing.

FAMILY CYPRINIDAE

This family includes fresh-water and diadromous fish. The cyprinids do not have teeth in their jaws,

but they do have pharyngeal teeth. There is one dorsal fin. This is the most numerous family of fish (by number of species).

The waters of the USSR alone contain 118 species (over 1,000 species of cyprinid fishes are known).

The most important commercially are the following cyprinid fishes: bream, wild carp, carp, vobla, taran, roach, grass carp, ide, asp, barbel, marinka, crucian carp, shemaia, vimba, white-eyed bream, blue bream, silver bream, chekhon and silver carp.

The meat of cyprinid fishes varies by species and is not uniform in quality, but in most fish it has excellent taste, aroma (if it does not smell of mud), and excellent consistency. They are normally average to fat fish. The fat content in cyprinids fluctuates considerably depending on the species of fish, its age (size and weight), season of catch and frequently the habitat.

Our country is richer in wild carp fishes than any other country in the world.

Work is being done on the acclimatization of the most valuable species of cyprinids in natural and artificial water reservoirs. In addition, fish conservation

measures are being applied more rigidly, as well as other measures for restoring the carp reserves. Cyprinids used for food purposes are normally marketed live, iced, or frozen. Many cyprinids are dried (carp is the best raw material for drying). The following fish are excellent after processing by the cold-smoked method: bream, vobla, taran, roach, kutum, grass carp, ide, asp, barbel, marinka, shemaia, vimba, white-eyed bream, blue bream, silver bream, chekhon, and many Amur river cyprinids.

Those cyprinids that are the least useful as food (very small and bony) are successfully utilized in the preparation of hors-d'oeuvres.

The wild carp (fig. 22) is the most important in the basins of the Caspian, Azov, Black and Aral Seas and Lake Balkhash.

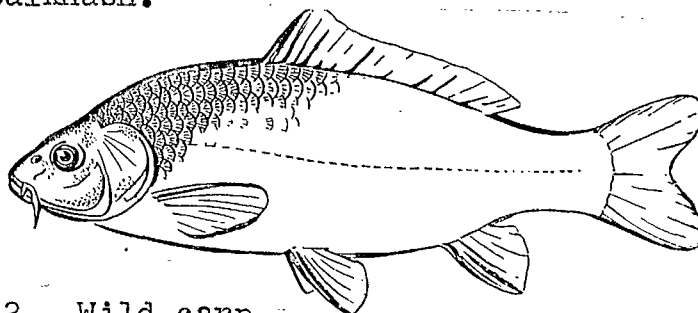


Figure 22. Wild carp.

The minimum length of wild carp that may be taken is: in the Caspian Basin (except the southwestern part) - from 40 cm, in the Black-Azov Sea - from 30 cm, in the

water reservoirs of Kazakhstan (excluding Kzyl-Ordinskaya Oblast') from 26 cm, and in the Danube River from 25 cm. Wild carp weighing 0.6-5.0 kgm predominates in the catch, but occasionally specimens weighing up to 20 kgm are landed. The fat content of wild carp meat (except the Amur) is normally within the limits of 2-6%. Wild carp meat, raw and processed, is dark, but the colour is similar to that of warm-blooded animals and is distinguished by its unique aromatic-taste properties. A small quantity of wild carp is caught in the Amur river (300-500 tons), but this fish is much fatter, larger in size, and is particularly delicious.

Carp is caught mainly in the spring, less in the fall and by ice-fishing. In addition, wild carp is sometimes raised, like carp, in fish-rearing economies.

The average chemical composition and the amount of meat obtained from a wild carp is shown in Table 14:

Table 14

Basin and season	% Content				Yield of meat %
	moisture	Protein	Fat	Ash	
Caspian					
spring	78.6-80.0	16.4-16.5	2.6-3.8	1.0-1.1	42.5
autumn	77.6	18.3-19.3	2.1-3.1	1.0	42.5
Aral					
spring	73.7	18.0	6.2	1.1	58.9
autumn	77.8	17.8	3.1	No data	No data
Black Sea-Azov	75.02	18.0	5.5	1.1	50.2
Amur River	67.0-78.8	17.1-18.2	2.5-23.0	1.4-2.6	No data

The Amur River wild carp is an excellent material for fish propagation.

Live and iced wild carp is very stable during storage and shipment in comparison with many other fishes.

The total catch of wild carp in the country as a whole was 31.2 thousand tons in 1966.

The carp is the cultured form of the wild carp. It is the main variety reared in pond economies. There are carp varieties that have scales, mirror carp with scattered scales, mirror carp with linearly positioned scales and bare or naked carp that is scaleless (leather?? carp) (fig. 23). In the first type the whole body, like the wild carp, is covered with scales, in the other forms

the skin is only partially covered with very large scales. In the USSR the mirror forms predominate.

Most often a carp is sold as a commercial live fish weighing from 0.4 to 1.2 kgm, with fat content of meat between 3 and 10%. The carp is more tender, tastier and normally fatter than the wild carp. The ponds are fished out in the fall. Conditions are particularly favourable for intensive carp culture in the chernozem zone of the RSFSR, the Ukraine and Belorussia. There are great prospects in the USSR for further development of the carp-rearing economy.

The carp is the basis of the live-fish trade, it is sold, as a rule, alive and sometimes iced. In 1906 in the USSR 28.6 thousand tons of commercial carp was sold.

Bream is caught mainly in the basins of the Soviet Caspian, Aral and Azov Seas. The bream taken from the water reservoirs in the Baltic Republics is much less important. Bream fishery has dropped significantly in the main regions of its fishery and fluctuates greatly from year to year. Bream is caught mainly in the spring, much less in the autumn, and still less during the winter (ice-fishing).

The chief natural deficiency in bream, as in almost all cyprinid fish) is the presence of a great number of tiny prickly bones in the meat. This deficiency is overcome during cold-smoking, drying and canning since the bones then become undetectable.

The minimum length of bream which may be caught are: in the Black Sea Basin and the water reservoirs of the northwestern region 30 cm, in the Baltic Sea Basins 29 cm, in the Sea of Azov 28 cm, in the Caspian Sea 27 cm, in the Aral Sea 25 cm and in the Danube River 20 cm.

Depending on the age (size), season, fishery and habitat, and taking into consideration the minimum length permissible, it may be assumed that the fat content in bream meat varies from 2 to 10-11%.

The leanest bream is the Astrakhan and Azov (which earlier were exceptionally fine), and the tastiest and fattest is the Aral bream (if we ignore the not infrequently caught large, fat and delicious bream from the numerous artificial water reservoirs).

At one time the Azov bream was, together with the Aral bream, the very best. An excellent bream is obtained from the newly created water reservoirs in the Baltic regions

and the lakes of the northwestern part of the RSFSR, as well as the Amur River, but there is relatively little of the fish in these waters. The bream harvest in the USSR during 1966 was 45.7 thousand tons.

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The weight of the bream predominating in the catch varies from 0.3 to 2.0 kgm. The amount of meat obtained varies between 43 and 67.5%.

Bream is usually delivered frozen (iced in much smaller amounts), cold-smoked and salted. Retail enterprises handling salted, round and frozen bream usually smoke cure it. Also, large quantities of bream are fried and baked in the cooking enterprises at consumer centers. Dried and cold-smoked bream is produced in unjustifiably small quantities.

The Asp does not have much commercial importance. The largest amounts are landed on the Southern Caspian and in the Aral Sea. There is a local form of asp in each of these water bodies. The Southern Caspian red-mouthed asp is of considerably higher quality than the North Caspian and Aral asp. This fish is frozen, hot-smoked, dried and used for cold-smoking. The average fattiness in the meat of North Caspian asp is 4%.

The minimum length of asp which may be taken from the Caspian and Aral Seas is 20 cm. Asp roe is considered

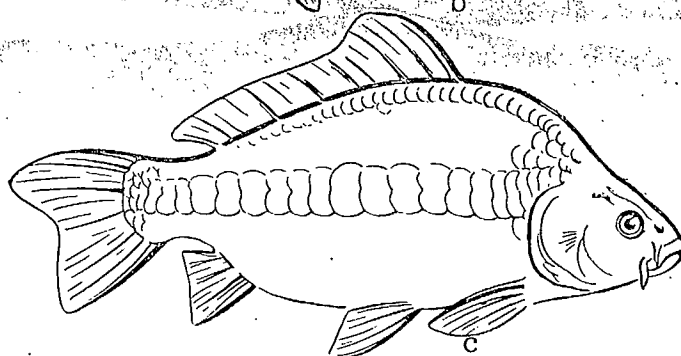
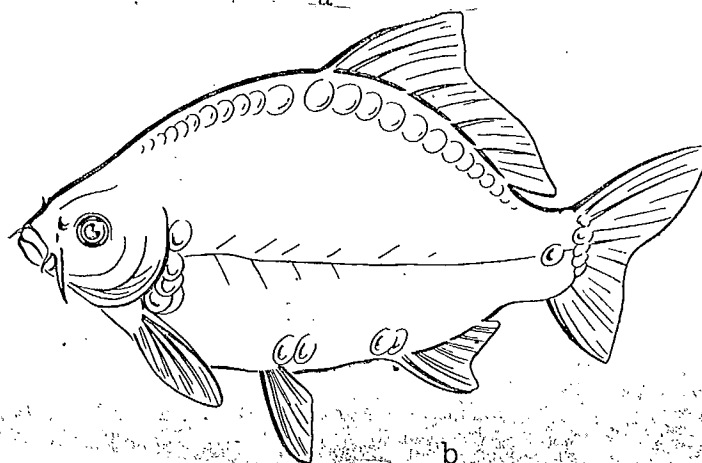
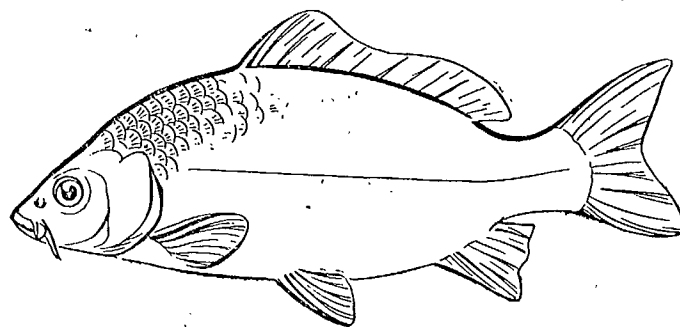


Figure 23. Carp: a- with scales; b- leather;
c- mirror.

the best carp roe.

The silver bream is not a commercially important fish. It is taken along with other fish. In Azerbaydzhan, the minimum length of silver bream which may be taken is 19 cm. In this region they are larger and fatter than elsewhere. Morphologically the silver bream is similar to the bream but, because of its comparatively small size, small amount of meat and large amount of bone, it is considered a low-value fish in the other parts of the Caspian, Black Sea-Azov and other natural basins.

Nevertheless, in many water reservoirs and in places in the North Caspian Basin, the meat of silver bream has become fatter in recent years.

The vobla, taran, roach and Siberian roach are systematically very similar sub-species, races and populations of the same species of roach. In the Caspian Basin the roach is represented mainly by the vobla, which is best known as a dried, cold-smoked, frozen and baked fish. Vobla is also hot-smoked. Vobla and taran dried and cold-smoked are particularly popular. The Aral vobla is slightly inferior to the Volga-Caspian, but it occupies a prominent place in Aral Sea fishery. It is mainly dried, smoked and salted. Taran from the Azov Sea Basin is, as a rule, somewhat larger, fatter and

more delicious than vobla when it does not have an odour of mud, but it is caught comparatively little and the catch fluctuates widely from year to year. Azov taran is also mainly dried and cold-smoked. Siberian roach is smaller than vobla on the average. It is generally unsuitable for drying. [] With the whitefish, it is one of the main Siberian commercial fishes.

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The minimum length which may be taken are; for Caspian vobla 17 cm, Aral 16 cm, Black Sea taran 19 cm and Azov 16 cm. Raw vobla meat normally contains from 1 to 4% fat, that of Azov taran from 2 to 6% fat. The average loss of meat during drying is about 50%. On the average, dried vobla contains 58% edible part (meat and roe) and 42% unedible waste. The vobla, taran and roach catch is 40-48 thousand tons.

Crucian carp is mainly a small-lake fish. It has a very high body and coarse scales. It is very resistant to oxidation starvation (which is very important during winter kill, as well as in fish-rearing and live fish trade). The crucian carp when it does not smell of the bottom is an excellent fish, particularly after having been fried in sour cream.

Salted crucian carp is an extremely low quality product. This fish is mainly consumed locally. Winter

crucian carp from the lakes in the Aral Sea Basin is excellent, as is that from the Amur River.

The crucian carp with its very large, coarse scales, and occurring almost universally, should not be confused with the ocean carps (many fishes of the Sparidae family). These fish do not have anything in common except a remote similarity of their exterior. Two species of fresh-water crucian carp are known, the golden or round yellow, and the silver or gray.

Depending on the environment, the crucian carp can be very small (dwarf forms), but in some water reservoirs they achieve average weight of 0.5 kgm and over. The golden crucian carp occasionally weighs up to 5 kgm, while the silver goes over 1 kgm (very rarely). In the Ob' River Basin it is permissible to catch crucian carp measuring over 12 cm, and in the Volga Basin the minimum length is 15 cm.

In many regions of Siberia and the Volga River Basin the crucian carp is of vital importance to the industry and trade. Fatness of crucian carp meat normally is within the limits of 1-3%. Amur crucian carp goes up to 9.5% fat content. The yield of meat from small crucian carp is very low (28-30%), that of large specimens is from

46 to 55%.

Every effort should be made to organize the industry and transportation in such a manner that the trade would be supplied with live, iced and frozen crucian carp. Dried, smoked and salted crucian carp are low quality products.

Chekhon of market interest is found only in the Azov, Kakhovka, Rybinskoye and Tsymlyanskiy areas.

Caspian, Aral and all other chekhon is relegated to small fry. It is much smaller, less meaty, leaner and less tasty than the Azov chekhon. This fish has a sabre-shaped body with shiny silvery scales and upturned snout. (Fig. 24)

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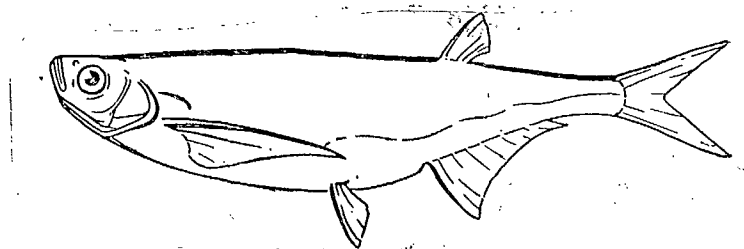


Figure 24. Chekhon.

The body is greatly compressed on the sides and it has a zigzag lateral line. It normally weighs from 0.2 to 0.4 kgm, but occasionally achieves 1 kgm. The shortest length of chekhon which may be taken in the Black Sea-Azov Basin is 24 cm, and the Tsymlyanskiy minimum is 23 cm.

The average chemical composition of chekhon meat and the yield for the main fisheries is shown in Table 15:

Table 15

Basin and season	% Content				Meat
	Moisture	Protein	Fat	Ash	
Caspian . .	75.0	21.0	2.5	1.5	46.0
Aral; spring.	79.3	18.0	1.2	1.2	67.0
autumn.	72.8	22.8	3.8	No data	
Black Sea-Azov. . . .	67.4-77.1	17.1-21.2	2.0-11.5	1.1-1.7	56.5

Chekhon is used fresh, or smoked by the cold or hot methods, and also salted, dried and canned.

The best shemaia is caught in the Kyban', Don and Kura River estuaries, but mainly in the Kyban'. The weight is normally from 60 to 360 gm. This is the best cyprinid fish according to its gastronomic properties. It is very fat (6-23% fat content), tender, delicious and aromatic. It is marketed in the cold-smoked state. Dried shemaia is excellent, but unstable in storage. Aral shemaia, of which 10-15 times as much is landed than of the Azov shemaia, is a product of ordinary quality (on the same

level as vobla), and is far behind Azov and Kura shemaia (the fat content in the spring is no more than 3%, and in the fall 7%). The minimum length of Caspian, Black Sea-Azov and Aral shemaia which may be taken is 19 cm.

The Black Sea-Azov shemaia fishery has been very sharply curtailed, while that in the Kura River has always been insignificant.

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The vimba, along with the shemaia, is a foremost delicacy when prepared by the cold-smoked or drying methods. This fish is caught in the Don, Kuban', Dneper Rivers and in the Baltic. Its weight is usually from 0.2 to 0.5 kgm. The meat is white, fat and aromatic. It is zoologically similar to the bream but differs from it by having a dorsal keel (situated in front of the dorsal fin), covered with scales, and also a lower body. The vimba from the Baltic Sea is usually somewhat inferior to the Black Sea-Azov vimba in fatness and taste. The fattiness of Azov vimba is usually between 7.5 and 10.0%.

The vimba caught in the Caspian Basin is the same as other low-value cyprinid fishes in commercial-food value and is considered a run-of-the-mill fish (the fat content of the meat during the spring averages 2.4%).

The minimum permissible length of Black Sea-Azov vimba which may be taken is 22 cm, that of the Baltic is 24 cm, Caspian 17 cm. The Caspian vimba is normally not caught separately from the vobla and other small cyprinid fishes in this reservoir; it is not accounted for and is not marketed.

The white-eyed bream is a small fry and only the South Caspian white-eye from the Kura River is recognized (under the trade name of Azerbaydzhan white-eye), along with the autumn Aral Sea white-eye, as fat and tasty fish. The weight is usually between 0.2 and 0.3 kgm. It is particularly esteemed following processing by the cold-smoking method. The minimum length for Aral white-eye has been set at 18 cm.

The blue bream known as Tsymlyanskiy, Rybinskiy, Volgograd, and Azov blue bream is excellent and in quality is similar to the Kura white-eye. It is permitted here to take this fish down to a length of 24 cm. All other blue bream is relegated to small fry.

The earlier Astrakhan commercial and trade name for blue bream, "sop", was incorrect, although it had become well established.

The barbel is a genus which contains up to 300 species. In the USSR the most important is the Aral barbel (fig. 25), this is a valuable Aral Sea fish (it is not numerous in the Caspian). The barbel has a shaft-like body, a miniature, pointed conical head and two pairs of long barbels. The usual weight is 2-8 kgm, but specimens weighing up to 22 kgm are landed. The fat meat is very pleasing in consistency and has a piquant aroma (it has a "milky" odour). The minimum length of barbel which may be taken in the Caspian has been set at 52 cm, and for the Aral Sea 55 cm.

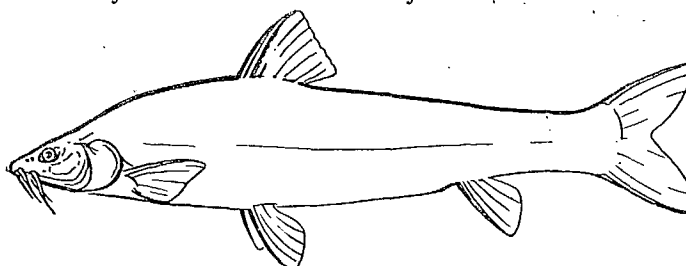


Figure 25. Aral barbel.

Chemical composition and yield of raw meat for the barbel is shown in Table 16 (average data are given for the Aral barbel).

The barbel is used in the production of excellent balyks, it is smoked, frozen and a small amount is dried.

Table 16

Region and season	% Content				% Meat
	Moisture	Protein	Fat	Ash	
South Caspian	71.7-78.9	19.0-20.9	4.5-8.3	1.0	52.7
Aral					
spring	68.3	17.7	12.1	1.2	75.0
autumn	70.2	19.7	10.3	1.2	75.0

The Amur grass carp until recently in the USSR was known only from the Amur River. White and black grass carp are distinguished. The latter is of little importance. The length of the white grass carp is normally 52-100 cm, that of the black is 66 to 80 cm.

The white Amur grass carp (fig. 26) has shown excellent results in acclimatization to the European part of the Soviet Union (from the Baltic to the Black Sea-Azov, the Volga delta, as well as Central Asia, for example, in the Karakumskiy Canal).

The grass and the silver carp are now being acclimatized in new regions and are being reared in fish-rearing (pond) economies. These fish are valuable because they do not compete

with other carp and wild carp for food; they only eat aquatic vegetation which is not eaten by other fish; and at the same time they keep the water bodies from becoming overgrown.

The grass carp is an excellent, valuable fish with very tasty, pleasing, firm, white meat.

The white grass carp from the Amur River normally contains 73-75% moisture, 16-19% protein, 5-7% fat in the meat and the yield of meat averages 55%.

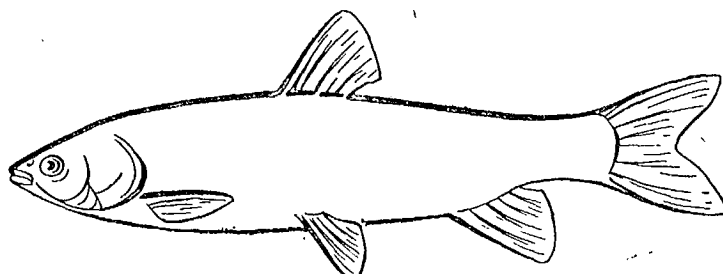


Figure 26. White grass carp.

The Amur grass carp has been widely distributed in our country in the past few years.

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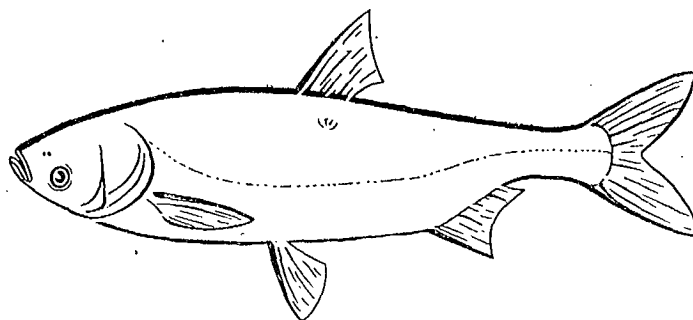


Рис. 27. Толстолобик.

Figure 27. Silver carp.

The silver carp is an extremely variable fish depending on the place and time of catch. For example, the silver carp imported from the Chinese People's Republic is, as a rule, extremely watery, lean, tasteless (all the species). The silver carp from the Amur River estuary is better tasting and fairly fat. The length goes up to 1 m, and the weight up to 16 kgm (fig. 27). The fat content of the meat of our own Amur silver carp is normally 8-13% (up to 23%), and the raw meat contains 16.5-18.3% protein. It is excellent when smoked.

The silver carp is a subject of acclimatization and fishery particularly in the southern part of the USSR. Here, it has acquired fully acceptable food qualities. It is very interesting as a raw material for balyk.

The marinka normally weighs from 0.3 to 2 kgm. Its body surface is dark and mottled. The meat is fat and tasty. The black membrane lining the abdominal cavity, the roe and milt of the marinka, are sometimes poisonous and must be removed during processing. The raw meat averages 17% protein content and up to 7% fat. It is usually marketed dried and cold-smoked.

The ide is very important commercially only in Siberia. This fish is much larger and fatter in Siberia than elsewhere. Landings are particularly significant in the Ob'-Irtysk Basin, where the ide is one of the

main commercial fishes. Its average weight is about 0.8 kgm. Ide weighing 2.0-2.5 kgm is not a rarity here (up to 4 kgm specimens are landed). In the Lena and Yenisei Rivers there is a smaller kind of ide. The fat content in the meat is from 3 to 16%. The meat has a slightly yellow, sometimes pinkish tinge. It is permissible to catch ide measuring from 25 cm in the Ob' River Basin, while in the Black Sea-Azov Basin the minimum length is 20 cm.

It is used mainly frozen, smoked and salted, and also in canned products. The meat of the Siberian ide that has been cold-smoked often suggests ham by its aroma.

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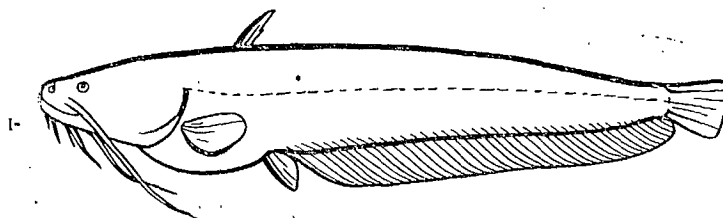


Figure 28. Common catfish.

FAMILY SILURIDAE

The catfish is a fresh-water fish populating the rivers and lakes. It is diadromous in the Caspian Basin. The main fishery for catfish takes place in the Caspian, Aral, Azov and Black Sea Basins. The catfish is widely distributed also throughout the Baltic Sea Basin and the

lakes in the northwestern part of the RSFSR. Its features are enormous whiskers or barbels, very long anal fin, exceptionally short dorsal fin, the absence of scales, *and* very constricted caudal part of the body (fig. 28).

Catfish meat is fat, white, tender and sweet, it has few bones but is rather sickly sweet. Landings most frequently include specimens weighing from 1 to 6 kgm, but huge specimens are sometimes caught. The Azerbaydzhan catfish is particularly large. There is no limit on the catch of this predator. Catfish less than 25 cm in length are rejected. It is classified as large or small. The meat of small catfish differs sharply in fat content from the meat of the large catfish. The rear part of the body is much fatter than the forward part. The fattiness of the meat along the entire length of the body is from 1 to 12%. The yield of meat is 50-60%.

The technical processes used in its preparation are cooking (frying), hot smoking, canning in tomato sauce and freezing. It is specially recommended to use sharp piquant additives when preparing canned product, cooked dishes and even hot-smoking products (to remove the sickly sweetness normally present).

FAMILY OF SEA CATFISHES

The fish of the sea catfish family (they are sometimes called little sea catfishes, even though there are fish among them weighing several kilograms), are very meaty, beautiful, with rounded body shape, leathery-scaly covering of a dark silvery colour with very small scales. A characteristic of these fish, although they do not belong to the sub-order of salmonoid fishes and have nothing in common in shape of body or other properties with them, is that they do have an adipose fin like the salmonoids. According to this property they are close to the sub-order Salmonoidei. The colour of the meat is light-gray. The consistency of the cooked meat is pleasant, succulent, and quite firm. /104 The taste is excellent. It makes a rich soup. Sea catfish meat frequently has a medicinal odour. Two species are caught; these are Tachysurus maculatus (Thrunbergus) and T. caelatus (Valenciannesus).

According to the research done by L.I. Borisochkina (VNIRO Standards Laboratory), the species T. maculatus has the following composition:

<u>Substance</u>	<u>% Content</u>
Moisture	80.9
Fat	2.4
<u>Protein</u>	15.7
Ash	1.4

According to the same source, the composition of the meat in the species T. caelatus is as follows:

Substance	% Content
Moisture	76.1
Fat	5.4
Protein	16.4
Ash	1.4

ORDER ANGUILLIFORMES (or APODES)

The order contains 24 families which contain about 300 species. Of these, one family of European river eels lives in fresh-water (10 species). The remaining are marine fishes. Large scale fishery for ocean eels takes place in Japan (27-33 thousand tons annually), Argentina, Chili, France and Spain.

FAMILY ANGUILLIDAE

The fresh-water eel propagates in the tropical regions of the Atlantic Ocean (Sargasso Sea) (fig. 29), whither it ~~goes~~ when it reaches sexual maturity to spawn. It perishes after spawning. It achieves a length of 1.5 m, and weight of 6 kgm. The size of the specimens usually

caught is 45-84 cm, and weight of 0.2-0.8 kgm.

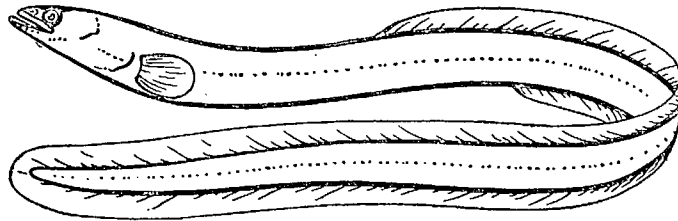


Figure 29. Fresh-water eel.

Even though the gastronomic properties of the fresh-water eel are proportional to its size (the larger the fish the greater amount of meat obtained, the fatter, more compact, tastier and aromatic it is), the standard does not distinguish between large and small eels.

The minimum length of fresh-water eel which may be taken in the Baltic is 45 cm, in the Ukraine 50 cm and in Belorussia 60 cm.

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At a length of 45 cm, smoked fresh-water eel normally weighs no more than 0.2 kgm, and the best quality eel weighs no less than 0.6-0.7 kgm.

The fresh-water eel is used mainly as a hot-smoked product (the classical delicacy of higher gastronomy), it is also used as a cooked food (in marinade) and fried. An excellent canned product is made of eel in jelly (normally with lemon). The fat content of eel varies from 30 to

33%, of which the head part contains 7 to 35% and the tail part from 16 to 54% of the fat. The yield of meat averages 73.3%. Eel meat has a unique, pleasant, firm consistency and is very aromatic.

CONGOR EELS

The congor eels (Congor congor) have completely different commercial and food properties. The thick snake-like body, sometimes measuring 2-3 mm, weighs up to 65-80 kgm. At a commercial length of 100 cm it weighs 2.7 kgm, and at a length of 170 cm the weight runs from 6.0 to 7.6 kgm. The average commercial length is 150 cm, and the weight about 4 kgm. The meat is significantly inferior to the fresh-water eel: fat content is from 0.8 to 5.2%, protein content is about 19%. The average weight of the head is 11.0%, of carcass 86.0% and viscera 2.6%. The consistency, taste and odour of the meat are commonplace. The meat is permeated with intermuscular bones which do not become sufficiently soft during cooking and hot-smoking. Beheaded and gutted congor eel is frozen (usually in pieces) for further processing, mainly by hot-smoking.

FAMILY SCOMBERESCOCIDAE

The sub-order Scombrescoidea has two families: Belonidae and Scombrescocidae. The needle fishes consist only of third-order fishes in volume of catch, the Pacific and Black Sea garfish.

Among the sauries, the most important in the national fishery at the present time are the saury distributed throughout the northern part of the Pacific Ocean, but there is justification for developing another, less valuable species of saury which inhabits the southern hemisphere and is found in considerable quantities.

The saury has a very elongated spindle-shaped body which is covered with fine, easily-removable scales. The covering is bright silver, sometimes with fine, scattered greenish spots. The dorsal fin is situated above the anal fin and is of the same shape. There are small fins behind the dorsal and anal fins. The lateral line is situated very low, near the abdominal keel (fig. 30).

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Figure 30. Saury.

National fishery for saury was begun in the open part of the Pacific Ocean (in the region of the southern islands of the Kurile Range) only in 1959 and is rapidly developing (in 1966 about 50 thousand tons were landed).

In Japan, the saury has long been one of the main commercial fishes, and about 300 to 600 thousand tons are caught annually. The Soviet Union has set itself the task of greatly increasing the saury catch in a short period.

The takeable length of saury is normally from 18 to 32 cm, with a weight of 20 to 176 gm (average weight 130-136 gm). It is accepted for processing at a minimum length of 18 cm.

The molecular chemical composition of saury meat, according to the data in the literature, is as follows:

Substance	% Content
Moisture	55.0-68.0
Protein	17.0-20.0
Fat	10.0-27.0
Ash	1.2- 1.6

At the beginning of the fishery season the saury evidently is leaner and more watery than the data would indicate.

Saury is the raw material for the manufacture of popular food products. Among the canned products that are famous are "blanched saury in oil", and also "saury au naturel".

The saury delivered by the fishing industry in small quantities in the frozen state immediately shows signs of fat spoilage (frozen, smoked or as cooked products). On the other hand, the meat of prime saury (if the raw material is very fresh and the fat has been protected from oxidation spoilage) has a natural, amazingly bright and piquant aromatic and gustatory bouquet and is held in high regard by the majority of consumers. The unique sourness of the saury meat, in combination with the presence of its harmonious odour and very pleasing consistency, makes canned products of blanched saury similar to the best quality canned sardines, but with a much more distinct bouquet and special natural piquancy.

Canned saury au naturel is also excellent when it is prepared from raw material of irreproachable freshness.

Besides being used in canning, saury is frozen and is still being salted. It is not recommended for processing into a moderately salted, maturing product (barrel or can salting) because of the extremely high enzyme activity and extremely rapid maturing which results in a product that quickly over-matures.

The best and most proper technological method of utilizing saury is to can blanched saury in oil. However, at the beginning of the season the saury meat is so watery and lean, that during this period it is recommended to process most of the saury by freezing and quickly forwarding it to the consumer centers for immediate cooking and hot-smoking.

All the practically-available methods of protecting the fat in frozen saury from spoilage, except for extremely low temperature and short storage period, have still not given satisfactory results. The amount of unsaturated fatty acids in saury fat is greater than in the fat of any other commercial fish. This makes it necessary to develop the saury trade to the fullest on a reliable technical basis (canning lines and refrigeration) and for a specialized trade that is highly flexible (with the know-how to quickly deliver and utilize frozen fish).

FAMILY GADIDAE

The commercial fishes in the Gadidae family are exceptionally varied and numerous in the North Atlantic.

The common features of this family are:
the ventral fins are located in front of the pectoral fins or under them (not elongated), there are no spiny rays in the fins, the caudal fin is symmetrical and does not fuse with the others, it is always somewhat distinct from the dorsal and anal fins.

A.N. Svetovidov divides these fishes into three sub-families:

- a) the true Cods;
- b) Hakes;
- c) Nalim (Rocklings).

The sub-family of true cods is distinguished by three dorsal fins and one short barbel on the lower jaw; this includes the cod and all its sub-species (Baltic, White Sea, Kilden, Greenland, Pacific Ocean, as well as haddock, whiting, coalfish, arctic cod, navaga, pollock, and "poutassu" (Merlangus poutassou)).

The fish in the hake sub-family have two dorsal fins and no barbel.

The fish in the sub-species (sic) of rocklings, which includes both the fresh-water burbot and the marine nalim,

ling and cusk (fig. 31), have one or two dorsal fins and one barbel.

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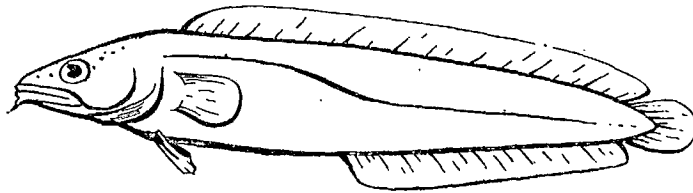


Figure 31. Cusk.

In spite of the continually decreasing reserves of cod fishes, about 29% of the national catch in the Barents Sea is made up of cod at the present time.

The catch of cod for the USSR was, in 1964- 919.3, in 1965- 1380.8, in 1966- 1488.0 thousand tons (cod- 444, pollock-426, hake-433 (1965)).

All the cod (except the fresh-water burbot) are marine fishes. The cods and nalim (rocklings) are characterized by low fat content in the meat (normally about 1%) and deposition of large reserves of fat in the liver, which grows and increases in weight as the fish fattens. The amount of fat in the liver of these fish frequently reaches 60-70 and even 75%. In the hakes the meat is fatter, and the liver is

smaller and less fat than that of the cod.

Cod liver is an extremely valuable raw material for the manufacture of medicinal preparations and gastronomic products.

The white, pleasantly juicy consistency of the meat of almost all the cod fishes is free of coarse fibers, fine bones and is very suitable for commercial and domestic preparation. The small amount of fat usually contained in the meat is easily compensated by proper cooking. The cod has its own characteristic ocean smell which some find unpleasant at first. However, the consumer soon gets accustomed to this odour and then other fish cannot substitute for cod, haddock and coalfish from this point of view. The odour of navaga is considerably different from that of cod, haddock and coalfish. The smell of fried navaga is normally highly esteemed by the consumer. Freshly-caught cod fishes that are immediately prepared and served have an odour that is delicate and pleasant, and somewhat suggestive of crustaceans. However, under less favourable conditions of preparation, shipment and storage the natural cod odour can be changed considerably and it gradually deteriorates.

Cod. Not only does the price list not differentiate between Atlantic and local sub-species of cod (Pacific, Baltic, White Sea, Kildin, Greenland), but it also combines all the cod together with the haddock and coal-fish in one and the same line. In this case, the ling (molva) should also be added to them.

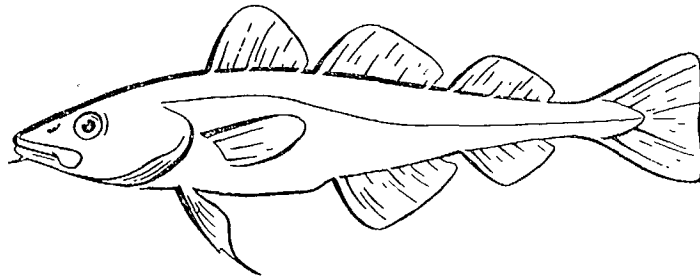


Figure 32. Cod.

Nevertheless, it is known that the Baltic and particularly the Pacific Ocean cod are much inferior to the Atlantic species.

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Atlantic cod (fig. 32) produces a tasty, aromatic meat of pleasing consistency. When produced as a frozen fillet it is frequently somewhat coarser and dryer than that of unfileted fish.

The meat of live Atlantic cod is also differentiated in quality depending on the season of catch and the size of the fish. Cod weighing over 6-8 kgm has coarse meat, while the meat of very large cod is tough and fibrous. The so-called caplin cod (voraciously devouring caplin immediately after spawning) is distinguished by its watery, flabby, tasteless meat

which is comparatively poor in protein. But this caplin period is only observed in certain fishing regions and is of short duration.

According to the latest information, during the spawning period (March-April) cod meat from the front and middle parts of the body loses about 20% of its fat. During the intensive feeding period (May-June) fat is accumulated. During the 7-8 month period of "rest" (normally from August through to February) the fat content in the meat gradually decreases. In the caudal part of the cod fillet the fat content is greater than in the remaining parts.

Cod meat is richest in protein during the period of October-November. After that the protein content gradually decreases and reaches a minimum immediately after the spawning peak (normally in May). The smallest amount of protein is normally found in the caudal part of the cod.

The maximum amount of moisture in cod meat is found during May, and the minimum in December.

The average molecular composition of raw cod meat and the yield ~~are~~ shown in Table 17. The average chemical composition of the roe taken from Barents Sea cod (raw) is given below:

Substance	% Content
Water	75.8
Fat	1.8
Protein	20.0
Ash	1.3

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Cod	% Content				Meat, %
	Moisture	Protein	Fat	Ash	
Barents	79.8-80.4	17.6-18.9	0.3-0.4	1.1-1.3	47.7
Baltic	80.6-85.1	13.4-13.6	0.1-0.4	1.2	45.3
Bering	80.5	17.7	0.7	1.5	54.8
Okhotsk	79.5	17.1	0.9	1.2	-

The average weight of cod heads is 21.5%.

The yield of cod liver from Atlantic species varies between 1.4 and 14.4% of the ungutted fish, averaging about 5.5%.

In Atlantic cod taken from the Barents Sea the average yield of liver is as follows (depending on the size of the fish):

Length of cod in cm	Yield of liver in %
Over 70	About 7.0
50-70	About 6.0
Under 50	4.0-4.5

Raw cod liver contains the following (on the average):

Substance	% Content
Moisture	22.2
Protein	5.3
Fat	70.5

Atlantic cod achieves a length of 169 cm, and weight of 40 kgm, in very rare cases.

Pacific Ocean cod reaches a length of 120 cm, and weight of 17 kgm. At the present time the landed weight varies between 0.8 and 4.5 kgm. It is permissible to take cod measuring over 30 cm. Cod is produced mainly frozen, gutted and beheaded, hot-smoked (large amounts), *as* cooked products, canned products, and also salted.

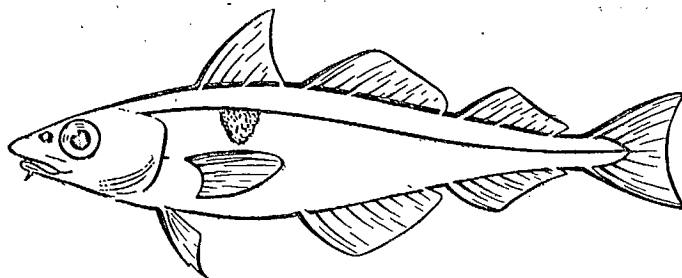


Figure 33. Haddock.

Haddock. This fish differs from other cods /111
by a definite black lateral line and a black spot
beside the pectoral fins (fig. 33). Haddock meat is
even better than cod, it has a more pleasing aroma,
taste and consistency. However the liver contains less
fat, is greyish in colour and frequently has a very
strong odour of iodine. The fish reaches a length of
1 m, and weight up to 19 kgm; the usual weight in the
catch is between 0.3 and 2.3 kgm. It is permissible
to take haddock from 27 cm in length. It is marketed
under the name of cod. In most countries of Western
Europe the haddock is preferred over cod. The consumer
in our country also prefers "black-stripe cod", i.e.,
haddock.

The average yield of meat is about 55%.
The gross chemical composition of haddock meat does not
differ significantly from that of cod.

Haddock liver is not as good in quality as cod
liver (it has greyish tones and is small). The yield of
liver is from 1.1 to 6.9% and averages up to 4.5%.

Whiting (fig. 34). Fishery for this fish in Iceland,
England and the Scandinavian countries is growing rapidly,
but it is developed very little in our country to this time.

The usual length of the whiting is 23-35 cm. In external appearance it suggests the haddock, but the lateral line is white. The whiting is less stable in storage than other cod fishes.

Coalfish. The lateral line on this fish, like the cod, is light in colour, but it is almost straight, and the caudal fin is slightly notched (fig. 35); the scales are dark with a metallic glint which is absent in other cod fishes (black cod). The usual length of the main species of coalfish landed is 60-90 cm, with a weight of up to 7 kgm. The other commercial species is the silvery coalfish (lur). Its length is normally 45-60 cm. It does not have real importance in fishery.

Meat of the coalfish is greyish in colour, it has a ~~rare~~, pleasing taste and a unique texture.

It is widely used in Western Europe for drying, production of frozen fillets (for export), canning and in cooked products. In both East and West Germany they manufacture preserves made of coalfish which are called "Sea Salmon in Oil" (the fine, slightly salted strips are sometimes slightly smoked after salting). The "salmon" colour of the coalfish strips is produced by a specially-prepared salmon colouring (laks-farben).

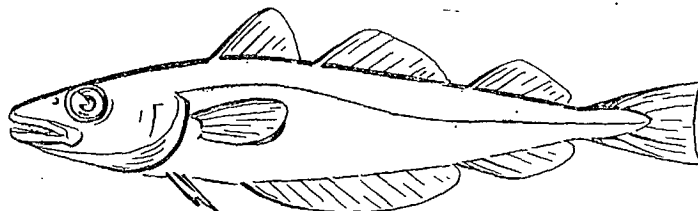


Figure 34. Whiting.

The amount of fillets obtained from coalfish is very high, about 55-58% of the weight, while the weight of the head is about 17%.

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Navaga. In the systematic and trade sense it is divided into Northern (fig. 36) and Far East (Pacific Ocean). The northern navaga is caught only during the winter (ice fishing) in the White Sea (mainly in the Dvina, Onega and Mezen Bays), on the west coast of Kanin Peninsula, around Kolguev Island and in the Chesh and Pechora Bays in the Barents Sea. The nutritional value of navaga changes in relation to the place and time of catch (at the beginning or towards the end of winter), as well^{to} as the weight of the fish.

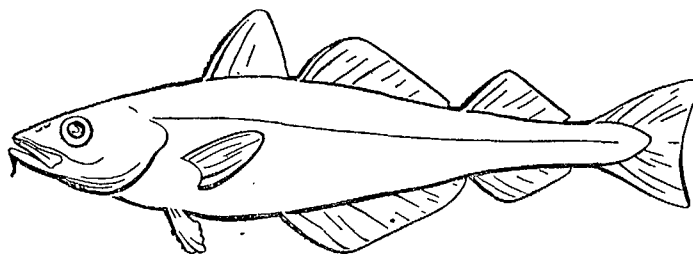


Figure 35. Coalfish.

The Mezen, Kanin, Kolguev and Pechora navaga are considered the best; these are not very small, and they weigh no less than 70-100 gm. Maximum weight is 0.7 kgm. The price list does not differentiate northern navaga according to weight and fishing ground. The meat of the northern navaga on the whole is more tender, succulent and aromatic than that of the Pacific Ocean navaga. The unique and pleasant aroma and the layered nature of the meat in fried navaga is very highly esteemed by the consumer.

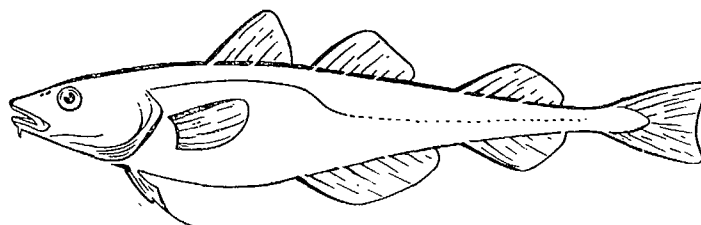


Figure 36. Northern Navaga.

Raw navaga meat averages 81% moisture, 17% protein, up to 1% fat and 1-1.5% ash.

Between 2.5 and 3.0 thousand tons of northern navaga are caught annually.

The Pacific Ocean navaga is much larger, but is less in demand by the consumer. Its weight goes up to 1.1 kgm. In gastronomic properties the meat of Pacific Ocean navaga is somewhat inferior to that of the northern navaga, although the gross chemical composition of Pacific Ocean navaga meat is almost the same as that of the northern navaga.

The Pacific Ocean navaga is 1.5 times cheaper than the northern species. The catch of Pacific Ocean navaga fluctuates between 20 and 30 thousand tons.

The usual commercial length is 25-35 cm at an average weight of 200-600 gm.

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Far East and Northern Navaga (except Unsk Bay UdsK?? navaga) may be taken at a minimum length of 19 cm. The smallest navaga which may be taken in the Unsk Bay is 17 cm.

An admixture of young navaga measuring from 19 (17) to 13 cm is permitted up to a maximum of 15% (of the number of fish in a homogeneous lot).

The admixture of off-size navaga is not sorted before processing if the amount does not exceed the limit.

It is not possible to deliver all the landed navaga in the frozen state. Salted navaga is an extremely low quality product. When hot-smoked, the fish has lower nutritional properties than the frozen variety, but it is an acceptable product in comparison with the salted navaga. Navaga canned in tomato sauce and in oil differs very little from other small canned fish. The best method of preparing frozen navaga is to wrap it in egg batter with very coarse bread crumbs and then fry it in butter (then serve it up hot immediately after frying, with lemon and without vegetables).

Pollock. The lateral line on the pollock has a very sharp bend in it under the second dorsal fin, the lower jaw protrudes forward, the barbel on the lower jaw is barely noticeable (poorly developed), the skin is spotted in colour, the caudal fin is only slightly notched. The body is more elongated than that of other commercial cod fishes (if the actually inedible polar cod is discounted).

The pollock is caught in the northern part of the Pacific Ocean along the eastern and western coasts. The usual length is 30 to 52 cm, with a weight of 0.2-1.4 kgm. The largest and best pollock is found in the Bering Sea (up to 2.8 kgm), and the smallest in Korea Bay.

Pollock makes up about 85% of the national catch of cod fishes taken from the Pacific Ocean. However only a small amount of the pollock is being used for food at the present time. It is intended to make wide use of pollock in the manufacture of food products by applying new technology which will provide boneless protein mass.

The average weight ratios of individual parts of the pollock body are given below:

Body part	% Content
Head	26.6
Meat	47.8
Liver	4.0
Roe	11.0

Pollock meat contains the following (on the average):

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Substance	% Content
Moisture	83.5
Fat	0.3
Protein	14.6
Ash	1.1

The average yield of liver fat from pollock is about 32%.

According to data provided by I.V. Kizevetter and L.Ya. Ertel', the composition by weight of Bering Sea pollock fluctuates very significantly (Table 18):

Table 18

Body part	% ratio of part to whole by weight	Average yield in % of whole fish		
		April	June	November
Head	17.1-31.8	18.1	23.6	19.1
Fins & Bones	8.6-22.3	14.3	14.3	16.2
Viscera	3.7-13.6	7.4	11.5	No data
Filletts with skin	41.4-53.2	49.2	45.2	40.1
Sexual products	2.9-21.1	10.3	No data	No data

The relative weight of liver varies from 2.4 to 7.5%, and that of clean meat from 35 to 45%.

The chemical composition of the body parts of Bering Sea pollock differs very little from pollock taken from other seas in the Far East.

Pollock roe has excellent gastronomic features. It is similar to vobla roe, but has better food properties. Pollock roe can be used in the preparation of excellent dried and smoked ovaries with membranes, and also caviar paste.

From 300 to 400 thousand tons of pollock can be taken along the coast of Western Kamchatka. It would be expedient to organize the manufacture of fish meal on this raw materials base with simultaneous utilization of the high vitamin content pollock liver oil for preparation of medicinal fish oil. The liver oil from pollock taken along the coast of Kamchatka is particularly high in vitamin A activity.

The putassu¹ (fig. 37) differs from the majority of gadid fishes by being a pelagic fish which remains mainly above depths of 1,000 m.

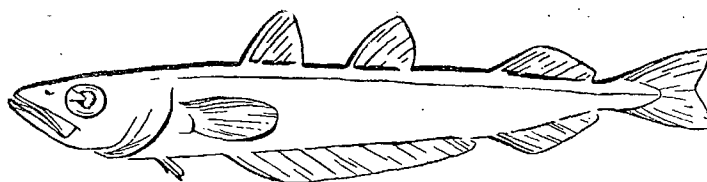


Figure 37. Putassu.

The length of the putassu in the Norway Sea / 115 is 15-36 cm (landed), with length of 25-28 cm predominating.

The average weight of putassu measuring 26 to 30 cm fluctuates from 110 to 220 gm.

The yield of liver from the putassu is no less than that from cod (7.6-9.1%).

1. This seems to be Merlangus poutassou, a whiting fish.
- Translator.

Putassu meat approximates that of hake in nutritional properties.

The commercial-food properties and reserves of putassu permit plans to be made for organizing fishery for food purposes.

These preliminary data concerning putassu, which were taken from "Sevryba" materials, apply only to fish from the Norway Sea.

Meat of Arctic putassu weighing 300-1500 gm (average weight 950 gm) had the following composition:

Substance	% Content
Moisture	80.6
Protein	14.2
Fat	3.2
Ash	1.2

The yield of edible parts averaged 45.7%, and liver 10%.

The putassu taken from the waters off South America, and which contained approximately the same amount of moisture, turned out to have a greater amount of protein (16.8%), and considerably less fat and ash (1.7 and 0.9%),

than there were in putassu taken in the Antarctic.

Hake (merlus)¹ (fig. 38). The names hake and merlus are synonyms. On the world market both names are used interchangeably depending only on the regions (countries) where the fish are caught and marketed.

For example, in France, Spain, and the countries of Africa and South America it is customary to call these fish merlus, while in Canada, the USA and England they are called hake.

The name of merlus for this fish is of Latin-Spanish origin, whereas hake is of English origin.

All hake have noticeable ridges on the rear ends of the second dorsal and anal fins (higher rays). The mouth is superior. There are no barbels on the lower jaw. The lateral line is continuous.

The skin and scale cover on the hake varies from yellowish-silver, grey or brownish to very dark (almost black).

Seven species of the hake family have been described. The length of the hake does not depend so much on the species, as on the region, season, method and, most important of all, the intensity of fishery; the length of

1. Merlucius merluccius; Merlus, "merlusse" from the French.
- Translator.

landed fish goes from 17 to 130 cm. The meat of hake / 116
is as good or even better than cod in quality. It is white,
fairly tender, has excellent aromatic-gustatory properties
and normally is considerably oilier than cod.

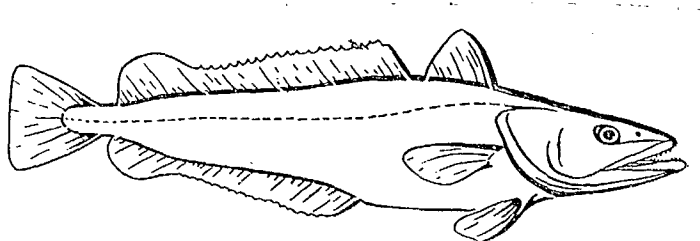


Figure 38. Hake (merlus).

Special national fishery for hake has been organized since 1962, mainly along the Nova Scotia shelf (chiefly on Georges Bank).

The national catch of hake has increased very intensively during the past few years.

Until very recently, large fish was seldom caught in the Pacific Ocean, but at the present time fairly good stocks (0.5-2.5 kgm) of it have been found.

Various species of hake are known in the catches of other countries; these names were given mainly in relation to the place of occurrence; i.e., Cap, Argentina, Pacific Ocean, Chile, New Zealand, Senegal or black hake.

Following research on specimens of hake at PINRO (Minder and Khobotilova), the following data were obtained:

Weight of whole fish, gm	$\frac{113-500}{254}$
Absolute length, cm	$\frac{27.4-41.0}{32.8}$
Yield, % carcass	$\frac{64.2-74.2}{70.3}$
Meat	$\frac{54.9-67.2}{62.3}$
Liver	$\frac{1.8-6.9}{3.7}$

The very high yield of meat is emphasized (considerably more than from cod).

The gross chemical composition of the meat is given below:

Substance	% Content
Moisture	$\frac{77.1-81.2}{79.1}$
Fat	$\frac{1.2-4.1}{2.6}$
Protein	$\frac{15.6-17.9}{16.7}$
Ash	$\frac{0.9-1.3}{1.2}$

Research results obtained by AtlantNIRO are similar.

The amount of oil in the raw liver varied between 22.5 and 59.8%, and the average was 44.3% (average amount of protein was 9.6%).

Most of the Soviet researchers and foreign authors are in agreement with the foregoing data on hake.

The roe of this fish is a valuable product. It contains an average of 7.2% oil and 19% protein. Salted hake is a low-quality product. Processing into canned products is not satisfactory either.

Without doubt, the meat of hake from one zoological species, region and season of catch differs noticeably from that of other species, regions and seasons of catch. But these differences are no greater than those of many fish that are marketed under general names and at the same price (for example the difference between bream from Astrakhan and the Aral region, sturgeon from the North and South Caspian, Siberian and Azov sturgeon, Atlantic and Pacific Ocean cod etc.).

Ling (molva, ocean pike). The shape of the body of the ling suggests the fresh-water burbot, the

ling does not have barbels on the nostrils either, but the body is longer and more shaft-like (fig. 39).

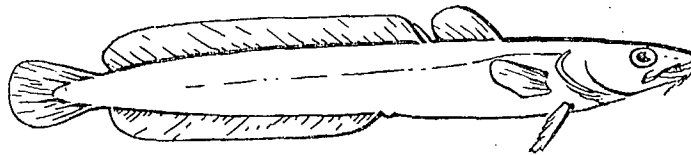


Figure 39. Ling.

The ling is distributed along the Atlantic coast of Europe. The main stocks are formed along the coast of Norway, Scotland and Ireland.

The size of ling normally landed is up to 150 cm, and weight 20-25 kgm.

Besides the main species, there are others; in particular the blue ocean pike, or byrkelange (bakerling), as well as the Mediterranean pike.

Fish of the Molva genus are not normally differentiated in the trade, but in Norway and West Germany the bakerling is considered separately.

At the present time the amount of ling caught in the USSR is very small.

According to data in the literature, ling meat is of very high quality. The average wholesale price for round ling is 15-20% higher than the average wholesale price for round cod, but frozen ling fillet is normally no higher, and even sometimes cheaper than cod.

Analysis carried out at VNIRO (Borisochkina) showed the following composition of the fillet:

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Substance	% Content
Moisture	80.7
Fat	1.9
Protein	16.5
Ash	1.02

Tests carried out by VNIRO on samples of imported (Norwegian) ling fillet during sample cooking showed its great similarity to cooked cod fillet. It was found that the ling fillet in all versions of defrosting and heat processing was more fibrous, coarser and dryer than cod fillet processed under the same conditions.

Ocean nalin (American hake; Rockling??). Two main commercial species of ocean nalin (species Urophycis) are recognized; the White Ocean nalin (fig. 40) and the Red (fig. 41). The former reaches a length of up to 120 cm, and a weight of up to 13 kgm. The average landed length is

70 cm, and weight 4 kgm. The body is relatively short, it is scattered with round dark spots, the fish has a massive barbel on the lower jaw and also barbels at the nostrils. The maximum length of the red nalim (American hake) is 75 cm, with a mass of 3 kgm (the average landed weight is from 0.2 to 1 kgm). The upper barbels are absent, and the lower one is very small (barely noticeable); the body surface is smooth, the pelvic fins resemble long filaments (they are positioned before the pectoral fins).

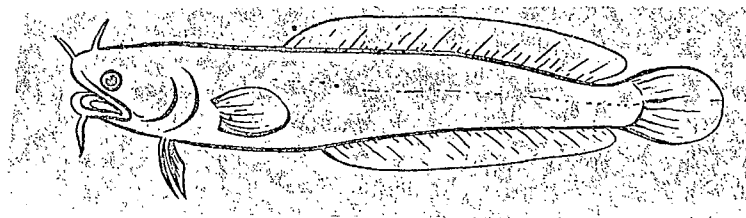


Figure 40. White ocean nalim.

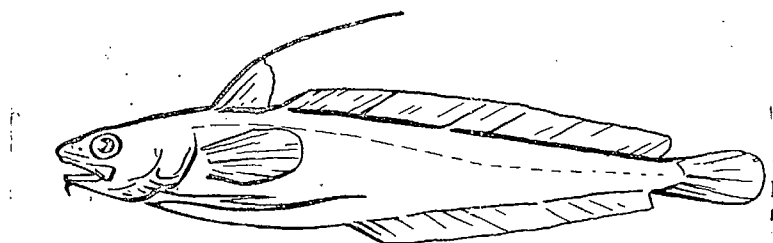


Figure 41. Red ocean nalim.

According to research by PINRO (Minder and Khobotilova), specimens of Urophycis-nalim had the following indices:

Total weight, gm	$\frac{224-1655}{842}$
Absolute length, cm	$\frac{35.0-60.3}{46.5}$
Yield carcass	$\frac{46.8-56.7}{52.0}$
Weight, % head	$\frac{12.6-17.0}{14.7}$
liver	$\frac{1.2-8.8}{4.9}$

The molecular chemical composition of the meat is as follows:

Substance	% Content
Moisture	$\frac{81.0-83.1}{82.1}$
Fat	$\frac{0-0.4}{0.1}$
Protein	$\frac{15.2-17.6}{16.1}$
Ash	$\frac{0.8-1.3}{1.1}$

The liver of the white American hake contains from 23.6 to 62.0% oil (average 46.7%). The yield of liver is considerable and the fat content is high. The meat has rather high water content, it is coarsely fibrous, but has acceptable culinary properties. The meat of the red (small) American hake is considerably more tender,

succulent and generally tastier. Average data for composition of the meat are given below:

Substance	% Content
Moisture	79.92
Fat	0.41
Protein	20.1
Ash	1.09

A four-bearded nalim (fig. 42) is also found in the catch, as well as a polar nalim (fig. 43).

Burbot (fresh-water nalim). The upper jaw protrudes above the lower. The head is flattened on top, the tail compressed on the sides, there is a barbel on the lower jaw. The scales are very fine, and cover the bases of all the fins, the gill covers and head to the nostrils. Colour is variable, but most frequently dark brown with light-coloured spots (fig. 44).

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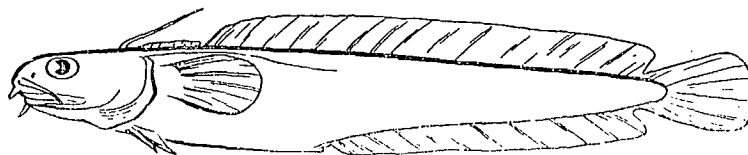


Figure 42. Four-bearded nalim.

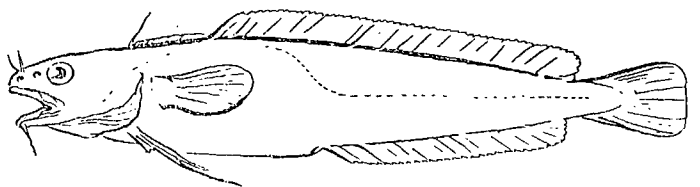


Figure 43. Polar nalim.

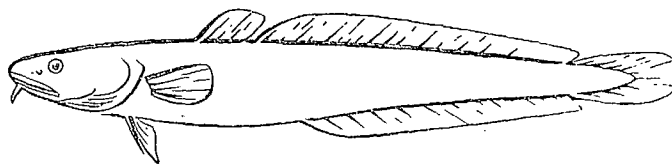


Figure 44. Burbot (fresh-water nalim).

About 95% of the total catch of nalim comes from Siberia. The meat has the following composition:

Substance	% Content
Moisture	79.5-81.5
Protein	15.8-20.2
Fat	0.1- 0.9
Ash	1.1- 1.8

Nalim is famous for its liver. The meat is not particularly good (normally tough, with a rather unpleasant colouring and a medicinal odour). The yield of carcass is from 51 to 63%, heads from 18.6 to 22.7%, liver from 3.2 to 7.4%. Before spawning the average weight

of the liver in large specimens is from 9 to 10%, and in some specimens from 13 to 15%. The raw nalim liver contains 51-67% oil. The liver is considered a delicacy when canned and in soup made of fresh nalim. The fish is used frozen and canned. Salted American hake is of very low quality; the quality of the dried fish is better. There is no limit on the catch of this predator. The fresh-water burbot is considered a first-class fish when the length is over 20 cm, and the remainder is waste. An excellent new canned product is "Nalim Soup" ("Nalim Chowder").

FAMILY MACROURIDAE

This family consists of deep-water fish distributed in the Atlantic and Pacific Oceans. Commercial stocks of grenadiers were found only recently as a result of development of the ocean depths which had not been fished before in the Atlantic and Pacific. In the Pacific Ocean alone at least 7 species of grenadiers are known.

Grenadiers. A spine-like, blunt ridge runs under the eyes down both sides of the head from the tip of the snout towards the gill covers. The snout is pointed, pyramidal in shape, and protrudes far beyond the mouth. The mouth also protrudes. There is one barbel on the

lower jaw. The body is spindle-shaped and fairly large. The caudal part of the body is very much tapered, whiplike (fig. 45). All the scales have thorny, sharp injurious barbs which are turned backwards. The skin and scale covering varies from dark-grey to brown without a metallic tinge.

The grenadiers reach a length of 1 m, the landed weight is usually from 0.4 to 3.0 kgm.

The whole grenadier fish has an unpleasant appearance and there is much waste during processing, but the coefficient of meat content of the carcass is sufficiently high. The presence of injurious scales compels the industry to deliver grenadier in the form of skinned frozen fillets or as carcasses with the scales removed.

Judging from the specimens delivered to VNIRO, the Atlantic grenadier has attractive meat (white with ^apink tinge), very pleasant consistency (fairly firm, but not fibrous or friable, regardless of the method of cooking), excellent taste and odour. The carcasses are easy to cut. Cooked, fried meat and soup made from Atlantic grenadier are tasty. In this sense the grenadier even surpasses the Atlantic cod. In composition the meat of raw Atlantic grenadier (VNIRO data) is as follows:

Substance	% Content
Moisture	80.7
Protein	16.3
Fat	0.8
Ash	1.2

The salted meat of Atlantic grenadier is noticeably inferior to frozen meat, but undoubtedly it is better than salt cod. The skin comes off easily and without ripping.

The roe and liver of the grenadier are of very high quality. Raw liver contains about 55% fat, it is free of parasites, and canned products made from it are of better quality than those of cod liver.

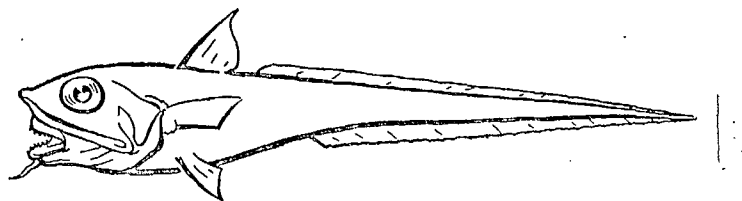


Figure 45. Grenadier.

The roe is very similar to that of salmon in gastronomic properties and appearance, but the eggs are smaller (1.8-2.5 mm in diameter), and their casings are weaker. The grenadier roe is also very similar to salmon roe in chemical composition.

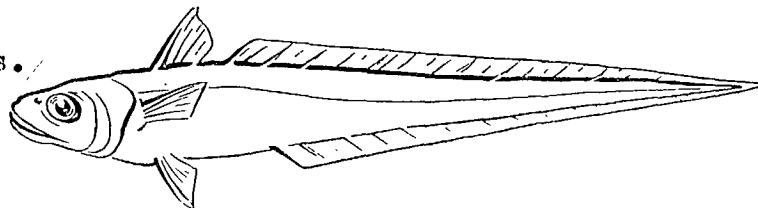
Nevertheless, the meat of Bering Sea grenadier taken during various months is considered to be medusa-like in consistency, to have other unpleasant, unsatisfactory technological and consumer properties, and to be extremely poor in protein (moisture content is 90-93%, protein 6-8%, fat 0.1%). Judging from preliminary research results, it would be difficult to say whether all Atlantic grenadier would provide first-class food meat, and also whether the meat of all the Bering Sea grenadier will be suitable only for fish meal.

It is possible that both kinds of grenadier will be found in both the Atlantic and in Far East waters under various conditions, and this will require a differentiated approach to the utilization of this fish.

Another macrourid fish "macouronus" (fig. 46), taken in the southwestern Atlantic, and measuring 50-80 cm in length, and weighing 300-1600 gm, has the following composition:

Substance	% Content		
Moisture	78.4	Fat	2.9
Protein	16.9	Ash	1.1

Fig. 46. Macouronus.



The yield of edible part was 52.7%.

The meat of steam-cooked "macouronus" in consistency, taste and aroma was evaluated, even after prolonged storage, as fully satisfactory, with excellent pleasing odour approximating that of cod, although it did have its own characteristic features. This evaluation was confirmed several times by the tasters at VNIRO.

"Macouronus" fried in vegetable oil was compared to cod in gastronomic properties by the tasters.

The meat of this fish, after hot-smoking which was proceeded by approximately half-year storage, had a dryish-firm consistency and was fully satisfactory from the point of view of taste and aroma. The appearance of the smoked carcasses was unattractive. This was caused partially by insufficient strength of the skin cover during the heat processing (the skin did not remain intact).

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Both the macouronus and the grenadier can be frozen, but it is necessary to first remove the viscera, heads and the long caudal peduncles. In this condition the carcasses acquire an ordinary appearance.

FAMILY SERRANIDAE

In foreign fishery the fish of the Serranidae family are called rock perch, sometimes sea bass, or sea perch. They are all marine fishes. Over 400 species are known for this family.

The most important in fishery is the genus Mérou¹ (Morio, Grouper??). The anal fin, on all merou, begins with three powerful spines; the front spine and the rear soft fin are fused into one caudal fin without a notch. The body is short, thick, with a massive head.

Merou. The true merou is the main species among the fish of this genus. (fig. 47). The skin and scale cover on it is of chocolate tones. The abdominal part has a lead glint. When the commercial length is 65 cm the weight is 5.1 kgm, and at a length of 69 cm it weighs 6.1 kgm. Individual specimens achieve a weight of 50 kgm. The minimum permissible length of the merou has been set at 30 cm. The weight of the head of a fish measuring 65 cm was 37.8%, and a fish measuring 69 cm had head weight of 41.6%. The yield of meat with skin of a fish 5.1 kgm in weight was 40.3%, bone 10.1%, scales 1.2%, fins 3.4%, viscera 7.0%. The fat content of the meat varies from 0.83 to 3.0%, that of protein from 18.8 to 20.7%.

1. This appears to be Epinephelus gigas, or some kind of Grouper. - Translator.

The merou is beheaded and gutted for freezing. This fish is an excellent source of raw material for cooking and hot-smoking. The fish is easily portioned, the meat is milky-white, very tasty, firm but with pleasing consistency. The skin on the merou is very thick and strong.

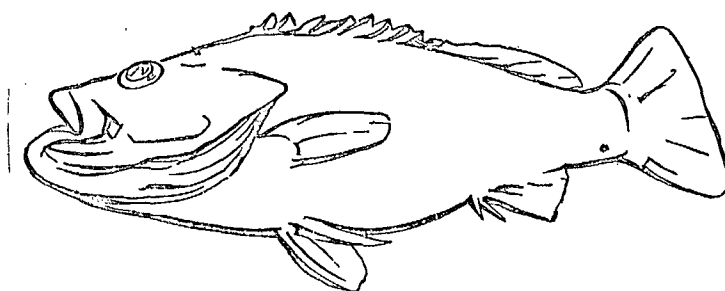


Figure 47. Merou.

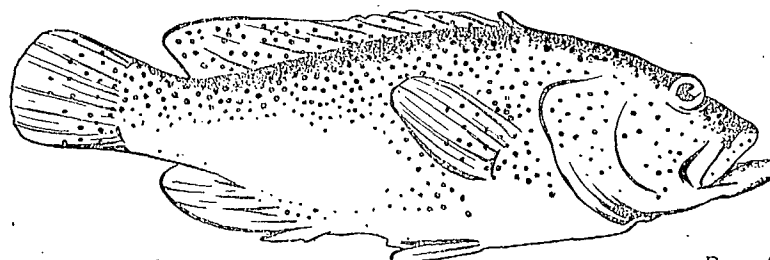


Figure 48. Speckled merou.

ДИА. 49

It is particularly expedient to produce frozen fillets and smoked products from the merou.

Striped merou. This fish weighs from 15 to 20 kgm; it has 3 light bands on the head (from the eyes at an angle along the gill covers) and 6 broad dark perpendicular stripes on the body.

Speckled merou. This fish weighs up to 3 kgm; it has a bright orange coloured skin and scale covering

with numerous dark blue spots (fig. 48).

Black rock perch. According to data provided by L.I. Borisochkina and T.A. Dubrovskaya, black rock perch taken during September from the Indian Ocean measuring 52.5 cm, and with body weight of 4.7 kgm, had the following weight of parts of the body:

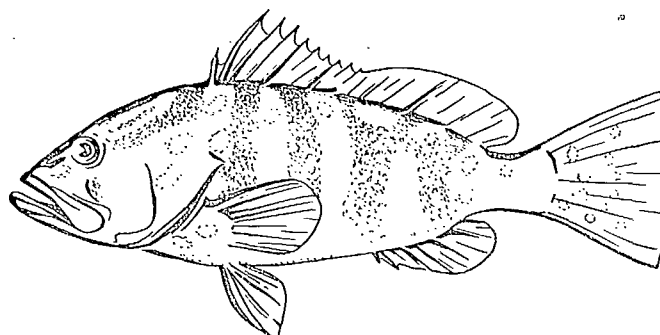
Body part	% Yield
Head	24.2
Meat	47.9
Skin	3.8
Bone	8.0
Scales	4.2
Fins	2.8
Viscera	8.2
Roe	3.2
Liver	0.9

The chemical composition of the black rock perch meat is as follows:

Substance	% Content
Moisture	71.3
Fat	9.7
Protein	17.9
Ash	1.1

Because of the high fat content in the meat, the black perch stands out sharply from the rest of the rock perches.

Cherna. This fish (in Cuban Cherna americana) occupies an important place in the family Serranidae. The scientific name for this fish is Epinephelus morio (Valenciennes).



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Figure 49. Black rock perch.

This fish has a very unique appearance, it is large with a mottled skin and scale cover (fig. 49), its meat is fairly tasty, although very lean. The usual landed length is 64-81 cm, with body weight of 5-9 kgm. The composition by weight of the body is as follows:

Body Part	% Yield
Head	28-42
Meat and skin	39-52
Viscera	3- 6

The average chemical composition of the meat is as follows:

Substance	% Content
Moisture	80.5
Protein	18.0
Fat	0.3
Ash	1.2

The Serranidae family includes fish which reach a length of 2-3 m, and weigh up to 200 kgm. The Japanese market carries a valuable fish under the name of Japanese Sea Bass, which ^{is} a member of this family, that attains a length of 80 cm (catch of 5-6 thousand tons annually).

FAMILY PERCIDAE

This family of fishes has been known for a long time in our country.

Our water bodies contain 3 genera of percid fishes which are of nutritional value: bass, perch and pike-perch. Common properties of the percid fishes are: the first dorsal fin is spiny, the second (rear) is soft. The scales are small, and very closely packed. There are one or two spines in the anal fin.

The main commercial fish is the bass. Much less important are the perch and the Balkhash white perch, and even less important are the Volga pike-perch and pike-perch.

Bass. This is one of the best fishes from the gastronomic point of view, and which is very popular throughout the USSR and abroad (fig. 50). It normally has from 0.6 to 2.5 kgm of meat on it, but occasionally it reaches 20 kgm. The meat is not fat, but the abdominal cavity of a large bass is frequently filled with thick fatty deposits or layers.

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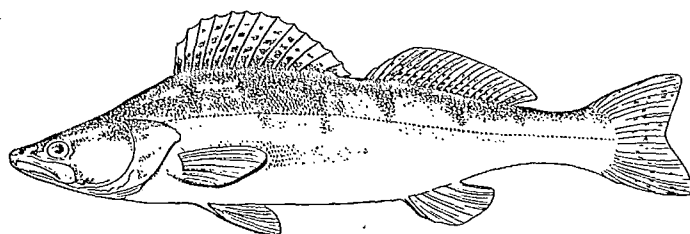


Figure 50. Bass.

The chemical composition of bass meat is given in Table 19.

Table 19

Substance	% content in Bass meat from:	
	Caspian Sea	Sea of Azov
Moisture	79.0-80.0	78.0-78.5
Protein	18.5-19.5	18.5-19.0
Fat	0.4- 0.7	1.3
Ash	1.1	1.0- 1.2

The amount of meat obtained in spring is 52-53%, in the autumn 57-58%.

It is caught mainly in the spring, less in the autumn and a small amount is taken by ice fishing.

Fish-processing enterprises produce bass in the iced, frozen and cooked state (in jelly, fried, as a stuffing). The best dish is jellied bass, as well as steamed and served-up in the Polish fashion. A soup made with bass is also excellent. Bass is practically never salted, smoked or canned, and this is quite in order.

It is permissible to take bass over 43 cm in length from the Caspian and Black Sea Basins, while in the Tsimlyanskiy Reservoir and the water bodies in the central part of the northwestern region, including the Pskov-Chud Lake and the Baltic Basin, the minimum length is 40 cm, in the Azov Basin it is 38 cm and in the Danube 30 cm. An exception in the Caspian is a peculiar species, the sea bass, which inhabits the Southern Caspian. This is a considerably smaller fish and the permissible length is 30 cm.

The reserves of bass have been very greatly depleted and measures for their restoration have been proposed.

Pike-perch. This fish can be considered, from the commercial point of view, as a small bass. The meat is in no way inferior to that of bass.

Freshwater perch. When sufficiently large (for example, measuring 15-16 cm and over) this fish can replace bass. Very small perch is difficult to cut by hand, and it is therefore not highly valued. It is recommended to boil it, after thorough washing without removing the scales, and then remove the skin and scales from the boiled fish; or else scald the whole fish before removing the scales.

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Balkhash perch. This fish reaches a length of 50 cm, and weighs up to 1.5 kgm. The average commercial weight is 250-300 gm. Gastronomically, it suggests the bass. It is produced iced, frozen, salted and canned in tomato sauce.

Ocean perch. Although it is very small, it does make the very best broth for soup (the famous sterlet soup was, as a rule, prepared and is still prepared using an ocean perch broth as a base). Jellied fillet of ocean perch (for example, skinned) are a delicacy. Excellent canned products are made from smoked ocean perch in oil (the scales are not removed, it becomes soft during sterilization in the canning process).

FAMILY CARANGIDAE

These are mainly heat-loving fish. The laterally compressed body is covered with very fine scales or is naked. There are pectiniform growths along the sides down the broken lateral line, particularly at the caudal pedicle. There are two dorsal fins; the first is spiny, and the second (rear) is soft and much longer than the first. There are two isolated spines in front of the base of the anal fin.

Over 200 species of carangid fishes are known. The most important ones in fishery are the common scad (fig. 51) and the ten-fin scad (including the blue Senegalese and the small-fin), the leerfish, vomer, seriola and fish of the genus trachurus (the true trachurus, silver pompano and others).

Most of the carangids landed measure from 15 to 40 cm.

In world fishery the carangids are considered to be valuable fish (with a few exceptions). At the present time we are utilizing the carangids, except for the Black Sea species, to a very small extent. The volume of world catch of this fish is very large (in 1964 over 1.4 million tons was landed).

The catch is made up mainly of a few species and sub-species, which are in most cases not differentiated in either the catch or in the trade.

The true carangids (genus caranx) predominate in the catch of these fish, and their commercial importance continues to grow.

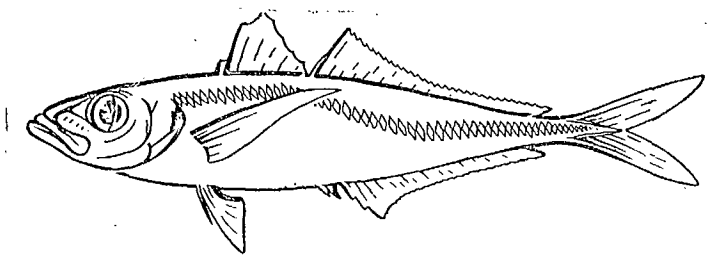


Figure 51. Common scad.

Large scad caught during May along the northwestern coast of Africa has the following weight composition (in %): carcass- 58.8, fillet- 50.6, head- 31.9 (the average length of the samples from the end of the snout to the fork of the caudal fin was 30.3 cm, and the weight was 381.5 gm). The average length of the scad landed here was 29.4 cm, with weight of 496 gm; the minimum length was 26.5 cm, and weight of 360 gm; the maximum was 38 cm and weight of 700 gm (according to data provided by Sukrutova, AtlantNIRO). / 128

It is permissible to utilize scad under its own name when the minimum length is (in cm): Black Sea- 10,

Atlantic and Pacific- 20, Gulf of Guinea- 12.

Scad from the Gulf of Guinea may be taken at a minimum length of 12 cm, and ^{with} fat content in the meat not under 10%.

According to the data provided by foreign researchers, the edible part of the scad averages 52%. According to other data, the carcass of large Atlantic scad makes up 62-66% of the round fish, while the head accounts for 22-28%, and the carcass of small scad comprises 59-61% and the head 22-30% of the weight of the round fish. The fat content of scad meat varies from 2 to 14% (leaner fish predominate in the catch).

The scad caught along the coast of Northwestern Africa and in the English Channel had completely different meat composition. Thus, the meat of scad taken along the African Coast contains 71.8% moisture, 3.5% fat, whereas the scad taken from the English Channel contained 65.6% moisture and 13.8% fat.

There is data available to show that scad caught in March along the African Coast contained from 2.7 to 3.9% fat in the meat, and from 18.4 to 20.0% protein.

Frozen Atlantic scad showed initial signs of slight subcutaneous yellowing earlier than other fish (normally 2-5 days after freezing in blocks). However such yellowing

during the initial period of storage for fish (up to 3 months) is not associated with organoleptic signs of oxidation spoilage of fat.

The scad in the Black Sea is divided into two groups; the fresh-water small form (length 7-15 cm, weight 6-45 gm, average fat content in the meat 6.4% and average protein 20.3%), and the sporadically appearing Mediterranean scad which is very large and fat and has exceptionally delicious meat, surpassing the scad from the international fisheries in the commercial-nutritional sense (weight up to 1 kgm, fat content up to 27%).

Of the two main commercial species of marine scad, the ten-fin scad is distinguished from the true scad by the small fin-like growths located behind the dorsal and anal fins (at the base of the caudal fin), and by the greenish-blue colour of its coating with a yellowish-gold tone (along the lateral lines over the gill covers, the caudal peduncle and the fin). The ten-fin scad is normally / 129 considerably larger than the common scad and its meat is better.

The scad of the East China Sea have their own biological peculiarities (Vakhrusheva, TINRO). Depending on the season, the scad taken from the East China Sea contains from 1 to 14% fat in the meat.

Scad from the Gulf of Aden (Indian Ocean) contained from 1.4 to 10.7% fat in the meat, and the protein content was fairly stable between 21 and 22% (data provided by AzcherNIRO).

Scad is mainly frozen and frequently directed into canning and salting processing. It is smoked by the hot and cold methods.

Leerfish. There are two species in the fishery. The international fishery trade names are Durfish and Garrick. Their size in the catch varies widely, on the average from 30-33 to 100 cm (fig. 52). The minimum permissible

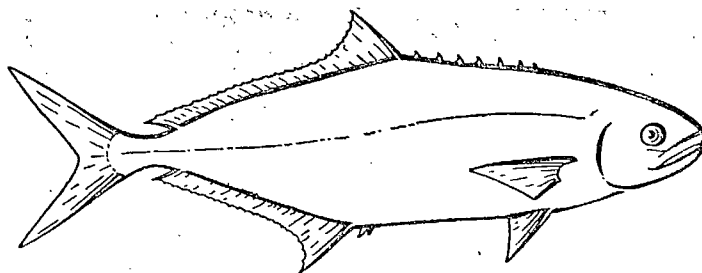


Figure 52. Leerfish.

length is 20 cm. The average protein content in the meat is about 20%, and fat content varies from 3.5 to 5.1%. The leerfish catch is not large.

The yield in % is as follows: carcass 60.6, head 19.1, viscera 5.1, bones and fins 13.7 (AtlantNIRO).

Vomer (half-moon fish or moon fish). The vomers have a greatly compressed and laterally flattened, high body.

The forehead slopes very steeply down to the upper lip. The lower jaw protrudes. The dorsal fins occupy the entire rear half of the body, and the pectoral fins are sickle-shaped (fig. 53).

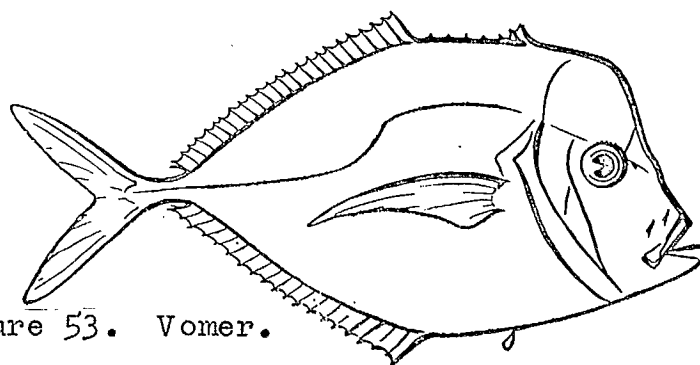


Figure 53. Vomer.

Colour is bright silver. Length is from 14 to 40 cm. Fat content in the meat is between 1.8 and 2.9%, protein about 20%. The meat is tasty. A second species, the selene vomer is known.

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The vomer is frozen whole. The catch is small.

Jack (caranx). Body is elongated, compressed from the sides. The first rays of the soft dorsal and anal fins are elongated. Several species are known, including a blue species, Senegalese (fig. 54), small-finned, crysos (fig. 55), spetsiozus, hippos and others.

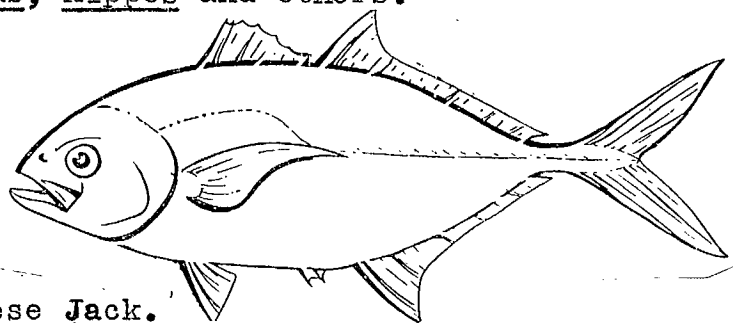


Figure 54. Senegalese Jack.

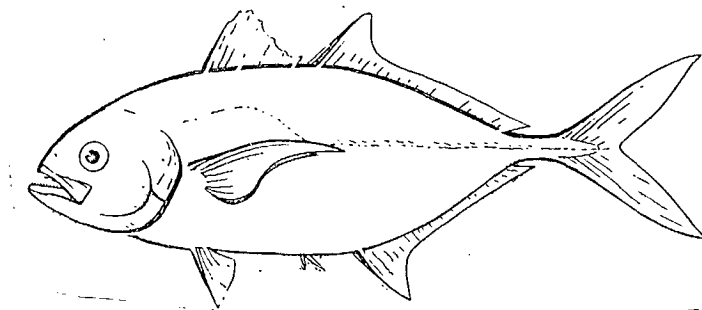


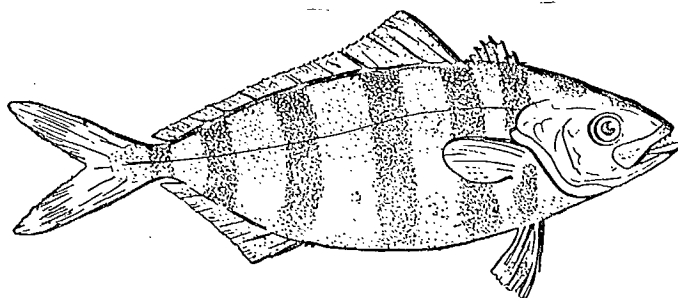
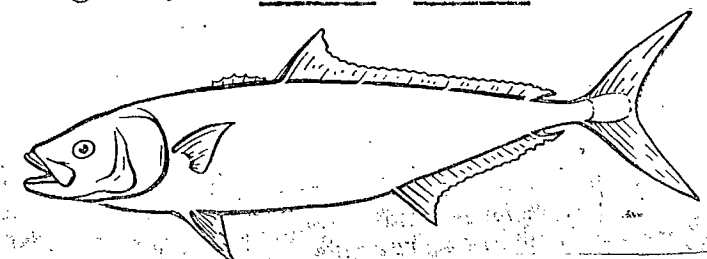
Figure 55. Garanx crysos.

The jacks reach a length of 80 cm, and weigh 16.5 kgm. The minimum permissible length is 17 cm. The meat, although it is very lean (0.2% fat), is very tasty, protein content is about 20%.

The amount of jacks taken by other countries varies over the years from 60 to 150 thousand tons, while in our country the catch is still insignificant.

The jacks are beheaded, gutted and frozen.

Seriola (yellowtail). The Seriola zonata has one keel on either side of the caudal peduncle. There are two small but very prickly spines in front of the anal fin. In contrast to the scads, the rudderfishes do not have pectiniform growths along the lateral line. The caudal fin is yellowish (figs. 56 and 57). The world catch varies from 43 to 56 thousand tons.

Figure 56. Seriola zonata.Figure 57. Seriola lalandi.

The *Seriola* is included in the tuna fishery. It reaches a length of 2 m, and weight up to 60-70 kgm. It is rarely caught by trawling. The fat content of the meat is 1.4%, and that of protein 20.1%. It will be included in the national catch in the near future. The chemical composition of *Seriola* meat is given below:

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Substance	% Content
Moisture	77.4
Fat	1.3
Protein	19.5
Ash	1.3

The meat of Atlantic *Seriola* contained (in %): moisture- 77.0, fat- 1.4, and protein 20.1 (AtlantNIRO).

Seriola is frozen after beheading and gutting, and the largest specimens are cut into fillets or slices before freezing.

In the Far East, fishery has also begun for *seriorella*.

FAMILY POMATOMIDAE

The only species in this family is the bluefish. It slightly resembles the carangid fishes, but it does not have the pectiniform plate-protuberances along the lateral line, the caudal peduncle is high, and there is a dark spot at each of the pectoral fins.

The amount taken from the Black Sea is insignificant (the bluefish landed measure 20-60 cm).

There is special fishery for the bluefish in Roumania, Bulgaria and Turkey, along the eastern shores of the Atlantic Ocean in Morocco and Angola, and along the western shores in the USA, Venezuela, Brazil and Argentina.

The average landed length is 68-74 cm, with an average weight of 4.0-4.6 kgm. The least length of bluefish is 20 cm. Individual specimens reach a length of 1.5 m, and weigh 15 kgm. The weight composition is given below:

Body part	Yield in %
Carcass	51-57
Head	28.0-33.6
Meat & Skin	38.5
Bone	10.9
Fins	3.0
Viscera	17.6

The amount of fat in meat varies from 0.4 to 5.3%, protein is about 21%, and moisture 71-78%.

The fish is beautiful, and has an excellent commercial appearance. The meat is of pleasing, firm consistency, tasty, aromatic and fairly highly valued. Its greyish-green colour (after heat processing) lowers its gastronomic properties to some extent. Bluefish is produced frozen (beheaded and gutted). Hot-smoked bluefish is superb. The possibilities for bluefish fishery on the open seas are ~~exploited~~ to a small extent by us at the present time.

The world catch of bluefish fluctuates between 5 and 12 thousand tons.

FAMILY SCIAENIDAE

Fish of the Sciaenidae family are characterized by the presence of short frontal dorsal and

anal fins and well-developed mucous canals on the head. This family contains about 150 species. There are particularly large reserves and catches of these fish in the waters of the Chinese People's Republic. The world catch exceeds 200 thousand tons.

In the national fishery for sciaenid fish, the most important are the otolithus and the croakers, such as the white croaker (fig. 58), Atlantic and yellowfin croakers.

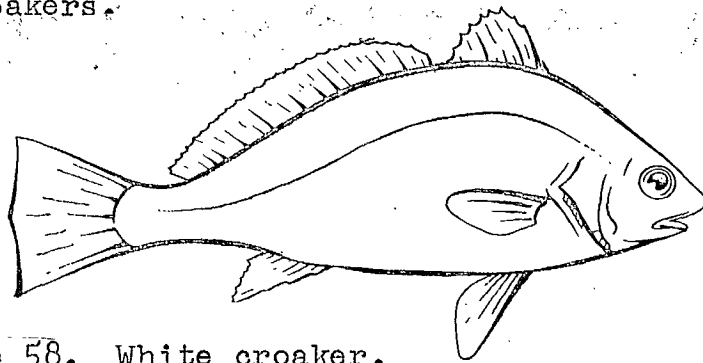


Figure 58. White croaker.

Our catch sometimes contains insignificant amounts of spot-fish (spotfin croaker??), maigre, croaker and other true croakers.

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The maigre reaches a length of 2 m, and weighs up to 200 kgm. The meat is delicious. However, some of the other large croakers (weighing up to 180 kgm) have coarse, fibrous meat.

Otolithus (Captain). This is a genus of large croakers. In foreign fishery, and in the trade, fish of this

genus are normally called captains. Unfortunately, the Soviet consumer got acquainted with the otolithus under the unexpected and not particularly applicable name of captain-fish.

This is a large fish whose tasty meat has a pleasant pink colour. The skin covering is normally pale brown in colour (fig. 59). The usual size of otolithus landed is from 50 to 120 cm. The fat content in the meat varies considerably, from 0.3 to 3.2%, and protein content from 17.7 to 20.4%. The meat of a medium sized otolithus, although not very firm, is not coarse or tough. In very large fish the meat is coarsely fibrous.

Otolithus is marketed (still under the name of captain) in the frozen state, beheaded and gutted.

An otolithus measuring an average of 114.4 cm (from the tip of the snout to the fork of the caudal fin), and average weight of 19.45 kgm, had the following weight composition:

Body part	Yield in %
Carcass	64.3
Fillet	54.3
Head	26.2

A small otolithus weighing 0.7 kgm had the following composition by weight:

Body part	Yield in %
Carcass	65.5
Head	23.5
Scales	2.0
Fins	2.0
Viscera	6.3

Otolithus measuring 132 cm weighed 27 kgm.

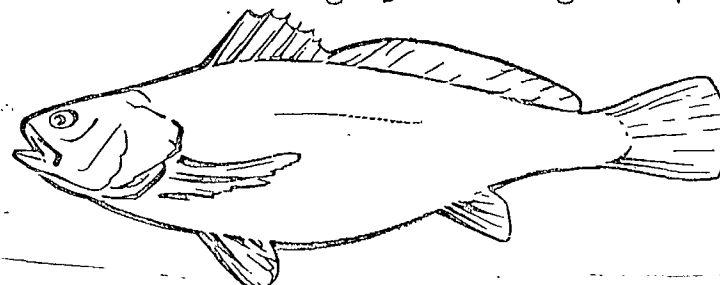


Figure 59. Otolithus (Captain).

Croakers. The national catch contains croakers-
sciaena of the following species in commercial quantities:

grey croaker (measuring up to 90 cm in length and weighing up to 5.5 kgm), the still larger spotted weakfish, the comparatively small (up to 1 kgm) maigre, as well as the kingfish, ombre, white croaker and red drum.

The croakers are mainly large fish that are distributed in all three oceans and are important in the fishery of many countries. They reach a length of 180 cm, and weigh up to 45 kgm. The smallest permissible length is 17 cm.

VNIRO did research on croakers weighing from 685 to 995 gm. The average weight composition was, according to data provided by T.I. Makarova and T.V. Sergeeva, as follows:

Body part	Yield in %
Head	24.0
Meat & Skin	50.7
Bone	10.8
Scales	0.9
Fins	1.9
Viscera	8.6

Drums. This genus includes many species.

The drums can be distinguished from the other sciaenid fishes by the single short leathery chin barbel, the very small mouth, the dark slanting lines on the back and the greyish brown colouring of the belly. The average length taken is 34 cm, and the weight 860 gm. They reach a length of 50 cm. The drum is marketed at a minimum length of 18 cm. Its meat is tender, succulent,^{and} often has a pleasing sweetish taste, although the fat content is not very high (0.1-0.5% fat and 19.3-19.7% protein).

In fishery and on the market the drum, like fish of several other similar genera, are often called croakers (maigre, ombre, yellowfin, Atlantic, Arctic, California).

The permissible length for drums varies depending on the species and ranges from 0.17 to 1.5 m (the weight goes up to 32 kgm).

The catch, according to international statistics, fluctuates within the limits of several thousand tons.

At the present time the national catch of drum taken on the open seas consists of admixture with other fish.

FAMILY ANARHICHADIDAE

The fish in this family have characteristically very large heads that are equipped with large powerful teeth. The single dorsal fin extends down the entire length of the body, and the anal fin is also very long; ventral fins are absent. The wolffishes have a very thick and strong skin. These are large marine fishes caught in the northern parts of the Atlantic and Pacific Oceans. Our catch of wolffish comes almost exclusively from the Barents Sea.

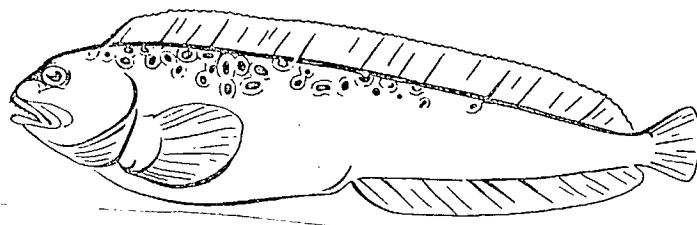


Figure 60. Spotted wolffish.

The unattractive external appearance of the wolffish / 135 (rounded head with continuous enormous teeth) was long an obstacle to the utilization of this fish, in spite of the high gustatory properties of the meat from the majority of wolffish species. The meat of the Atlantic and spotted wolffishes is white, of excellent tender consistency, fat and without intermuscular bones.

In the past few years the USSR has taken between 12 and 18 thousand tons of wolffish annually (as an admixture in the catch). All wolffish is marketed beheaded and gutted.

The spotted wolffish (Leopardfish). (fig. 60). The length of this fish is normally from 73 to 116 cm, and its weight is from 3 to 18 kgm.

According to data published in 1966 by R.A. Minder ("Rybnoe Khozyaystvo", 1966, No. 5), the spotted wolffish has the following weight composition:

Body part	Yield in %
Meat	$\frac{41.0-49.3}{45.2}$
Skin	$\frac{3.4-7.2}{5.5}$
Head	$\frac{14.6-24.2}{19.8}$
Bone	$\frac{5.8-11.2}{8.1}$
Fins	$\frac{3.8-7.7}{4.9}$
Viscera	$\frac{10.9-17.8}{13.9}$
Liver	$\frac{1.3-5.6}{2.7}$

When the head is removed with a straight cut, the proportion is 24.1%, whereas if a more economic semi-circular cut (along the boundary between the skull bones and the meat) is made, then the head amounts to only 17%.

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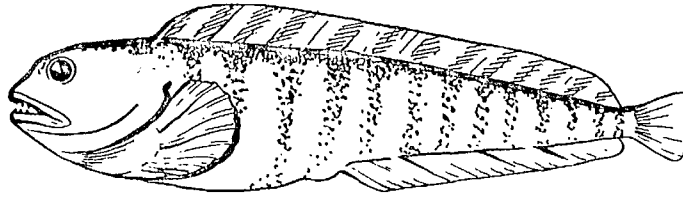


Figure 61. Atlantic wolffish.

Raw meat of the spotted wolffish has the following chemical composition:

Substance	% Content
Moisture	$\frac{74.4-82.6}{78.3}$
Fat	$\frac{2.3-9.0}{5.3}$
Protein	$\frac{13.3-17.7}{14.8}$
Ash	$\frac{0.7-1.2}{1.0}$

The head of this wolffish is twice as fat, and the bones are three times as fat as the meat. This shows that the head and bones are particularly valuable as a raw material for soup stock.

Spotted wolffish meat is very tender, firm, and of pleasing consistency. It is a first-class raw material for the manufacture of cold and hot-smoked products, cooked products and, when convenient, for canning.

Cold-smoked wolffish is almost always produced as balyk products.

Atlantic (Common) wolffish (Catfish). (fig. 61).

The length of this fish is normally 58-88 cm, and the weight varies from 1.7 to 4.9 kgm.

The composition by weight of the body of the Atlantic wolffish is as follows:

Body part	Yield in % of whole fish
Meat	$\frac{42.6-49.9}{46.4}$
Skin	$\frac{3.4-5.5}{4.6}$
Head	$\frac{19.5-28.5}{22.8}$
Bone	$\frac{4.5-10.4}{8.3}$
Fin	$\frac{3.5-8.0}{5.3}$
Viscera	$\frac{7.4-18.8}{10.9}$
Liver	$\frac{0.8-5.7}{3.1}$

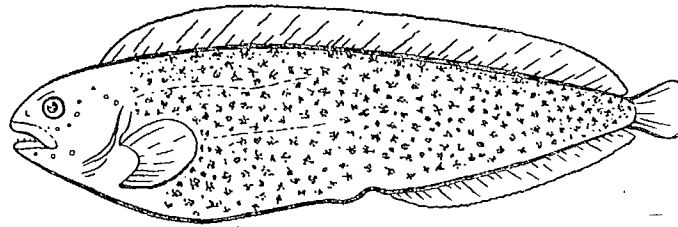


Figure 62. Northern wolffish.

The raw meat of the Atlantic wolffish has the following chemical composition:

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Substance	% Content
Moisture	$\frac{69.8-82.3}{77.2}$
Fat	$\frac{0.7-13.1}{5.0}$
Protein	$\frac{13.3-18.3}{16.0}$
Ash	$\frac{1.1-1.7}{1.6}$

In contrast to the spotted wolffish, the head of the Atlantic wolffish is not distinguished by very high fat content (up to 6.4% fat), the bones contain from 5.4 to 17.4% fat. Meat of the Atlantic wolffish is practically equal to that of the spotted wolffish, although it is normally softer.

Northern wolffish (fig. 62). The length of this fish is normally 90-129 cm, and the body weight goes from 7 to 24 kgm (rarely up to 32 kgm).

In contrast to other species of wolffish, the meat of the northern wolffish is comparatively leaner, watery, particularly poor in protein and tasteless. The chemical composition of its meat is as follows:

Substance	% Content
Moisture	$\frac{90.1-91.8}{91.0}$
Fat	$\frac{0.6-1.8}{1.0}$
Protein	$\frac{5.2-7.2}{6.5}$
Ash	$\frac{0.6-1.2}{0.9}$

The composition by weight of the body of the northern wolffish is as follows:

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<u>Body part</u>	<u>Yield in % of total weight</u>
Meat	$\frac{57.1-58.7}{54.7}$
Head	$\frac{14.9-18.6}{16.6}$
Skin	$\frac{4.1-8.0}{6.2}$
Bone	$\frac{4.6-7.3}{5.8}$
Viscera	$\frac{9.7-18.0}{12.9}$
Liver	$\frac{1.0-3.1}{2.1}$

The spotted wolffish is foremost in fishery, while the northern wolffish is of much less importance. The Atlantic wolffish is included with the spotted variety for commercial purposes.

The spotted and Atlantic wolffish is produced commercially frozen (for subsequent processing at consumer centers into cooked and hot-smoked products), salted (for subsequent processing into balyk products), (translator's note: either a filleted or canned product), and directly as cold-smoked balyk products.

An exceptionally fine and original new product, which has been developed by the Murmansk Combine, consists of the belly of the spotted and Atlantic wolffish processed, by the hot-smoking method, into meat loaf from the salted semi-product (after sufficient soaking). In appearance, the cross section of the roll suggests cake roll, the taste and aroma are piquant, and the consistency is pleasantly gelatinous.

The northern wolffish is marketed only as a salted product.

FAMILY ZOARCIDAE

The fish of this family have a long low body. The skin is covered with sline. The scales are very fine

and are buried in the skin. The rear part of the very long dorsal fin has a notch which is characteristic of the eelpouts.

The family zoarcidae consists of six sub-families, several score genera and a very large number of species, but, until recently, our national fishery commercially utilized only the eelpout taken from the Baltic Sea. This small viviparous fish (normally measuring up to 30 cm) was of third-rate commercial and nutritional importance in this country.

The meat of the Baltic eelpout contains from 1.6 to 7.0% fat, 16 to 18% protein and is distinguished by fairly good taste after cooking, when smoked, and also when canned in oil.

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It is known that the greatest number of eelpout species inhabit the northern parts of the Pacific and Atlantic Oceans, the Arctic and the Antarctic Oceans.

During 1966, we began to take considerable numbers of large eelpout on the open seas of the Atlantic. That taken on Georges Bank and the regions thereabouts measured from 60 to 70 cm, its weight averaged about 1.5 kgm, and it yielded the following percentages of body parts (VNIRO data):

Body part	Yield in % of whole fish
Carcass	$\frac{61.0-62.9}{62.0}$
Meat	$\frac{47.7-48.5}{48.0}$
Head	$\frac{13.7-21.2}{17.4}$
Skin	$\frac{5.1-5.5}{5.3}$
Bone	$\frac{7.3-9.0}{7.9}$
Fins	$\frac{2.1-3.2}{2.7}$
Viscera	$\frac{14.2-21.9}{18.1}$

The scientific name of this species of eelpout is Macrozoarces americanus (fig. 63), and it is becoming an important part of national fishery.

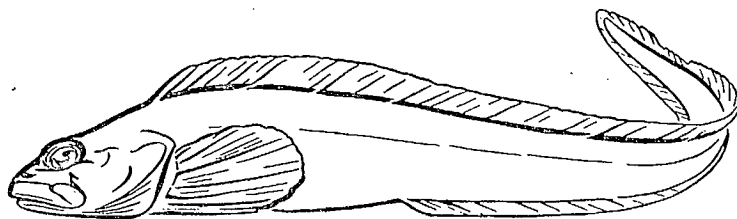


Figure 63. Eelpout.

The chemical composition of its meat, according to VNIRO data, is as follows:

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Substance	% Content
Moisture	74.8-77.5
Fat	5.8- 6.5
Protein	16.1-16.7
Ash	1.1- 1.2

According to data provided by the industry, the fat content of the meat of Macrozoarces americanus fluctuates between 2.6 and 3.6% when the protein content is 18.0-18.8%. Even before fertilization its roe approximates that of the pink and some keta salmon roe in size. It is yellow in colour.

The meat of this eelpout when cooked and fried was evaluated as a high quality product at tasters' conferences. Following heat processing it has a light grey colour, very pleasant consistency, bright, unique aroma and excellent taste. The head and bones yield a very highly saturated, tasty and aromatic broth.

Large eelpout, in spite of the unattractive shape of its body in the round and the particularly abundant secretion of mucous, is a high-quality fish from the point of view of nutrition and its fishery on the open seas should be expanded by all possible means.

SUB-ORDER SCOMBROIDEI

There is no single established systematics for the scombroid fishes at the present time. Nevertheless, it appears convenient to use, as a basis, the work of leading national and Japanese specialists, along with the trade classification for the group of scombroid fishes. In doing so, it is proposed to combine the fish in the mackerel, tuna, pelamid, gempylid, swordfish and sailfish families into a common group of scombroids.

The tuna fishes can be reckoned with separately by introducing two commonly used sub-groups of scombroids fishes, for example: a) tunas (tuna, swordfish, sailfish, marlin); and b) other scombroids (mackerel, pelamid, gempylid, cutlassfish or hairtail).

FAMILY SCOMBRIDAE

This family contains the fishes having fusiform body covered with small cycloid scales. The head is conical. There are two dorsal fins (the first is spiny and is situated a considerable distance ahead of the second). Behind the second dorsal and the anal fin are 4-6 small auxiliary finlets. The pectoral fins ride high. There are two indistinct keels along the sides of the caudal peduncle. Maximum length is 60-70 cm. The minimum length

of the Black Sea-Azov mackerel is 15 cm, that of ocean mackerel is 20 cm.

The total world harvest of mackerel is evidently over 700 thousand tons annually.

There are four main commercial species in the Scombridae family: Japanese; Common; Indian Ocean, and Indian Coastal.

The Japanese (Pacific) mackerel is of foremost commercial importance in the Pacific Ocean Basin and is less important in the Indian and Atlantic Ocean Basins. In the Atlantic Basin the Japanese mackerel normally is not distinguished from the Common mackerel.

The Japanese mackerel has a swim bladder, whereas this organ is lacking in the Common mackerel.

The Common mackerel is also called the Atlantic mackerel or simply mackerel. It is distributed in the seas and waters of the continental shelf in the North Atlantic Basin. It is caught along the shores of Europe, America and Africa. It is an important object of fishery in France, Portugal, Spain, Italy, Turkey, Norway, Denmark, Sweden and Holland.

The Indian Ocean mackerel has a body which is compressed laterally. It is distributed throughout the tropical and

partially the sub-tropical waters of the Indian Ocean and the western part of the Pacific Ocean. It is a very important object of fishery in India, Burma and the Phillipines.

The Indian coastal mackerel has a higher body than the ocean mackerel, and it has phosphorescent spots above and below the eyes. It is an important object of coastal fishery in India, Ceylon, Thailand, the Phillipin s and Indonesia.

The Japanese mackerel, like the Pacific Ocean species of sardinops (ivasi), is not a significant factor in the national catch at the present time. However, Japan and other countries catch over 400 thousand tons of this fish annually. Japanese mackerel was an important object of our Far East fishery during the postwar years, and it is to be expected that this high quality, fat, meaty and large fish will again occupy an important place in the national catch.

The composition of Japanese mackerel meat is as follows:

Substance	% Content
Water	63.1-66.6
Fat	11.8-15.8
Protein	14.7-20.5
Ash	1.1- 2.6

It measures up to 50 cm, and weighs up to 1.5 kgm. The catch consists mainly of specimens measuring 35-45 cm, and weighing from 0.5 to 1.2 kgm. The minimum permissible length is 17 cm.

The yield of meat is high (from 58 to 64%).
The weight of the head amounts to 16-20%.

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It is a beautiful, full-bodied fish. The meat is firm, tasty and aromatic. It is excellent in various canned products (particularly au naturel and blanched in oil), as well as hot and cold-smoked. It is fully adequate for cooking in the frozen state.

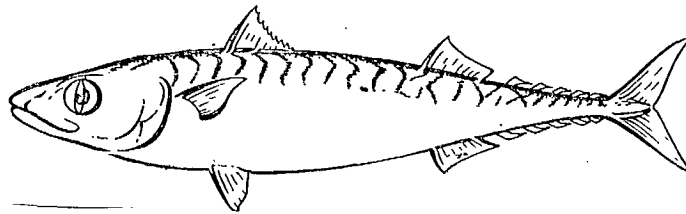


Figure 64. Atlantic mackerel.

The national catch at the present time consists mainly of the Common (Atlantic) mackerel (fig. 64) and, to a lesser extent, Indian Ocean mackerel. The landings of mackerel in the Black Sea are comparatively small in comparison with the catch on the open seas. Black Sea mackerel,

although it is systematically related to the Common (Atlantic) mackerel and is smaller than the latter, is the tastiest, most aromatic, tender and fat fish (particularly that taken during August and September) of all the mackerels. The minimum commercial length for Black Sea mackerel is 15 cm.

North Atlantic mackerel caught in the English Channel is fatter than the mackerel taken from the mid-Atlantic. Whereas the mackerel caught in May along the African Coast yielded meat containing an average of 6.0% fat, the fat content of mackerel meat caught during the same period in the English Channel was 12.3% (data provided by Sukrutova, AtlantNIRO).

Following heat treatment the meat frequently acquires a grey colour with a greenish tinge which lowers its value.

The average yield of carcass and head for May-caught mackerel taken along the northwest African Coast is given in Table 20:

Table 20

Data	1st measure		2nd measure		Weight, %	
	Comm. length, m	weight gm	Comm. length, m	weight gm	carcass	head
Average	35.4	768	37	930	63.0	25.8
Minimum	32.0	508	35	810	61.0	25.0
Maximum	38.0	934	41	1100	63.6	27.5

Mackerel, when alive, does not have subcutaneous yellowing. However, according to observations made by N.I. Sukrutova; mackerel delivered for freezing, when in the stage of rigor mortis or of autolysis, was found to have yellowing of the subcutaneous tissue in 30% of the specimens only five days after freezing. The pigmentation is initially observed as barely noticeable spots or small stripes, after that as more noticeable spots under the skin along the back. Among fish delivered alive for freezing it was found that up to 60% of the specimens had yellowing of the subcutaneous tissue 10 days afterwards, whereas fish frozen in the rigor mortis stage were found to have yellowing of the subcutaneous tissue in 60-100% of the specimens. All the fish sent to the freezers in the autolysis stage had yellowing of the subcutaneous tissue after 10 days. Nevertheless, during sample cooking using such mackerel after 10, 20 and 30 days of normal storage (glazed blocks stored in cardboard boxes at an atmospheric temperature of -19 to -20°C) there were no noticeable traces of fat oxidation odour, bitter aftertaste or yellowing within the body of the meat.

Mackerel is usually frozen whole and utilized in the manufacture of various canned products. Insignificant amounts are salted. Frozen mackerel is quite suitable for hot-smoking, and the salted fish for cold-smoking.

Slightly salted fat mackerel is excellent.

Mackerel taken on the open seas and used in canned products is similar in consistency to the Black Sea mackerel (cooking under pressure removes the comparative coarseness of the meat tissue).

Fat mackerel can be used to produce excellent natural canned products, and the leaner fish can be used blanched or dried for canning and packing in oil. Frozen mackerel is undoubtedly a very interesting raw material for drying (when used quickly). A tasty product is obtained from mackerel of average fatness even when dried artificially.

Whereas in 1958 the Soviet fisherman took a total of 0.1 thousand tons of ocean mackerel, in 1966 their catch amounted to 30.0 thousand tons.

FAMILY OF TUNA FISHES

The representatives of this family have a strongly fusiform body which is either completely covered with scales or only in the region of the pectoral girdle. The head is of medium length. There are three leathery keelsons on either side of the caudal peduncle. There are 7-9 auxiliary small finlets behind the second dorsal and the anal fins. The tunas travel at enormous speeds.

The main species in fishery are: skipjack, yellowfin, albacore, common, bigeye and the frigate mackerel.

The common (Eastern) tuna. This fish attains a length of 3.5 m and weighs over 700 kgm. It is the largest of the tunas. Its body is stout and completely /114 covered with scales. The back is dark blue in colour,

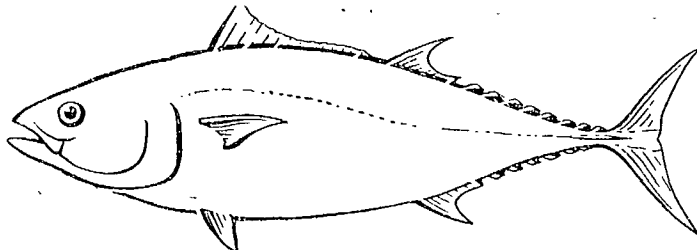


Figure 65. Common tuna.

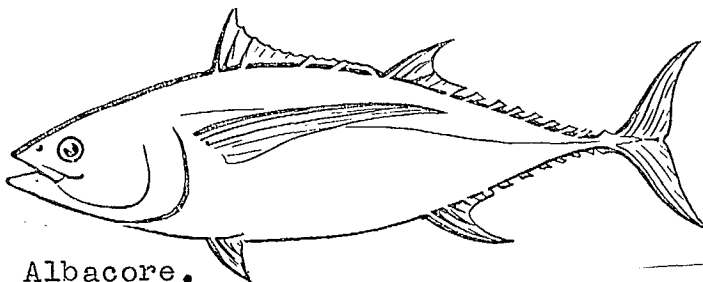


Figure 66. Albacore.

with a metallic greenish glint; the sides are greyish, the belly silvery white; additional dorsal fins are yellow with dark edges. The mouth is fairly large. The trailing edge of the first dorsal fin is slightly concave, the second dorsal fin is strongly curved and acuminate,

the pectoral fins are significantly shorter than on other tunas. This fish has a round anal aperture, in contrast to the oval aperture of the yellowfin and bigeye tunas (fig. 65).

In the North Sea the permissible length is 170-280 cm, and the weight is 60-385 kgm, in the Bay of Biscay it is 70-125 cm ~~and~~ weight of 4.5-42 kgm. In the Pacific Ocean the average permissible length is about 200 cm, and weight of about 200 kgm (but specimens weighing up to 375 kgm do occur). Among the catch landed by the scientific-exploratory expedition of 1963, operating in the western part of the tropical Atlantic, there was common tuna measuring from 205 to 254 cm (average 224 cm), and weighing 151-283 kgm (average 183 kgm).

Albacore or longfin tuna. The body is completely covered with scales. The deepest part of the body is situated behind the second dorsal fin. The sides and abdomen are a dull brown colour, there is a narrow blueish band along the sides, the auxiliary fins are darker than on the common or bigeye tunas. The pectoral fins are very long, sword-like, and extend to the rear edge of the second dorsal fin. The anal aperture is round (fig. 66).

The albacore attains a length of 1.5 m, and weighs up to 45 kgm. The catch usually consists of tuna measuring from 80 to 100 cm, and weighing from 10 to 22 kgm.

The meat is white, it is very much in demand on the market, and is used mainly in the preparation of canned products.

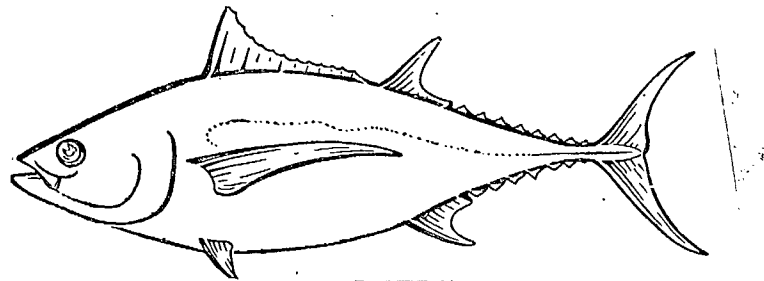


Figure 67. Bigeye tuna.

Of the tuna landed, the albacore normally comprises from 17 to 20% of the world catch.

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The Japanese are the main suppliers of albacore. They catch it in the tropical waters of the Indian and Atlantic Oceans with as much success as in the Pacific Ocean.

Bigeye tuna. The body is completely covered with fine scales. The largest part of the body extends to the second dorsal fin. The back is dark blue, the sides and abdomen greyish, the caudal and pectoral fins are reddish-black, the first dorsal fin is yellowish and the auxiliary finlets are yellow with black edges. The pectoral fins are long and extend to the middle of the second dorsal fin. The second

dorsal and the anal fins are fairly long. The anal aperture is oval (fig. 67).

The bigeye tuna attains a length of 2 m and over, and weighs up to 100 kgm. Specimens weighing 16-35 kgm predominate in the catch (on the Eastern Coast of Australia the predominant weight is from 37 to 78 kgm). The bigeye tuna comprises 10-12% of the total tuna catch.

The meat is pale pink and delicious.

The meat of a bigeye tuna had the following chemical composition:

Substance	% Content
Moisture	67.3
Fat	1.06
Protein	30.8
Ash	1.6

According to data provided by AzcherNIRO (Yaroslavtseva), the meat of the bigeye tuna taken during July in the Gulf of Aden had the following chemical composition (Table 21):

Table 21

Substance	% content in meat	
	light	dark
Moisture	73.67	72.74
Fat	0.28	1.01
Protein	23.50	21.44
Ash	1.38	1.32

Yellowfin tuna, yellowtail tuna, albacore./ 146

The body has clean lines and is completely covered with scales. The head is elongated, and comprises $\frac{1}{5}$ of the total fish length. The back is blue, without stripes and spots, the belly is light-coloured. The fins are silvery-yellow, and the auxiliary dorsal finlets are bright yellow, both have dark bands along the edges. The young tuna are observed to have vertical bands or spots that are whitish in colour. The skin and scale covering of landed tunas becomes dull, the yellow colour disappears from the fins. In mature specimens the second dorsal and the anal fins are elongated and reach $\frac{1}{2}$ the length of the body and over. The pectoral fins are long and may extend to the middle of the second dorsal fin (fig. 68).

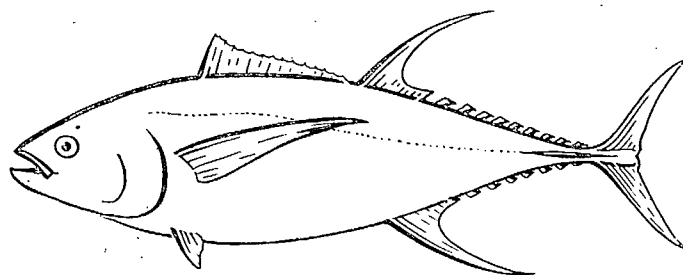


Figure 68. Yellowfin tuna.

The yellowfin tuna attains a length of 3 m, and weighs up to 200 kgm. In the coastal regions, specimens weighing 10-20 kgm predominate, while the larger specimens are found in the open sea. The usual commercial size is related to the fishing area and varies greatly between the limits of 50 and 180 cm, with a weight of from 2 to 90 kgm.

According to data provided by an expedition, the yellowfin tuna landed measures from 98 to 175 cm (average 135 cm), and weighs from 17.2 to 73.4 kgm (average 44.8 kgm).

The length of this fish taken in May and June around Dakar was 148-176 cm, and the weight from 53 to 105 kgm. Chemical composition of the meat was as follows:

Substance	% Content
Moisture	72.2-75.2
Fat	0.2- 1.8
Protein	22.3-26.2
Ash	1.2- 1.3

As in the majority of fish, the abdominal part (belly) has the fattest meat.

Yellowfin tuna taken in the Indian Ocean yielded 63.0% meat with fat content of 1.1-1.2% and protein from 22.6 to 25.3% in January and September (AzcherNIRO). Experimental preparation produced high quality sausage and cooked dishes.

Skipjack tuna. The body is thick and rounded / 147 in cross section (fig. 69). Body scales are found only in the corset region and along the lateral line. The back is steel-blue in colour, the sides and abdomen white, and the lower part of the sides is covered with dark blueish-brown longitudinal bands which run from the pectoral fin to the tail. The edge of the first dorsal fin is crescent-shaped. The bases of both dorsal fins merge.

The skipjack rarely attains a length of 1 m and weight of 25 kgm. Predominant sizes in catches are: in the Pacific Ocean - specimens measuring from 40 to 55 cm, and weighing 1.5-3.5 kgm at an age of 2-3 years; in the Atlantic Ocean - specimens measuring 50-60 cm, weighing 3.5 kgm at an age of 4-5 years.

The meat is excellent and is used mainly in canning.

According to AzcherNIRO data, the skipjack taken from the Indian Ocean during January and September yielded 65.6% meat. The fat content of the meat was 0.6%, and protein content was 25.9%. Meat of skipjack tuna taken from the Atlantic Ocean was found to contain 71.7% moisture, 0.1% fat, 26.8% protein and 1.4% ash.

Approximately the same protein content was found in the Pacific Ocean tuna of this species.

The following relationships of length and weight were determined:

Length (cm)	136	157	166	180
Weight (kgm)	49	69	97	102

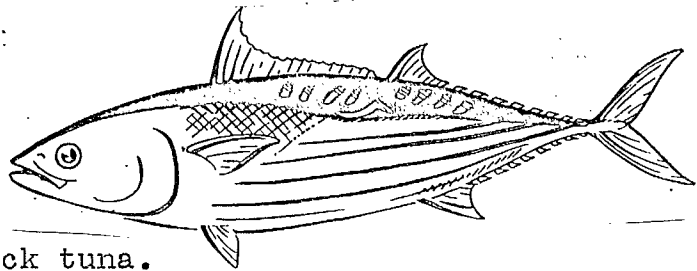


Figure 69. Skipjack tuna.

The yield of individual parts of the body (in % of total weight) from the Pacific Ocean tuna was as follows:

Body part	Yield
Trunk	75.0-77.0
Head	11.0-14.0
Blood	6.5- 7.0

The meat of a skipjack tuna landed on the 26th of November 1961 was found to contain 67.3% moisture, 1.06% fat, 30.8% protein and 1.6% ash.

Frigate mackerel. This is the smallest of the tunas. /148
 Its average length is 30-40 cm, and its weight is 2-5 kgm. The meat is edible, but is not highly prized as a food. The dark red colour of the light-coloured meat makes it difficult to distinguish from the dark meat. Its gustatory qualities are mediocre, although the amount of fat in the meat, according to AzcherNIRO data, is over 3% (September catch in the Red Sea). The yield of light meat is 32.0 and dark 12.9% of the weight of the whole fish (an unusually large yield).

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The light meat of the tuna is the most valuable. The amount of brown (dark) meat normally is 4-5% of the total weight of the majority of tuna species.

The meat on the back contains the least amount of fat. The fat content of the belly meat sometimes reaches 33%.

The chemical composition of the light meat varies considerably depending on the tuna species, its size (age),

season and place of catch (Table 22):

Table 22

Tuna	% content			
	water	fat	protein	ash
Yellowfin	72,2—75,2	0,2—1,8	22,3—26,2	1,2—1,5
Skipjack	65,3—75,4	0,4—10,6	18,3—26,8	0,9—2,8
Albacore	61,6—66,8	2,6—12,8	23,5—26,6	1,3—1,4
Bigeye	67,3—73,7	0,3—1,1	23,5—30,8	1,4—1,6
Common	65,0—78,0	1,0—11,8	17,1—26,5	1,2—1,7

The flesh of these and other tunas contains very large amounts of protein.

The brown tuna meat is friable, more watery (70-74% water) when compared with light meat (from the same fish) and less oily, but it contains a large amount of extractive substances.

Whereas in most fish the dark meat is tastier and much oilier than the light meat, in the tunas and most of the other scombroid fishes it is considerably inferior to the light meat in nutritive and other gastronomic properties. In the canning industry the brown tuna meat is utilized apart from the light meat and is produced under another name.

The dark meat of tuna contains very much iron (up to 11 mgm per 1 kgm).

The body fat of the tuna is highly unsaturated.

The high water-retaining properties of tuna meat, in contrast to the meat of most other fish, makes it a valuable raw material for the manufacture of unique sausage and fish cake products.

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Table 23 shows data for the weight composition of tunas (according to research data provided by AtlantNIRO and TINRO):

Table 23

Tuna	% yield				
	trunk	head	viscera	blood	fins
Yellowfin	72,0—79,2	9,0—15,5	3,8—5,2	7,0—7,4	1,1—1,7
Skipjack	71,0—86,0	11,0—26,5	6,6—21,6	no data	1,5—2,5
Bigeye	74,8—77,0	11,0—14,2	3,1—7,0	6,5—7,0	1,0—1,5
Common	75,1	16,1—17,5	5,8—8,8	no data	1,4—1,6

The chemical composition of tuna meat undergoes seasonal variation. Thus, for the common tuna found in the eastern part of the Pacific Ocean, the best meat is obtained during the winter; whereas during the summer, in the season of

roe deposition, the meat becomes almost unedible. There is more fat in the tissue of tuna meat during the winter than during the summer. Body fat is not uniformly distributed throughout the tuna. A relatively thick layer of fat, which is nearly $2/3$ lipids, is found under the skin of the fish. The fattest part of the tuna body is the belly.

Fresh tuna meat has a sharply expressed acidity which is its specific property. According to TINRO data, the acidity of light tuna meat is 1.1-1.7, and dark meat 0.7-1.3% of lactic acid.

Tunas landed on the deck are usually killed by puncturing the skull.

Immediately after being caught the tuna are bled because the blood, which averages about 7% of the weight of the fish, causes darkening of the meat, degrades the taste and hastens spoilage.

There are several methods of bleeding tuna: cutting open the body along the gill covers in the area of the main artery, cutting the main artery, stabbing the heart or completely removing the gills.

A sign of correct (timely and adequate) bleeding in tunas is a clearly distinguishable boundary between the dark and light meat, except for the frigate tuna.

When cooled tuna meat is stored under the most favourable conditions, the meat retains its satisfactory quality for no longer than 4 weeks. When necessary to store tuna for a longer period it is frozen.

On board modern tuna-fishing boats all systems /150 for freezing include preliminary chilling in sea water to a temperature of -1 or -2°C . This process considerably reduces the time required for freezing and produces a better-quality product.

On board our new tuna-fishing ships the tuna is frozen and canned, the waste products are processed into fish meal. Such products as "tuna au naturel", "blanched tuna in oil" in round cans, "blanched tuna in oil (belly)" in oval cans are produced.

BONITO FAMILY

This family of pelamid fishes contains those fish which are close in the systematic and commercial-nutritional senses to the mackerels and tunas. The distinctive features of this family are: fusiform body, scaleless or covered with fine scales. There is a clearly defined corselet of elongated scales in the area of the pectoral girdle. There are at least six small additional finlets behind the second dorsal and anal fins. The caudal peduncle has three leathery keels on either

side. This family contains six genera of fish which are of commercial importance, including the wahoo, king mackerel, gymnosarda (transliteration) and the true bonitos.

The bonitos occupy an important place in world tuna fishery, during recent years the catch has amounted to 250-300 thousand tons annually. The main bonito fishery is carried on by Peru, Turkey and Spain. Bonito fishery is still insignificant in the USSR.

Wahoo. Body elongated, compressed laterally and covered with scales. Snout very long (longer than the remaining part of the head), powerful cutting teeth on the jaws. The first dorsal fin is large and spiny, the second dorsal and anal fins are small. The wahoo achieves a length of 2 m and weighs up to 60 kgm. The usual landed weight is from 10 to 30 kgm. The meat is tastier than that of other pelamids. The world catch amounts to 8-12 thousand tons annually.

King mackerel. On all the king mackerels the crest of the second dorsal fin is higher than that of the first dorsal fin. The second dorsal fin is equal in size to the anal fin. The snout is elongated, but is not longer than the remainder of the head.

The following species of king mackerel are of special importance in fishery: S. cavalla (length up to 150 cm and weight 45 kgm), S. commersoni (length to 180 cm and weight 50 kgm), S. maculatus (length to 90 cm and weight to 4.5 kgm), Californian, Western Atlantic (landed fish usually weigh 2.0-4.5 kgm), African (length to 104 cm), Japanese (length to 100 cm and weight to 4.5 kgm), Australian (length to 120 cm) and Indian (length to 60 cm) having particularly tasty meat.

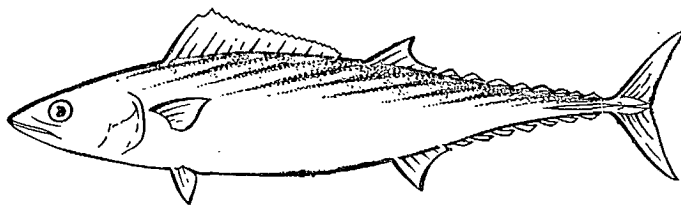


Figure 70. Atlantic bonito.

According to AzcherNIRO (Yaroslavtseva) data, for king mackerel caught in September in the Red Sea with permissible length of 75-90 cm and weight of 3.2-6.0 kgm per specimen the yield of trunk was very high, 78.5-81.0% and heads 14.1-14.8% when the fat content of the meat for the species Sc. commerson was 0.36%, while for the species Sc. guttatus it was 9.68%.

The world catch of king mackerel varies between the limits of 75 and 100 thousand tons per year (heavy fishery).

The king mackerel (bonito family) should not be identified with the golden mackerel (coryphene or dolphin family) whose commercial importance is very small.

Gymnosarda. Body compressed longitudinally, stout, round or oval in cross-section (like the tuna), scales only on the corselet. There are scale-covered keels on the caudal peduncle.

These fish have tasty white meat.

Bonitos. Similar to the scombroids, they differ from them by having keels on the sides of the caudal peduncle and normally ^{by} large size. The jaw teeth are powerful and triangular (fig. 70).

The most widely distributed bonito species are the Chilean (length up to 90 cm), Atlantic (length to 75 cm and weight to 3 kgm), and Eastern (length to 80 cm and weight to 3 kgm).

The Chilean bonito is of great importance in fishery (the landings normally vary between 60 and 83 thousand tons annually). Its meat is tender and tasty, but it does have

a fairly strong specific acidic aftertaste.

The Atlantic bonito (or simply the bonito) enters the Black Sea in large numbers in certain years. At first the meat seems to be excessively (unpleasantly) sour, and therefore during canning, cooking and even hot-smoking, the fish requires special processing which consists of preliminary soaking, sometimes combined with brine, and mainly ~~by~~ using specially-selected sauces.

The meat of Atlantic bonito (taken in the Black Sea) contains:

<u>Substance</u>	<u>% Content</u>
Moisture	72.6-75.1
Protein	21.5-24.4
Fat	0.6- 7.0
Ash	1.5- 2.9

The average length of this bonito normally varies between 60 and 65 cm, while the weight varies from 2.4 to 4.0 kgm. It sometimes reaches a length of 85 cm and weight of 7 kgm.

According to data contained in foreign literature,
bonito meat contains:

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<u>Substance</u>	<u>% Content</u>
Moisture	74.78
Protein	23.25
Fat	1.79
Ash	1.47

The meat of the Eastern bonito is worse than that of other true bonitos and pelamids in general.

FAMILY GEMPYLIDAE

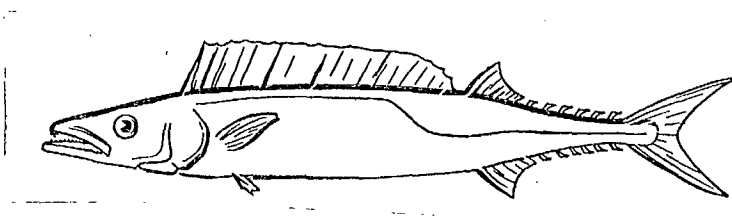


Figure 71. Snoek.

The national tuna fishery includes the snoek or barracouta (Thyrsites atun Euph.) which is of interest. It reaches a length of 135 cm and weighs over 5 kgm.

In the catch its average length is 80 cm and average weight is about 3 kgm.

The snoek has a trim, elongated trunk and snout. The body is silvery, the back steely-blue. The first dorsal fin is spiny and very long. Scales are fine. There is a sharp bend in the front part of the lateral line under the end of the dorsal fin. The first ray of the anal, ventral and spectral fins is spiny (fig. 71).

In 1958 the world catch was 22.9 thousand tons (Chili, Republic of South Africa, South-west Africa). Smoked snoek meat is highly esteemed. The other name for this fish (barracouta) must not be confused with that of the true barracuda (sea pike) (family Sphyraenidae), which we shall not describe (at times and in certain regions it is toxic).

In addition, this family includes the snake mackerel, the grey delicatessen mackerel, and two other fish whose names are transliterated as prometeeva fish and puveta (ruvetto??).

FAMILY XIPHIDAE

The fish in this family have a powerful body with an elongated snout resembling a sword. There are no ventral fins. The dorsal fin has a high crest but is short. The back is blue with ^areddish or brownish tinge, the belly is

blueish white. It achieves a length of 5 m and weighs over 400 kgm. The average weight of landed swordfish is usually much less. The total world catch of this fish is about 20 thousand tons, of which the Japanese contribute 85%.

The amount of trunk is 65.1-69.3%, weight of head is 14.8-19.7%. The proportion of blood when bleeding live fish is 6.9-7.1%. The length to weight ratio (data provided by Podsevalova) is as follows:

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Length, cm	143	287	400
Weight, kgm	54	73	137

The meat is dark red, but in taste and other gustatory properties it is considerably inferior to that of marlins and sailfish.

Blanched swordfish meat canned in oil had (after sterilization) very weak, watery and even flaccid consistency. -- TINRO and Dal'ryba came to the conclusion that swordfish was not suitable for this purpose.

Good filleted products are obtained from swordfish, and utilization of swordfish for this purpose is very promising.

FAMILY ISTIOPHORIDAE

The true sailfishes have a snout which is less extended than that of the swordfish and suggest a spear more than a sword. The ventral fins have from 1 to 3 rays. The dorsal fin is very high, long, dense and consists of spiny (in front) and soft rays (fig. 72). There are two anal fins. There are two keels on the sides of the caudal peduncle. The length to weight ratio is as follows:

Length, cm	190	218	232	238
Weight, kgm	16.6	23.6	47.0	33.0

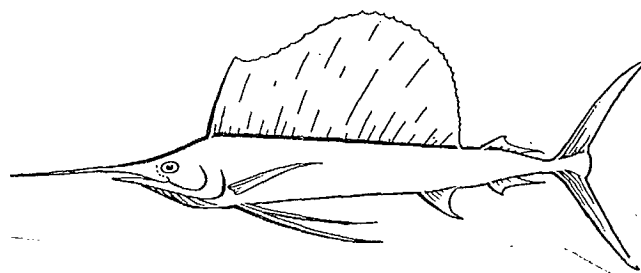


Figure 72. Sailfish.

The weight of the head varies from 7 to 15% of the weight of the whole sailfish. The trunk yields from 61.5 to 74.4%.

Fluctuations in the chemical composition of various parts of the body are significant (Table 24):

Table 24

Body part	% content		
	Moisture	Fat	Protein
Front section	75.1	1.4	22.0
Middle part of the back	73.4	2.1	23.0
Caudal part	74.0	0.2	24.6
Belly	69.0	15.8	14.2

Sailfish meat is red. The best meat is obtained from fish of the summer and autumn catch. However, in the majority of cases it is infested with copepoda, and is then not suitable for food purposes.

Marlin. These fish also belong to the family Istiophoridae (sailfishes). The upper jaw is also considerably elongated. There are black, white, silver, blue and striped marlins. The white marlin reaches a weight of up to 72 kgm (normally 13-27 kgm), the striped marlin measures up to 3 m and weighs up to 300 kgm, and the black measures up to 5 m and weighs up to 624 kgm (normally the landed weight averages 130-180 kgm). The silver marlin reaches a length of 2.5 m with a weight of 320 kgm, while the blue marlin measures up to 4 m and weighs up to 300 kgm.

The blue marlin landed varies from 50 to 300 kgm, but it can go over 600 kgm.

The length and weight ratios for whole marlin are given below:

Length, cm	195	240	248	266	375
Weight, kgm	19	109	85	111	250

The amount of trunk obtained (in %) is as follows:
from 71.5 for the smallest to 76.0 for the largest fish;
the weight of the head varies between 10.5 and 10.6%.
The weight of blood is 6.6-7.1%.

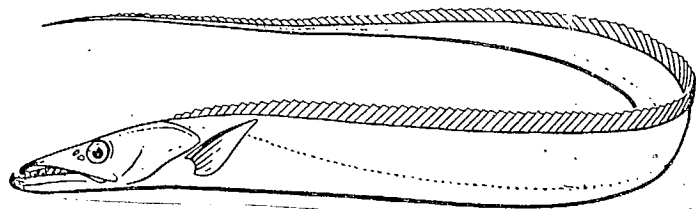
Raw marlin meat is usually pink, and when cooked it is pinkish yellow. Trial cooking of the meat of a comparatively small specimen of a black marlin, carried out by us at the end of 1966 in the standards laboratory of VNIRO, showed that it was extremely tough, the consistency was coarse even after thin pieces had been boiled for an hour. However, when we prepared lightly-salted fillets from the same specimen (pieces weighing 700-900 gm each), the consistency was excellent and resembled sturgeon fillet, and the colour of the meat had (in the flakes) pleasant dark pink tones. In spite of the comparatively low fattiness of the fillets (3.1% fat), its quality was fully acceptable. The black marlin can

certainly be used for production of fillets.

FAMILY TRICHIURIDAE

Several species of the cutlassfish family, or hairtails, are known in fishery, these have a very long, laterally-compressed, cutlass-like body (fig. 73). The dorsal fin extends along the entire length of the body. The tail terminates in a hair-like appendage. The body is uniformly dull silver in colour.

The harvest of hairtails in the three oceans exceeds 100 thousand tons (mainly Chinese Peoples' Republic).



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Figure 73. Cutlassfish.

The cutlassfish reaches a length of 200 cm. A specimen weighing 1.9 kgm measured 124 cm, while another weighing 2.4 kgm measured 157 cm. The yield of the various parts is given below:

<u>Body part</u>	<u>% Yield</u>
Trunk	67.0
Head	21.6
Fins	1.5
Viscera	9.3

Chemical composition of the meat was as follows:

<u>Substance</u>	<u>% Content</u>
Moisture	73.2-77.8
Fat	1.0- 7.3
Protein	18.0-19.3
Ash	1.4- 1.7

The meat is tasty and has a pleasing consistency. An essential shortcoming is the particular weakness of the skin cover (it readily disintegrates during cooking).

Cutlassfish is produced mainly in the frozen state (culinary stock) and hot-smoked. The canned product is unsatisfactory.

FAMILY GOBIIDAE

The representatives of this family have an elongated body which is covered with scales, spines or else is bare. There normally are two dorsal fins; the anterior fin is less developed than the posterior, and in some genera it is entirely absent. Up to 850 species of gobies are known. The main national goby catch for food purposes is carried on in the Black Sea-Azov area, where five species are caught; round goby, toad goby, monkey goby, weed goby and the syrman goby. The round goby is the mainstay of the catch (fig. 74).

Gobies are also found in the Baltic, Caspian and Japan Seas. There are many gobies in Lake Baikal, but they are of no importance as a food product because of either small catch, very small size, or unsatisfactory nutritional properties. In some places the inadequate utilization of goby for food purposes is the result of insufficient attention to this object of fishery. The goby harvest in the USSR was 64.4 thousand tons in 1966.

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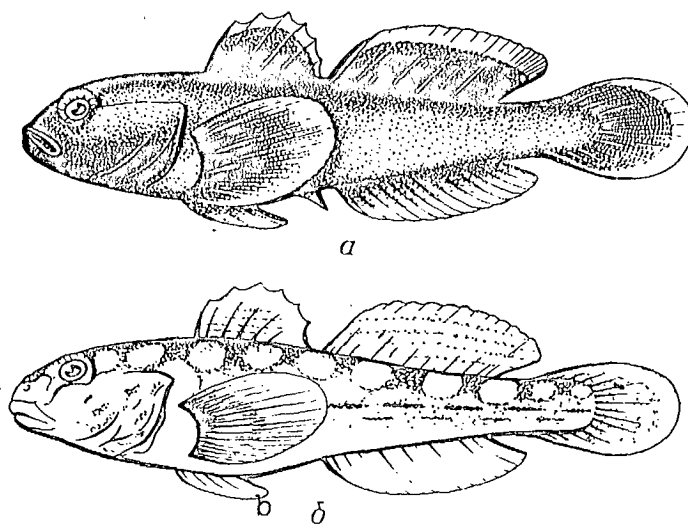


Figure 74. Round goby: a- male in spawning colour; b- female.

Most gobies have very tasty "sweet", attractive meat, both as cooked products and in the form of popular canned goods in tomato sauce and fish-vegetable mixtures. Certain gobies when smoked and dried are not bad at all.

The toad, monkey and weed gobies have always been considered the best in the trade. Of the other Black Sea-Azov gobies, the syrman goby has the least appetizing meat.

Round goby, frozen, loses much of its nutritional properties if it is caught during the spawning period, when the male is in spawning colour. During this period they become black.

The monkey goby has the lightest-coloured skin-scale covering among the gobies (white goby). When iced or frozen, this latter fish is a trade leader.

The toad goby is caught earlier than the other gobies, and it is considerably larger (individual specimens weigh up to 600 gm). Netted toad boby measures an average of 22-23 cm and weighs 120-180 gm.

The meat of the weed goby is more tender and aromatic than that of other gobies.

The meat of Black Sea-Azov goby normally contains about 1% fat and 18% protein. The price lists do not differentiate

Black Sea-Azov gobies according to species.

Gobies from other areas are not valued as highly as those from the Black Sea-Azov.

Salted goby is an extremely low-quality product.

The yield of meat from Black Sea-Azov gobies varies greatly, but in most cases it averages around 55-58%, and the weight of the head ranges from 18 to 22%.

A serious shortcoming in most gobies is the presence of crustaceans in their digestive tract. The presence of /157 small sized gobies in the catch is a serious obstacle to utilization of this raw material in the production of cooked and canned products when the fish are cut manually. However, enterprises in the Black Sea-Azov area have already developed and are now improving fish-cutting machines. The results of their work are very promising.

FAMILY SPARIDAE

In both the trade and fishery, the majority of the fish in this family are called sea or ocean breams (porgies) with the exception of the dentex, scup and the box-salpa (goldline).

The sea breams have a high body which is laterally compressed, the skin cover is pinkish-brown or reddish. Scales are large and lie flat.

The sea breams and other sparid fishes have one long dorsal fin whose forward part is spiny, and the rear part is soft. The anal fin has three spiny rays. The ventral fins are situated under the pectoral fins. Teeth are powerful. In the Middle Atlantic alone there are over 20 species of sea bream found in the catch.

The most frequently-occurring sparid fishes are the dentex, pagrus, pagellus ssp, goldline and scups.

Dentex. The body is high and comparatively short. The teeth consist of powerful fangs in a single row in the jaw bones.

The "large-forehead" (perhaps Taius tumifrons) dentex, and large and small Kanarskiy (Canary??) dentex are known in fishery. The dentex species have powerful fangs, but the cheek teeth are absent. The largest is the large-forehead dentex: the length of fish in the catch is 40-77 cm, and the average landed weight is 4.1 kgm. Specimens measuring 90 cm in length and weighing up to 11 kgm are known. This fish has a dark red covering, and old males normally have enormous foreheads

and a dark spot at the beginning of the lateral line. The large Kanarskiy dentex measures 35-60 cm and weighs an average 1.7 kgm. The small Kanarskiy dentex measures 19-35 cm and has an average weight of 400 kgm. The skin coverings are pinkish-red with several longitudinal lines that are gold in colour, the depressions under the pectoral fin are black, and there is a dark red spot at the base of the rear rays of the dorsal fin.

Normally the dentex is a large fish weighing usually from 1 to 4 kgm (figure 75). The minimum permissible length for dentex is 20 cm. The fat content of the meat is very small, being from 0.3 to 1%, and the protein content is 18-19%. The weight of the head is 32-34%, and the yield of trunk is 54-61%.

Pagrus. The body is high, short, laterally compressed (like fresh-water carp). The true pagrus has a spiny dorsal fin without elongated rays (fig. 76), whereas the long-finned pagrus (fig. 77) has very elongated front spines. Its characteristic property is the absence of incisors. The cheek teeth are situated in two rows. This fish achieves a length of 50 cm. The catch normally contains specimens under 43 cm with average weight

from 90 to 140 gm. The true pagrus has a pink, uniform skin and scale covering, while the long-finned pagrus has pinkish-red covering with numerous blue speckles. The meat of the pagrus is tender, succulent, but lean (0.7% fat), the protein content is about 20%.

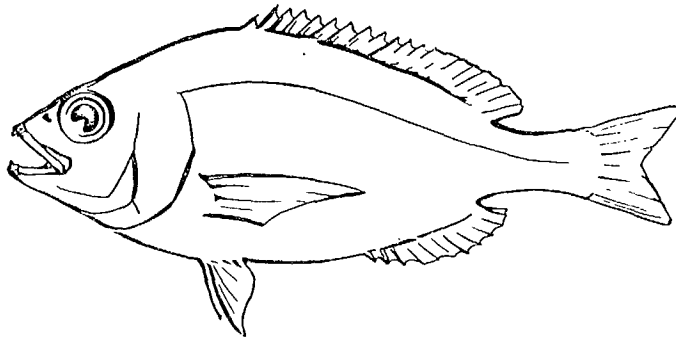


Figure 75. Dentex.

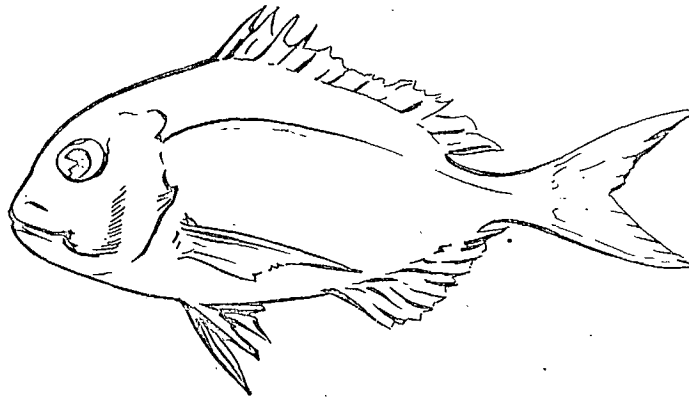


Figure 76. Pagrus.

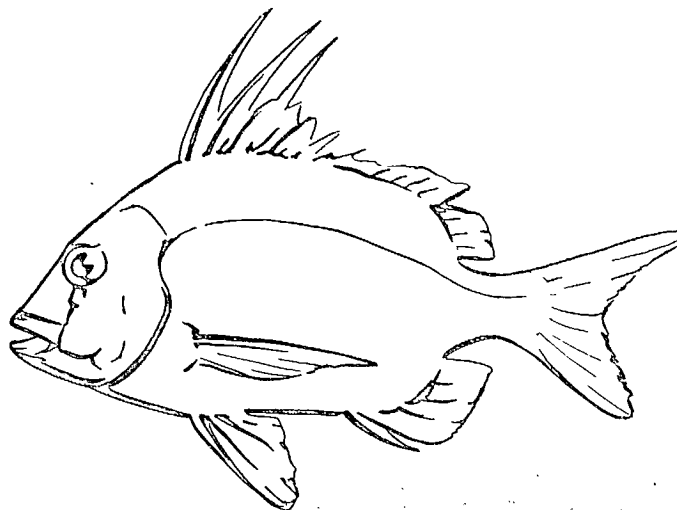


Figure 77. Long-finned pagrus.

Pagellus. The body is covered with tiny pink spots. The front teeth are fine and setiform. Cheek teeth are numerous. This fish occurs in fairly large numbers in catches.

In our national fishery the largest catch consists of Kanarskiy (Canary??) pagellus. The fat in the meat of this fish averages about 0.7%.

The meat of some other commercial species of pagellus is sometimes three times as fat as the meat of the Kanarskiy pagellus. The protein content of pagellus meat is normally around 20%. The Kanarskiy pagellus (fig. 78) is an excellent raw material for canning purposes. The commercial length is normally 18-31 cm with weight from 100 to 340 gm.

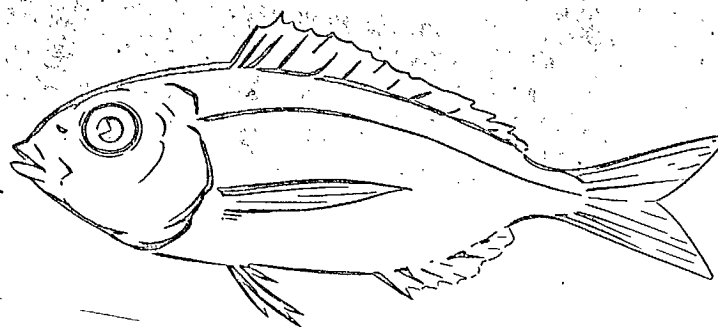


Figure 78. Kanarskiy (Canary??) Pagellus.

The average yield of trunk is 58%. The fat content of the meat averages about 0.7%. A multitude of genera and species of sea breams are known. They all inhabit the warm seas and are found mainly in the coastal waters. Most of them have very tasty meat and have serious commercial importance. Most of the sea breams contain about 19-22% protein and up to 1 or 2% fat in the raw meat. Among such fish are the red-finned and black-finned sea breams, the red and the yellow sea breams (Tai), and the bream-mullet. The Black Sea bream is distinguished for its high quality meat. Sea bream measuring over 30 cm are classed as large, while those under 30 cm are classed as small. It is used mainly as raw material for the production of cooked products, dried and canned goods.

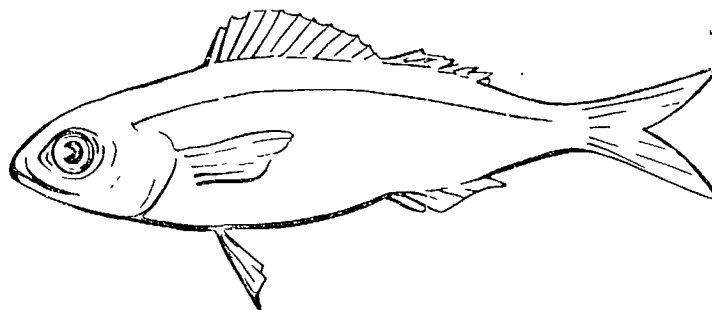


Figure 79. Goldline (box).

Goldline (box). The body is elongated, almost cylindrical. The skin cover is orangey-yellow with a brownish tinge. There are four or five longitudinal golden bands along the sides of the body (from which the fisherman's name of box-goldline) (fig. 79). The teeth consist of incisors (one row on each jawbone). The length normally runs from 12 to 16 cm. The average weight is about 50 gm. The yield of trunk averages 65%. Fat content of the meat is from 3.0 to 6.4%. Protein content is 18-20%. The goldline is excellent when canned in tomato sauce.

Scups. The group of fishes known in world fishery and in the trade as scups is separated from the sea breams within the Sparidae family.

It is also customary to call these fish "scups" in this country. The scups have a very high, compressed body, the head has an enormous steep front, the scale and skin cover is most frequently dark silvery.

The Atlantic scup is described under the specific name of Stenotomus vericolor. The scientific name of this fish testifies to the variety and instability of the tones of its skin and scale covering.

A scup taken in the Western Atlantic on 20 April 1964 had length, weight and weight composition as shown in Table 25.

Table 25

Таблица 25

Длина рыбы, см a	Масса, г b	С. Выход частей тела, %				
		тушка d	голова e	внутренности f	плавники g	чешуя h
24,6—25,6	501—520	56,1—58,4	19,5—21,4	10,8—14,1	2,9—3,8	3,9—4,4
16,9—20,4	157—254	57,8—59,4	20,3—22,3	7,4—8,8	3,3—5,2	4,5—5,4
15,9—16,0	124—127	57,2—61,1	20,4—21,0	7,6—8,8	4,5—4,6	5,0—6,4

a- length of fish, cm; b- weight, gm; c- yield of body parts, %; d- trunk; e- head; f- viscera; g- fins; h- scales.

Table 25 shows that the smaller the fish, the greater the yield of trunk (due to the decrease in the amount of viscera). One characteristic feature should be noted, this is the heavy scale covering (weight of scales is 3.9-6.4% of the weight of the uncut fish).

The weight composition of scup was found to fluctuate within the following limits:

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<u>Body part</u>	<u>% yield</u>
Trunk	56.1-61.1
Head	19.5-22.3
Viscera	7.4-14.1
Fins	2.9- 5.2
Scale	3.9- 6.4

The chemical composition of the meat of this scup(when the length of the fish varied between 18 and 25 cm) was as follows:

<u>Substance</u>	<u>% content</u>
Moisture	<u>70.09-73.44</u> 71.50
Protein	<u>17.50-18.17</u> 17.81
Fat	<u>6.87-10.50</u> 9.16
Ash	<u>1.09- 1.17</u> 1.13

The relationship between length and weight for scup is as follows:

16.9	16.0
156.6	125.5

Length, cm	25.6	25.0	25.0	24.6	20.4	18.7	18.7
Weight, gm	511.9	519.9	509.7	501.3	253.6	202.5	197.3

The results of these experiments showed that the storage period for frozen scup, in blocks kept at a temperature of -20°C (at sea) for one month and then at a temperature of -12°C (on shore), should not exceed a total of 5 months. During the sixth month of storage fairly significant changes in the contained fat were detected along with other signs of loss of quality. During the seventh month of storage the quality of the scup had sharply deteriorated¹.

According to data provided by Sevryba, the mean chemical composition of raw scup meat taken during January and March was as follows:

1
Aleksandrovskiy V.P., Andrusenko P.I., Baranov V.V.,
Rodin E.M., Yunosova S.Yu. Technochemical characteristics of
Atlantic scup and its utilization. "Rybnoe Khozyaystvo",
1965, No. 8, pp. 55-57.

<u>Substance</u>	<u>% content</u>
Moisture	69.1-69.6
Protein	17.1-19.2
Fat	9.1- 9.3
Ash	1.0- 1.1

The special nutritional value of scup is due to the high fat content in the meat.

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Scup from Delaware Bay, taken during October and November, contained up to 12.8% fat in the meat.

There is reason to suggest that dried scup will become a delicacy.

According to data provided by Yu. A. Korzhova, another species of scup, the Calanus bajohado, from the Carribean (Cuban fishery), with average weight of 287 gm, had the following weight composition:

<u>Body part</u>	<u>% yield</u>
Meat and skin	49.2
Head	31.0
Bones	9.6
Scale	2.8
Fins	2.0
Viscera	5.8

The fat content of the meat is only 1%, while that of protein is 22.9%.

There is a fish among the sparids which is known under the name of Chopa or Lagodon (in Cuban Chopa espina), for which the scientific name is Lagodon rhomoides (Linne).

The average weight of the trunk of this little fish in the catch normally is between 60 and 100 gm.

The composition by weight of the body parts is as follows:

<u>Body part</u>	<u>% yield</u>
Meat and skin	45
Head	27
Viscera	5

The mean chemical composition of Chopa meat, according to data provided by Yu. A. Korzhova, are given below:

<u>Substance</u>	<u>% content</u>
Moisture	74.9
Protein	19.3
Fat	4.1
Ash	1.4

The name Chopa is also applied to two other species:

the yellow chopra (amarilia) and white chopra (blanca).

Organization of frozen fillet production from the larger sparid fishes is advisable.

FAMILY SCORPAENIDAE

Fish of the Scorpaenidae family are called ocean perch (redfish) in both fishery and trade. The shape of the body is very similar to the freshwater perch, but the heads on almost all the commercial fishes of this family are very large and bulky. The dorsal fin has a ctenoid section. The skin and scale covering is red (with rare exceptions). Scorpaenid fishes are viviparous.

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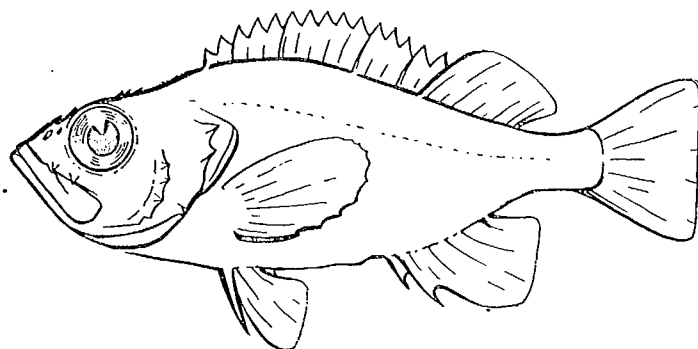


Figure 80. Golden redfish (Atlantic).

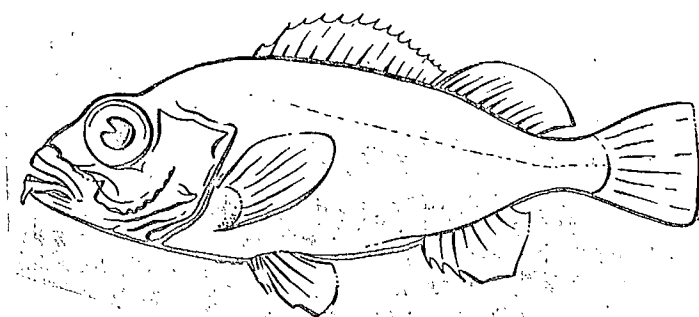


Figure 81. Deepwater redfish (Atlantic).

Common or golden redfish. (Figure 80). This fish is normally found at depths of 150-300 m, in some regions of the Atlantic it goes down to 800 and 1,000 metres during the winter. The catches contain specimens measuring 25-65 cm and weighing 0.2-3.5 kgm. The fish lives up to 60 years (the 8 to 30-year age group predominates in the catch).

Deepwater redfish (fig. 81). It inhabits only the North Atlantic. Normally, it accumulates at depths over 300 m. Landed specimens measure from 24 to 48 cm. The world catch of common and deepwater redfish from 1955 to 1961 fluctuated between 306 and 564 thousand tons.

During recent years the world catch of scorpaenid fishes, in spite of the strain placed on the reserves in old traditional fisheries, continued to grow from year to year.

For example, the catch in 1962 _____
 was 412, in 1963, 513 and in 1964 it was 774 thous. tons.

Over 80 species of Pacific Ocean redfish (genus Sebastes) are known. The Pacific Ocean redfish Sebastes alutus is the main object of redfish fishery in that ocean. This fish reaches a length of _____ 60 m, but the average landed length in the Bering Sea is 30-38 cm, while in the Gulf of Alaska it is 28-35 cm.

Small amounts of the giant-redfish (S. introniger), ^{/164}
 the S. poljspinis and S. alascanus etc. are taken along with the Pacific Ocean redfish.

The weight of the Pacific redfish is most often between 0.2 and 1.2 kgm. The average weight, depending on the fishery, is from 400 to 800 gm.

The yield of individual body parts, taken in the Gulf of Alaska, is given below:

<u>Body part</u>	<u>Average yield %</u>
Meat and skin	48-50
Head	32-35
Spinal column and fins	12.6-13.1
Viscera	3.6- 5.1
Liver of a large fish included	2.7
Liver of a small fish included	1.7

During the first quarter of the year the yield of meat and skin is 43-48%, while in the fourth quarter it is 46-53%. The giant-redfish caught in recent years has fluctuated between 1 and 12 kgm, but instances are known where S. introniger caught weighed up to 85 kgm.

The meat of the giant-redfish is the leanest in comparison with meat of other redfish (0.4-2.1% fat).

The chemical composition of raw meat of the Pacific redfish, according to data provided by I.V. Kizevetter and other scientists, is as follows:

<u>Substance</u>	<u>% content</u>
Moisture	73.1-80.9
Fat	1.5-10.6
Protein	16.8-19.7
Ash	1.2- 3.1

The fat content (in %) of the meat of Pacific redfish of various weights and during various seasons, according to data provided by I.V. Kizevetter, is given in Table 26:

Table 26

Season	% fat content in fish weighing, in kgm		
January-February	0.2-0.5	0.51-0.8	0.81-1.2
March-April	3.8-4.5	2.6-4.5	no data
June-August	3.0-10.6	2.7-5.6	1.5-3.0
September	4.8	4.5-7.0	4.4-5.5
	no data	4.1-6.1	2.1-4.0

G.A. Dolbish and I.V. Kizevetter (TINRO) determined /165 the following fluctuations in the relative weight of liver taken from Bering Sea redfish on the basis of investigation of many specimens (in % of weight of fish):

<u>Redfish</u>	<u>Weight of liver, gm</u>
S. alutus	0.6-4.0
S. introniger	1.6-3.5
S. poljspinis	1.2-2.3
S. alascanus	1.4-5.3

The amount of oil in the liver of Bering Sea redfish varies between 6 and 57%, the amount of vitamin A in 1 kgm of liver varies from 440 to 126,390 i.u., and 1 gm of liver oil contains between 3880 and 1,522,830 i.u.. The liver of the Bering Sea redfish is very rich in vitamin A. Redfish fishery was organized by the Soviet fishing fleet in the Bering Sea in 1959, and since 1961 in the Gulf of Alaska.

Characteristically, in 1961 the world catch of redfish was 93.3% fish taken in the Atlantic and Arctic Oceans, and only 6.7% consisted of fish caught in the Pacific Ocean.

Whereas in 1958-59 redfish was caught almost exclusively in the Atlantic, now it is caught mainly in the Pacific Ocean, and, in connection with this, large reserves have recently been discovered in entirely new regions.

According to data provided by N.I. Sukrutova (AtlantNIRO), the redfish caught in the vicinity of Newfoundland Bank had the following ratio between length and weight of the whole fish:

Length, cm	25	29	35	40	45	48	53
Weight, kgm	0.42	0.60	1.07	1.94	2.10	2.24	3.00

The average landed length of this redfish was 33 cm, and the average weight was 960 gm; the yield of fillet was from 47 to 56%. The weight of the head of large redfish varied from 17 to 25%, while that of small redfish varied from 20 to 31% of the whole fish.

The weight ratio of parts of the body of redfish caught in 1958-59 in the vicinity of Newfoundland Bank

is shown in Table 27 (data by Leonova and Pechatina).

According to materials provided by the same researchers, the amount of fat in the meat varied from 3.3 to 8.1% for large redfish and from 1.9 to 10% for small fish.

A precise relationship between the period of catch and the fat content of the meat of redfish was not established in that work. However, if the period from the middle of July through to the end of October is considered to be the period of lowest average fat content, when, for large redfish, the content was 3.3-3.4% and, for small redfish, it was 1.9-4.2%, then, in contrast, in February the average fat content for small redfish varied from 8.9% (25 February) to 10.0% (9 February). The meat of large redfish contained respectively 5.7 and 8.1% fat during that season, while the protein content in the meat throughout the year varied from 17.2 to 19.7% for large fish and from 15.6 to 19.8% for small fish.

Table 27

Body part	Yield in % of weight of whole fish during	
	Dec-Apr	June-Aug
Meat and skin, without scales	52.2-56.0	47.6-50.9
Head	17.4-21.5	25.8-31.9
Viscera without sexual products	7.0-12.2	6.0- 8.1
Sexual products	7.2	0.7- 3.1
Bones and fins	11.1-14.8	10.7-11.5
Scales	0.4- 1.5	1.1- 1.9

Redfish is divided into large and small in the standard and in the price list. The least commercial length is also regulated.

The chemical composition of raw meat from Atlantic species of redfish from various fishing grounds, according to long range observations, are characterized by the following data:

<u>Substance</u>	<u>% content</u>
Moisture	<u>71.3-79.6</u> 74.9
Protein	<u>15.6-19.8</u> 17.8
Fat	<u>1.9-10.0</u> 5.9
Ash	1.4

The tissue fat in redfish is light straw-coloured with a pinkish tinge.

The heads contain 63.0-71.5% moisture, from 8.0 to 13.8% fat and 12.4-17.2% protein. Thus, the caloricity of the heads of redfish is, on the average, considerably higher than the caloricity of the meat proper.

The heads and spinal columns of redfish are high-quality raw material for soup stock. Soups made from the heads and bones of redfish are exceptionally rich, tasty and aromatic.

The viscera of redfish contain from 16 to 40% fat.

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After cutting, the Far East redfish yields the following amounts of body parts:

<u>Body part</u>	<u>Yield in %</u>
Meat	40-58
Head	24-38
Bones	10-13
Liver	1.5-4.1

The harvest of redfish in the USSR for various years is given below:

Year	1957	1958	1959	1960	1963	1964	1965	1966
Harvest, thous. of tons .	112.1	174.1	243.5	183.9	184.1	364.4	480.1	309.6

There is cause to place the redfish alongside the best marine fishes taken in largescale fishery, the more so because the fish is not very small. It would be advisable to utilize this fish for cooked products, cold and hot-smoking and, in the future, for drying.

Frozen redfish is excellent as a fillet, gutted and beheaded, and gutted with the head on.

Redfishes yield particularly attractive, aromatic and tasty meat of pleasing consistency, and distinctive rich and aromatic soup stocks. These properties are not unique to the meat alone, but are even more pronounced in the head and bones, which are excellent material for the stated purpose. It is not profitable to process the redfish heads for fish meal.

In comparison with other fishes, the redfish is very unstable in storage and during shipment (particularly in the round).

FAMILY ANOPILOPOMIDAE

Coalfish. Of the two species of fish in this family the one which is of interest is the coalfish (on the international market it is called the Sablefish)¹.

It is distributed throughout the northeastern part of the Pacific Ocean, and is taken as an admixture in the catch during trawling at great depths in the Bering Sea and the Gulf of Alaska.

This fish has rather unusual properties.

The shape of the body of the sablefish suggests the cod, but the head is smaller; the skin and scale cover is a very dark colour, the back is almost black (hence the name - coalfish). There are two dorsal fins, and these are widely separated. The mouth is large and angles downward slightly. The peritoneum is black and easily removed. The scales come off easily (and if they are not removed then they almost completely dissolve into the broth during ordinary cooking). The meat is a very attractive white colour.

¹ It is permissible to take sablefish over 30 cm in length.
The other species is the Skilfish.

In the specimens studied by DD Bakzevich (Institute of National Economy named after G.V. Plekhanova), the yield of trunk was 65.5-72.1%, and the chemical composition of a stuffing made from raw trunks was as follows:

<u>Substance</u>	<u>% content</u>
Water	74.0-83.9
Protein	12.8-17.2
Fat	2.0- 8.4

DD Bakzevich particularly noted that the meat was very crumbly when defrosted under running water and that this shortcoming was not present when the meat was defrosted in the atmosphere (atmospheric temperature 2⁰ C).

This feature of frozen coalfish meat was checked by us in 1965 at the VNIRO Standards Laboratory. Both after defrosting in the atmosphere at room temperature and after defrosting under a stream of cold tap water the consistency of the coalfish was excellent before and after heat processing.

According to TINRO data (Rublevskaya), the yield of meat with skin for coalfish was between 58 and 65%, and that of liver 1.2-2.0%. Landed weight was from 0.5 to 3.0 kgm,

and the length from 36 to 66 cm.

The amount of moisture in the raw meat varied between 62 and 81%, while that of protein from 7 to 15%. Small fish normally contains 5 to 12% fat, while large fish contains 14 to 24%, and the oil content of the liver was, respectively, 10-16 to 20-35%.

According to the most recent complete data, provided by I.V. Kizevetter and others (TINRO), for fish weighing from 780 to 5950 gm (on the basis of 42 determinations) the yield of individual parts of the body (in % of total weight) was as follows:

<u>Body part</u>	<u>Yield in %</u>
Meat and skin	59.1
Head	20.2
Spinal column and fins	8.1
Viscera	12.8
Liver included.	1.7
Sexual products	3.1

The chemical composition of coalfish meat weighing from 1 to 5 kgm was determined by TINRO and the following results were obtained:

<u>Substance</u>	<u>% content</u>
Moisture	$\frac{62.8-81.9}{72.6}$
Fat	$\frac{4.9-24.2}{14.0}$
Protein	$\frac{10.8-16.2}{12.2}$
Ash	$\frac{0.8-2.6}{1.2}$

A few specimens of coalfish weighing 950-967 gm caught at the end of February and frozen in the round where investigated at the VNIRO Standards Laboratory (Borisochkina), and were found to have the following mean chemical composition of the meat:

<u>Substance</u>	<u>% content</u>
Moisture	81.0
Protein	13.9
Fat	3.9

Data provided by all authors indicate that the protein in coalfish meat deteriorates in comparison with the majority of other ocean fishes, and is unusually large for such high fat content and water content of the meat. The fat content in coalfish meat increases significantly with its age.

The relationship between the size of the fish, fishing season and fat content of the meat, according to I.V. Kizevetter and others, is shown in Table 28:

Table 28

Season	% fat content in specimens weighing, in kgm			
February-March	0,8-1,2	1,6-2,2	2,5-2,9	3,2-3,5
June-July	5,0-7,2 8,4	no data 11,2	15,5-16,8 no data	no data no data
August-September	4,9-11,5 12,2	12,5-17,5 no data	11,2-21,4	14,2-18,6 23,4
October-December				

According to TINRO, raw coalfish meat is noted for its instability during storage. At a mean temperature of 11°C, a small layer of fish (0.35 m) became second rate a little after a day, and after 1.5-2.0 days it was unsuitable for food.

Some specialists compare dried coalfish with whitefish fillet in gastronomic qualities, although they do acknowledge the presence of specific aromatic-gustatory features of coalfish. According to our own evaluation, the similarity between coalfish meat and whitefish from the

gastronomic point of view is very small, even though fillet from large coalfish taken in a sufficiently fattened state are actually excellent. This fish can be stored frozen for long periods, unglazed samples have kept for 2 months at temperatures down to -18°C (iodine number of the fat 85-100).

Coalfish is an excellent raw material for the manufacture of balyk (cold-smoked and dried).

Broth obtained when coalfish is boiled is not sufficiently strong (lacks body), and lacks aroma and taste. The meat of this fish is delicious when prepared by frying or over steam and also when cooked in water.

TINRO recommends that frozen coalfish be used for cooking, balyk manufacture and hot-smoking. We would permit salting only in cases when the semi-product is being processed further by the cold-smoking method. The canned products made from coalfish meat are characterized by very high gastronomic data. Coalfish meat can be used in the manufacture of balyks only when there is sufficiently high fat content (not under 6-8%), and the weight of the uncut raw material is over 2 kgm.

The national catch of coalfish was 420 tons in 1964, 670 tons in 1965 and 3,870 tons in 1966. The reserves are not

being fully utilized. This fish is so valuable that the Japanese have organized a special fishery for coalfish. The USA catch is 6,000 tons.

LINGCOD FAMILY

The fish in this family inhabit the northern part of the Pacific Ocean (along the Asian and American coasts and the Bering, Okhotsk and Japan Seas). Thirteen species of lingcod are known. The Atka mackerel is the most important in fishery (fig. 82), it is also called the Bering Sea or Kamchatka lingcod.

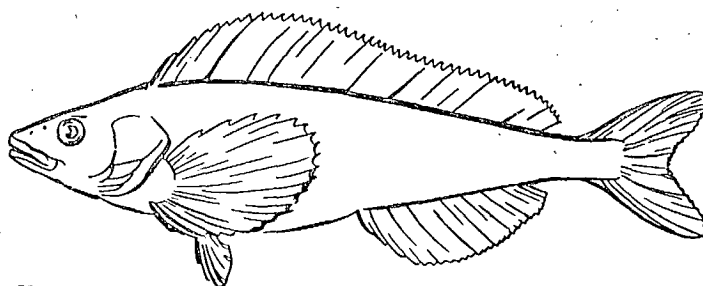


Figure 82. Atka mackerel or Bering Sea lingcod.

The length of this lingcod landed is 25-36 cm, and its weight is 195-560 gm, but sometimes it is considerably greater. The weight of the head is 19-22%, meat and skin comprise 56-59%, and without skin the meat comprises 47-49% (of the total weight of the fish).

The mean chemical composition of the meat is as follows:

<u>Substance</u>	<u>% content</u>
Moisture	76.7
Fat	4.6
Protein	16.4
Ash	2.0

In the Japan Sea and in the southern part of the Sea of Okhotsk (Soviet Maritime Province, Southern Sakhalin and Southern Kurile Islands), a species known as southern Atka mackerel, or southern one-fin lingcod, or Asiatic greenling is found. It measures up to 50 cm and weighs up to 1.5-1.8 kgm. The meat is of excellent quality (fat content 4-10%).

An even better quality lingcod is known, the "toothy" lingcod (measuring 58-100 cm and over); its commercial-nutritional properties are in no way inferior to halibut or salmon.

The ten-line American lingcod, or Alaska greenling, is found from Alaska to California, and specimens measuring 45-50 cm have high nutritional properties.

Japan had about 99% of the world catch of lingcod. In our country the possibilities for lingcod fishery are clearly underdeveloped.

FAMILY ZEIDAE

The John Dory (Zeus faber) body is very much flattened laterally. The back is dark-violet. The dorsal fin is high with spiny rays. There is one, distinct, round black spot on either side of the body (fig. 83). The John

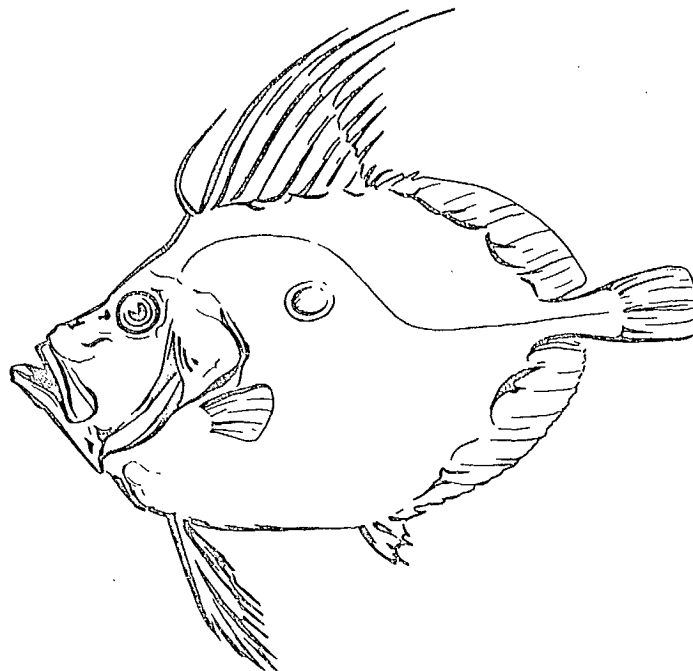


Figure 83. John dory.

Dory reaches a length of 50 cm and weighs up to 3 kgm.

The average length of this fish in the catch is about 30 cm

and weighs around 1.5 kgm. The minimum permissible length is 17 cm. The yield of carcass is 58-63%, head 22-23%. The average yield of fillet is 47%. The meat contains from 0.3 to 1.4% fat and about 20.0% protein. The fish is taken mainly along the coast of Northwest Africa. The John Dory is also found in the East China Sea.

The John Dory is frozen whole. When cooked or fried the meat is very pleasant (white, tender, succulent, exceptionally tasty and aromatic), and is rather suggestive of pickerel. The canned meat resembles chicken.

The John Dory occurs as an admixture in the catch and is found mainly along the African coasts.

FAMILY LUTJANIDAE

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Of the lutjanid fishes, the pargo is of great importance in Cuban-Soviet fishery. This beautiful, deep-red coloured fish most frequently measures 70-75 cm in length and weighs 7-10 kgm (fig. 84). The weight of its head averages 31.5%, and meat and skin about 45%. The average chemical composition of May-caught pargo, according to data provided by Yu.A. Korzhova, is as follows:

<u>Substance</u>	<u>% content</u>
Water	76.8
Protein	20.2
Fat	1.7
Ash	1.3

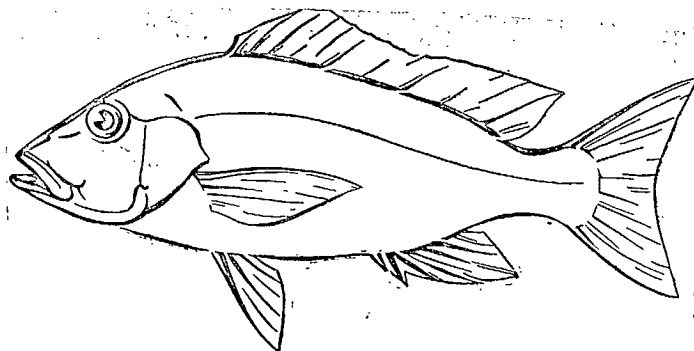


Figure 84. Pargo.

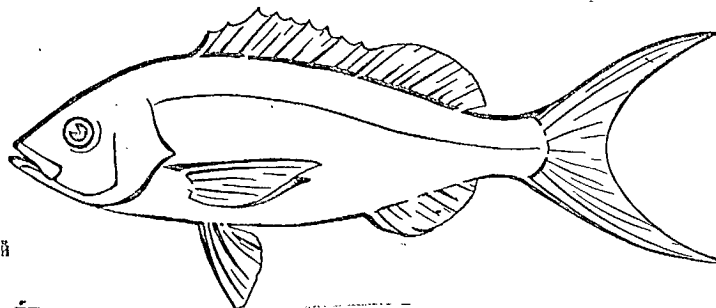


Figure 85. Yellow-tailed Snapper (rabirubia).

Small specimens (or forms) of the pargo are called pargetta in Cuba. Besides the pargo, another fish, called the pargo-colorado (red snapper) is also taken.

Several species of lutjanid fishes are widely known in the Caribbean Sea and the Gulf of Mexico; these include: yellow-tailed snapper (or the Cuban rabirubia) (fig. 85), grey snapper (caballero in Cuban), the snapper-cottoro, snapper-rubero, and the Cuban snapper, as well as the cubera. The snapper is the main fish in these waters. They make up 40-45% of Cuban fishery.

The rabirubia (yellow-tailed snapper) is an exceptionally beautifully-coloured fish: the back is pink with a violet tinge and bright yellow spots; the belly is pale pink. A broad, bright yellow band runs down the lateral line. The caudal fin has a very deep ellipsoidal notch and is also bright-yellow in colour. In addition, yellow, red, spotted, red-tailed and yellow-ide snappers are known.

Yu. A. Korzhova has established that the weight of the head of the snapper comprises 31-34%; and ^{that} the yield of meat is 49-50% of the weight of the whole fish. The mean

chemical composition of the meat of yellow-tail snapper taken during March was, according to Korzhova, as follows:

<u>Substance</u>	<u>% content</u>
Water	78.3
Protein	18.4
Fat	2.0
Ash	1.3

The length of snappers taken in Cuba lies mainly between 21 and 28 cm with weight of 250-400 gm.

The length of cubera landed is 24-39 cm, weight 0.4-1.3 kgm; the yield of trunk is 60.5, of meat 48.0%; the weight of the head is 27%. The meat is white, succulent, tasty, and contains about 1% fat.

ORDER HETEROSOMATA

This order consists of three main families of commercial fishes: the Bothidae, Pleuronectidae and Soleidae. In the commercial and trade sense the Heterosomata are divided, in this country, into two large groups:

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- a) the flounders (which include the fish in all the families enumerated);
- b) flatfishes, which are part of the families Bothidae and Pleuronectidae.

All these fishes have an asymmetrical body, both eyes on the same side, and one side of the body is normally entirely or almost entirely without pigmentation. The body is greatly compressed from the sides, it is leaf-shaped, ovate or rhombic in form. The eyed side has relatively dark colour, while the blind side is relatively light. Flounders are mainly marine fishes, although there are unique diadromous species (going from freshened and fresh-water to spawn in the sea). Examples are the fluke and the starry flounder.

FAMILY BOTHIDAE

The fish in this family are distinguished from other flounders by the pronounced asymmetry of the ventral fins and the position of the eyes on the left side of the body.

Thirty-eight genera of this fish are known and there are numerous species that are of commercial importance. These fish are found in the seas of the tropical and temperate zones.

The world turbot harvest varies between 50 and 55 thousand tons annually. The USA takes 21-23 thousand tons, Japan 6-11 thousand tons and Great Britain 4-6 thousand tons of this fish.

The species R. maximus is taken along the European coast from Scandinavia to the Mediterranean and Black Seas. It normally achieves a length of 40 cm, and in some cases up to 1 m and weight of 10 kgm.

The Black Sea brill (fig. 86) is found along the Black Sea coast. It reaches a length of 80-100 cm and weighs 10-15 kgm. The fish predominating in the catch measure 50-85 cm and weigh 2-7 kgm. The brill is a delicious fish, but its processing is complicated by the presence of scuta on the dark side of the body.

The average yield of meat from the brill is about 53.5%.

The other brill species are of less interest to us.

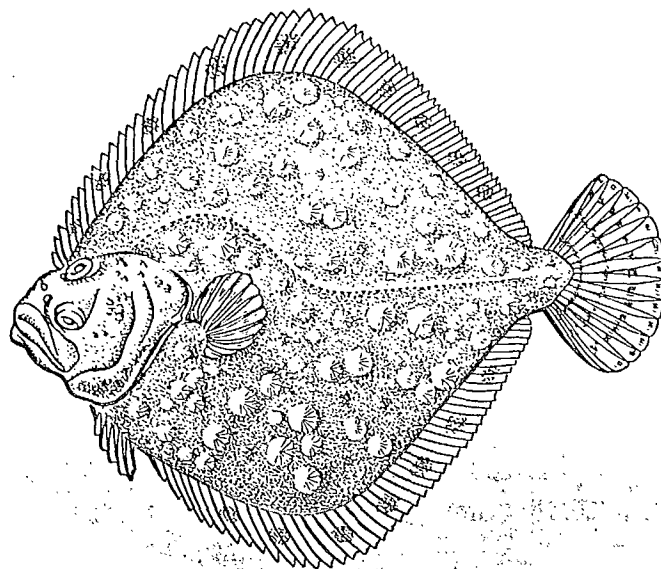


Figure 86. Brill. (Black Sea Turbot)

FAMILY PLEURONECTIDAE

The ventral fins on the fish of this family are symmetrical, and the eyes are on the right side of the head. The family consists of 44 genera and very many species. The commercially important genera are: arrow-toothed halibut, Greenland halibut, true halibut, flathead sole, arctic flounder, starry flounder (fig. 87), common flounder and dab (limanda). The flounders are found in almost all of the oceans. Many of them are the target of intense fishery.

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The market is supplied mainly with frozen Far East flounder. Arctic Ocean flounder is excellent.

Flatfishes. Market prospects for the arrow-toothed halibut from the Sea of Okhotsk and Bering Sea are good. The length of fish taken is usually 30-75 cm, and the weight 1-3 kgm. The catch of arrow-toothed halibut is not recorded separately. This fish frequently has structureless or watery, insufficiently firm meat.

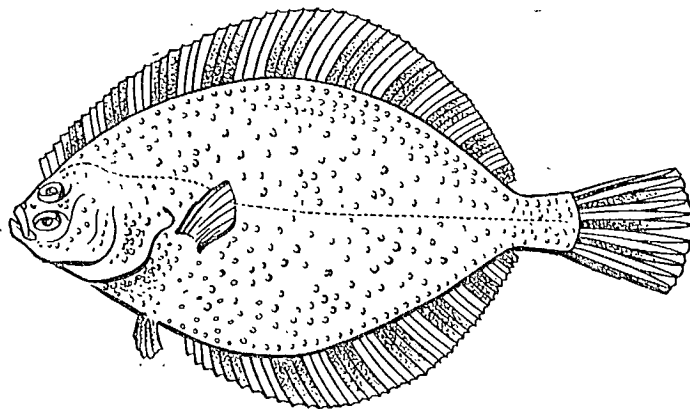


Figure 87. Starry flounder.

The arrow-toothed halibut in the salted state normally does not sustain soaking and converts to a structureless mass. It is necessary to basically improve the technology for processing arrow-toothed halibut, a high quality, fat and tasty fish for food purposes.

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The Greenland halibut is distributed throughout the northern part of the Atlantic and Pacific Oceans. There is a

species in the Bering and Okhotsk Seas which is close to the Greenland halibut.

The maximum length of Greenland halibut is 120 cm and weight 44.5 kgm. The usual length taken in the Bering Sea is 55-65 cm, and the weight 2-4 kgm. The average length taken in the Sea of Okhotsk is 57.5, and in the Bering Sea - 54.3 cm. In most countries the catch of Greenland halibut is not recorded separately. The meat of this halibut is of high quality. The traditional objections to the use of fresh (unsalted) meat of Greenland halibut is not justified. It can be used as food, like any other very fat product, in moderate amounts, with proper cooking and with plenty of bread and vegetables.

According to data provided by PINRO (R. Minder and Khobotilova), the Greenland halibut has the following characteristics (the numerator gives the limits of weight, length or yield; the denominator the mean weight, length or yield):

Weight of whole fish, gm	<u>743-3869</u> 2302
Absolute length, cm	<u>53-71.5</u> 60.6
Yield, %	
trunk	<u>67.1-80.2</u> 75.1

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meat	<u>56.1-70.9</u> 64.5
skin	<u>2.1- 2.9</u> 2.5
bones	<u>4.1- 7.3</u> 5.6
head	<u>12.1-15.0</u> 13.7
fins	<u>1.2- 2.3</u> 1.7
viscera, complete	<u>6.3-21.2</u> 10.1
included liver	<u>0.9- 3.3</u> 1.9

The Greenland halibut is a very valuable, fat and /177 tasty fish, even though the protein content is rather low (fat content 13-21%, protein content 12-13%).

The true halibut inhabits the northern part of the Atlantic and Pacific Oceans. It achieves a length of 5 m and weighs up to 300 kgm. The catch consists mainly of specimens measuring 40-85 cm and weighing up to 8 kgm.

The meat of the true halibut is distinguished for its high food qualities (colour, pleasant tender consistency, excellent taste and fine aroma). However, the soup made from this fish is thin and not particularly tasty.

Preserves in natural liquor made from ~~blanched~~ meat poured over with oil can be quite good. However, preserves made from fried meat with any kind of sauce, and also using smoked

meat in oil, results in a low quality product (TINRO experiments). The true halibut, like the Greenland halibut, is excellent in hot and cold-smoked products and in the dried form.

The amount of fat in the meat and heads of Pacific Ocean halibut is shown in Table 29:

Table 29

Halibut	Fat content %	
	Meat	Heads
Greenland	13	22
Arrow-toothed (American and Asiatic)	14	22
True	3.5	12

Yield of fillet is between 60 and 65%; weight of heads is between 15 and 20%.

The length and weight of halibut taken in our Bering Sea fishery fluctuates within the limits given in Table 30:

Table 30

Halibut	length, cm	weight kgm
Greenland	39-85	0.5-10.0
Arrow-toothed (American and Asiatic) . .	35-65	0.5-4.7
True	52-126	2.0-60.0

The weight ratios of parts of the body of the Bering Sea halibut, according to data provided by G.A. Dolbish and I.V. Kizevetter (TINRO), are given in Table 31:

Table 31

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Таблица 31

Halibut	Месяцы лова	Длина, см	Масса, г	(a) Выход в % к массе рыбы					
				(b) мяса	(c) головы	(d) позвонков и плавников	(e) внутренне-стей	(f) печени	(g) половых продуктов
Arrow-toothed Asiatic	III, VII, VIII	35,5—65,0	630—4650	51,9—65,9	17,6—22,2	6,0—13,5	7,9—18,7	1,2—1,9	0,7—0,8 (March)
Arrow-toothed American	III, IV, VII, VIII, VIII	37,7—61,5	530—3600	59,0—67,6	17,7—20,0	6,9—13,2	6,3—10,1	0,9—2,5	0,5 (March)
Greenland	I, II, IX, X	57,3—68,0 51,0—103,0	2170—4650 1900—23560	59,7—60,0 61,0—67,7	17,8—20,7 11,5—17,8	10,5—12,2 7,6—16,3	5,7—9,0 4,4—13,6	1,5—2,6 0,9—2,6	no data 0,3—0,6 (Jan-Feb)
True									

Legend: a- yield in % of weight of fish;
 b- month of catch;
 c- length, cm;
 d- meat, gm;
 e- meat;
 f- head;
 g- vertebrae and fins;
 h- viscera;
 i- liver;
 j- sexual products.

Of the halibuts, the true halibut is the largest and yields the greatest amount of sufficiently firm meat of comparatively low fat content. It is an excellent raw material for the manufacture of frozen fillets; however, we have not fully exploited the possibilities for increasing this fishery.

According to the same sources, the meat from the arrow-toothed Asiatic halibut is comparatively low in protein (12.9-17.5%), and it contains a significant amount of moisture (65.0-76.0%). The fat content of the meat varies between 0.5 and 21.3%. This halibut contains the greatest amount of fat during September (29.7-21.3% fat content). The American arrow-toothed halibut has even more watery meat (67.8-81.3% moisture), with slightly higher protein content (13.2-16.5%), and greatest fattiness (15.6-18.1%) from the third week of July through to the first week of August. Whereas for the Asiatic halibut the fat content did not drop below 6.5%, in the American halibut it dropped to 1.0 (11 August in a fish weighing 530 gm).

The size of the halibut has a very strong influence on the amount of fat in the meat; as a rule, the larger specimens are fatter than the smaller ones during the same period.

The smallest American arrow-tooth halibut are leanest during the period from April through September, inclusive.

Raw American arrow-tooth halibut is extremely unstable in storage. At an average temperature of 12°C and depths of thickness of fish measuring 0.35 m, the quality of the halibut had deteriorated to second grade after 11-18 hours of storage, and after 1.5 days it had become unsuitable as food.

Both raw and frozen arrow-tooth halibut meat frequently displays a structureless quality. TINRO recommends that this halibut be frozen only, and at points of consumption it should be fried in oil at a temperature over 160-170 °C after being dipped in batter. Salted meat of this halibut which has been stored for a long time in brine frequently separates from the skin and skeleton as a fibrous mass, and the process is accompanied by separation and floatation of free fat on the surface of the brine. The brine becomes very clouded by suspension formed from muscle fibre (TINRO data). /179

Meat of the Greenland halibut from the Bering Sea, from specimens measuring 57-85 cm and weighing 2170-9660 gm, was characterized by high fat content. From the end of March through to the middle of September, the fat content varied between 9.9 and 17.1% (in fish of the 15th September catch it was 6.5%). Nevertheless, the protein content of this halibut was exceptionally low (5.4-12.7%), while the water content is very high (67.8-84.0%). The chemical composition of meat of Greenland halibut taken from the Bering Sea 30 August (length 85 cm, weight 7.4 kgm) is very typical and is given below:

<u>Substance</u>	<u>% content</u>
Moisture	84.0
Fat	10.4
Protein	5.4
Ash	1.2

In spite of this chemical composition, the meat of the Greenland halibut retains its structure.

The greatest fat content is observed in the Greenland halibut during the period from June through August, with a significant reduction during September.

The meat of the true halibut taken in the Bering Sea is distinguished for its high moisture content (73-81%), by having the highest protein content (15-21%) in comparison with other halibut, and the low or comparatively moderate amount of fat (1-10%).

The weight of the true halibut taken from the Bering Sea normally fluctuates between 4 and 60 kgm (average 7.5-9.0 kgm).

During the first quarter of the year, the fat content in true halibut meat normally does not exceed 3%. From the end of June through to the first week of August inclusively, this fish was found to have its highest fat content (from 4.5 to 9.8%).

I.V. Kizevetter and others (TINRO) make special mention of the pleasant odour and taste of halibut tissue fat. This fat is straw yellow in colour.

Soup made from Bering Sea halibut is thin and not aromatic (TINRO).

G.A. Dolbish and I.V. Kizevetter determined the relative weight of Bering Sea halibut liver on the basis of numerous specimens. The results are given below:

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<u>Halibut liver</u>	<u>Weight in % of weight of fish</u>
True	0.9-3.3
Greenland	0.8-3.3
Asiatic (arrow-toothed)	1.1-4.0
American (arrow-toothed)	1.1-3.0

Significant differences in the amount of oil contained in the liver of Bering Sea halibut ~~were~~ not established according to species, but intraspecies fluctuations ranging from 7.4 to 61.1% do occur. During March and April the liver of these halibut contains less oil than from June to August.

The American arrow-tooth halibut contains less vitamin A than do the others (1 kgm of liver contains 1200-4,750 i.u., whereas 1 gm of liver oil contains from 3300 to 15,460 i.u.). For other halibut, the vitamin A content in the liver changes little with the species of halibut (1 gm of liver contains 640-33,910 i.u., whereas 1 gm of liver oil contains from 2,570 to 131,100 i.u.).

The liver of the main species of Bering Sea halibut is very rich in vitamin A.

True flounders. The American plaice (Hippoglossoides platessoides limandoides Bloch) is found in the northern part of the Atlantic Ocean. It is caught mainly at depths down to 500 m at temperatures above and below 0°C (to -1°C). Commercial quantities are normally not found at a temperature lower than -0.5°C . The maximum length of this fish found in the Barents Sea is 51.5 cm, with weight up to 1.5 kgm (fig. 88). In the national fishery the specimens are usually 20-45 cm long.

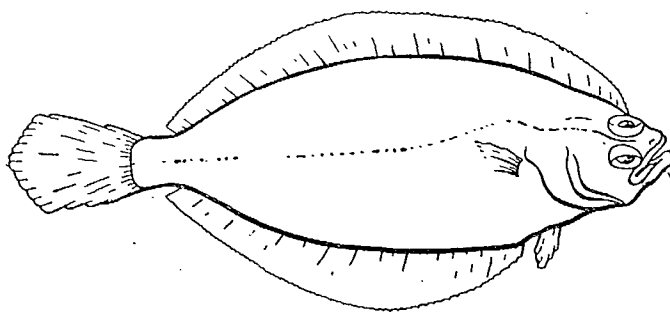


Figure 88. American plaice.

Flathead flounder. This fish inhabits the Bering and Okhotsk Seas. Specimens measuring 32-38 cm and weighing 450-550 gm predominate in the catch. Separate statistics of the catch are not kept.

Sohachi flounder. This fish is found in the Sea of Japan. The usual length is 25-29 cm and average weight is

280 gm. It is of some importance in the national fishery. The meat is of comparatively low quality.

Dab (Limanda). It is distributed throughout the northern part of the Atlantic Ocean, the Barents and White Seas. It reaches a length of 40 cm and weighs up to 720 gm. The usual commercial length is 20-30 cm and weight is 150-300 gm. This fish is taken from the Barents and White Seas (in small quantities).

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Yellowfin sole. This fish is distributed along the western and eastern coasts of the Pacific Ocean, and in the Bering and Okhotsk Seas. It is also found in the Sea of Japan. It reaches a length of 46-48 cm. The average length in Bering Sea catch is 32-33 cm with an average weight of 350-360 gm (fig. 89).

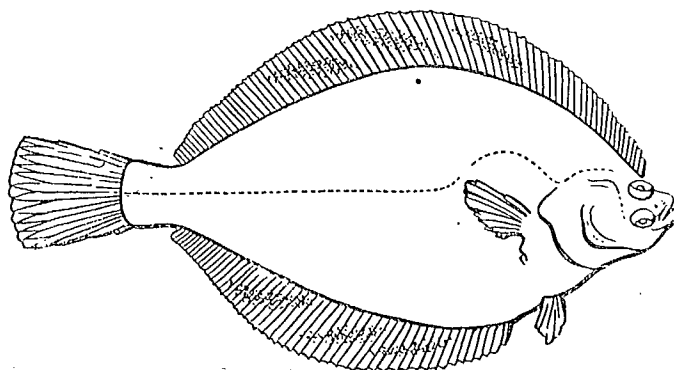


Figure 89. Yellowfin sole.

National fishery for yellowfin sole has been organized in the southeastern part of the Bering Sea since 1961.

This is the main commercial species of Far East flounder. About 80% of the national catch of Far East flounder during recent years consisted of yellowfin sole. This fish, taken from the Bering Sea, weighs 200-300 gm when caught during February and March; the yield of meat with skin varies between 52.8 and 56.8%. The weight of head is 15.3-17.1%, that of vertebrae and fins (together) is 14.5-23.3%, viscera weighs 6.7-13.4%, of which the liver is 1.1-1.7%, and sexual products (gonads) comprise 1.3-4.6%.

According to TINRO data, the meat of Bering Sea yellowfin sole, Alaka plaice, rock sole and flathead sole has a moisture content of from 76.6 to 83.7% and fat content from 0.9 to 4.0%, depending on the species, season and size of the fish.

Most of the commercially important Far East flounders are fairly stable in storage. The yellowfin sole is particularly suitable for storage. At an average temperature of 3°C and a layer of fish 0.3 m in depth, raw sole kept for 4-6 days corresponds to second grade fish (TINRO data). Yellowfin sole

becomes unsuitable for food purposes after ten days storage under these conditions.

Other flounders of commercial importance in the national Far East fishery are: the long-snout flounder (in spring it comprises 15-25% of the total catch taken by small boats), yellow-striped flounder (in the Zaliv Petra Velikogo (Vladivostock) it comprises 30% of the total flounder catch), Japanese flounder, which sometimes comprises 90% of the total catch taken by small coastal boats in April, Alaska plaice (the reserves have been considerably depleted by fishery), as well as the so-called fluke (coastal marine fish) in the Baltic, Barents and White Seas.

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The Far East flounder fishery also includes the slime flounder and the Nadezhda flounder (this may refer to a localized geographic form - translator). Because of the poor consistency of the meat, the commercial-nutritional properties of these flounders are normally low.

Plaice. This fish is found in the northern part of the Atlantic Ocean, Arctic Ocean, and the Baltic, Barents and White Seas. It occasionally achieves a length of

1 m, but the size of specimens predominating in the catch is 30-40 cm with weight of 0.5-1.0 kgm. Separate statistics for the catch are not kept in the USSR.

Fluke. This is the main commercial species of flounder in the Baltic Sea Basin. The catch usually contains specimens weighing from 70 to 500 gm, and the average weight is between 200 and 250 gm. The fluke has the following composition by weight:

<u>Body part</u>	<u>% yield</u>
Trunk	69.1
Head	15.0-19.0
Viscera	7.9-16.5
Fins	3.3- 4.3

The mean chemical composition of raw trunks of fluke taken in the Tallin region is given in Table 32:

Table 32

Таблица 32

Дата (a)	(b) Содержание, %			
	(c) воды	(d) жира	(e) белка	(f) золы
19/V	77,64	3,61	17,62	3,71
25/VI	77,15	6,51	13,25	3,08
25/VII	72,15	9,89	14,62	3,08
29/VIII	72,45	9,90	14,13	3,40
24/IX	72,75	9,70	14,37	3,30

Legend: a- date; b- % content; c- water; d- fat;
e- protein; f- ash.

FAMILY SOLEIDAE

Representatives of this family have dextral eyes, the body is greatly elongated, the mouth inferior, *the* snout blunt, and the lateral line is straight. One of the nasal apertures is broad, with a fringed margin, and is located on the blind side.

Soles are found mainly in tropical and sub-tropical waters. Some species are found in fresh water. The world catch is 35-50 thousand tons, of which a large amount of this flatfish is taken by Holland, France, Belgium, England, /183 as well as the countries of Asia and Africa (the catch in the Indian Ocean is up to 14 thousand tons).

The usual length of fish caught is 23.0-26.5 cm, but occasionally they go up to 61 cm. The meat of this fish is very tasty, but because of the abundant release of slime, there is a small demand for fresh sole. The average yield of meat is about 41.5%, that of carcass 82.5%, and of head about 10%. In Western European countries, the lean but tasty turbot (fig. 90) is highly regarded. The chemical composition of the turbot is as follows:

<u>Substance</u>	<u>% content</u>
Moisture	78.6-80.9
Protein	16.5-19.0
Fat	0.1- 0.5
Ash	1.4- 1.5

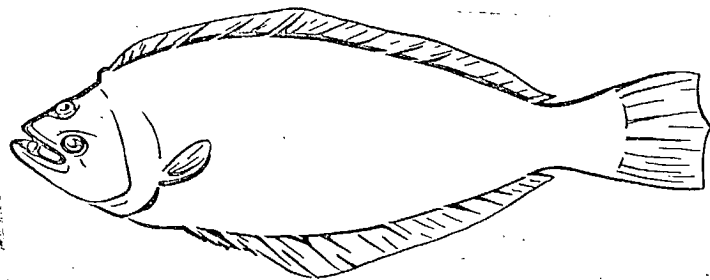


Figure 90. Turbot.

Flounders and halibut are excellent in the form of various cooked and smoked products. Large and fat flounders and halibut prepared as cold-smoked and dried products of the balyk type are considered delicacies.

In order to eliminate the unpleasant specific aroma of flounder, to remove the scales and avoid damaging its tender meat, it is recommended that sharp scissors be used to cut off the fins framing the body of the flounder when it is still frozen; next, the head should be removed, and after that, the skin should be ripped off.

In order to avoid damaging the trunk or pieces of meat during frying, it is best to first dip the meat in a batter of pancake-like consistency. Violent boiling during cooking and over-cooking should be avoided. It is best to steam flounder.

Many species of flounder can be used in the manufacture of forced and air-dried products of good quality. The following minimum lengths are permitted in the flounder catch: from the Gulfs of Finland and Riga - 15 cm, from other regions of the Baltic Sea - 19 cm, from the Pacific Ocean (Far East flounder) - 21 cm and from the Atlantic Ocean - 25 cm. The Atlantic flounder is measured from the tip of the snout to the end of the caudal fin.

FAMILY MUGILIDAE/184

This family includes about 100 species of mullets. These species are distributed throughout the warm and temperate waters in the Atlantic, Indian and Pacific Ocean Basins. As a rule, the mullets are found in coastal waters, bays and lagoons; they enter and can live in freshened and fresh waters.

The head of the mullet is covered with scales. They have a particularly broad forehead. The lateral line is absent. Seen from the front, the body is rather flattened (from top to bottom). The pectoral fins ride very high, there are two very short dorsal fins and the front one has spines. There is a deep notch in the caudal fin.

The best mullet is taken from the Black Sea-Azov Basin; the largest species, the striped mullet, is inferior to the others. The sharp-nosed mullet, long-finned mullet and little mullet from this basin have firm, succulent, white, fat, very tasty and aromatic meat.

The meat of the Black Sea mullets contains from 2.8 to 13.2% fat. When in excellent condition, the abdominal cavity of these fish contains deposits of firm, white, delicious fat. The protein content of raw meat is between 19.1 and 20.8%.

The striped mullet contains between 2.8 and 11.5% fat. Striped mullet measuring about 50 cm averages 1.2-1.9 kgm in weight. The sharp-nosed mullet from the Black Sea reaches a length of 43 cm, while in the Caspian Sea and the Atlantic Ocean it goes up to 52 cm. Pilengas weighing up to 2-3 kgm measures up to 60 cm, but the average length of fish in the catch is 44-45 cm. The catch is small. In the fall the Far East pilengas contains an average of 8.1-9.0% fat in the meat, and the protein content is between 20.4 and 21.6%. In summer the fat content drops to 4-5%.

The yield of meat from Black Sea mullets is between 55 and 60%, roe - 2 to 12%, heads - 11 to 13%.

The Black Sea-Azov mullet is the object of an evolving fish-rearing industry (special mullet rearing economies in the estuaries).

The mullet taken from the Black Sea Basin measures from 20 cm, while in the Azov and Caspian Sea Basins the mullet is larger and measures from 24 cm.

Mullet is produced frozen, hot and cold-smoked, dried and as canned snacks (in oil and tomato sauce). The dried ovaries in their membranes taken from the striped mullet and other mullets are highly esteemed. This product has a unique,

bitter taste, viscid consistency; it is aromatic, oily, a dark-brown in colour, and can be cut into thin slices. Such ovaries are stored in wax.

The mullet (long-finned and sharp-nosed) was acclimatized in the Caspian Sea in the early 1930's. In recent years its reserves have been seriously threatened by oil contamination of the Southern Caspian.

FAMILY STROMATEIDAE

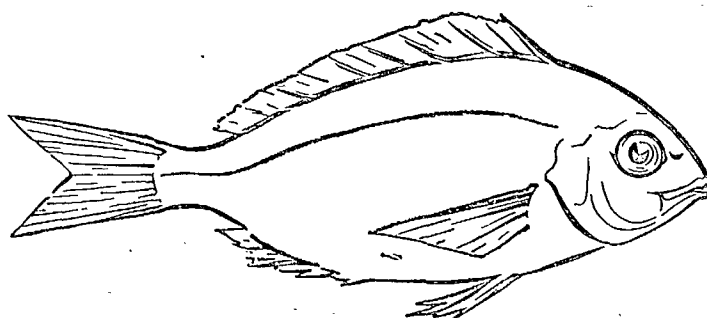


Figure 91. Butterfish.

The Stromateidae family consists of 15 genera and very many species. These fish are known in world trade and fishery by the names of butterfish, dollarfish, bluefish, poronot, palinuricht and stromateoid. The body of the butterfish is flattened from the sides. It has one dorsal fin which extends almost the entire length of the back. The head is steeply tapered,

the eyes are large. The mouth is small. The scales are small and easily removed. The skin cover of this fish is most frequently silvery-blue with many yellowish longitudinal stripes (up to 19 on each side). The lateral line is twice curved, at the nape and at the caudal peduncle (fig. 91). There is a dark, indistinct spot behind each gill cover. These features are typical of the largest stromateoid specimens known as butterfish in the trade.

These fish normally measure 20-22 cm and weigh from 230 to 280 gm, although specimens weighing up to 550 gm and measuring up to 30 cm do occur. Butterfish measuring under 17 cm in length is not marketed.

According to data provided by PINRO (R. Minder and Khobotilova), the meat of butterfish measuring from 17.6 to 20.5 cm in length and weighing from 125 to 234 gm, depending on the season, had the following chemical composition (Table 33):

Table 33

Substance	August	December
Moisture	80.2	63.8
Fat	1.2	18.0
Protein	15.9	16.7
Ash	1.3	No data

The composition by weight of these fish (referred to genus poronotus) is characterized by the following data:

<u>Body part</u>	<u>% yield</u>
Trunk	$\frac{69.5-74.7}{72.8}$
Meat (fillet)	$\frac{59.0-67.0}{62.8}$
Head	$\frac{10.6-15.8}{12.7}$
Viscera	$\frac{11.0-18.0}{13.4}$
Included gonads	$\frac{0-8.3}{3.2}$

The butterfish is distinguished for its excellent meat and comparatively small amount of waste. According to data provided by AtlantNIRO, the fat content in the meat varies between 6.0 and 14.75%, while that of protein is between 17.8 and 18.0%.

The butterfish is a good culinary material which can also be processed by the hot and cold-smoking methods if the specimens are not very small. Experiments have shown that this fish makes an excellent dried product.

A much larger and fleshy fish than the butterfish is caught in the equatorial waters of the Atlantic Ocean. This fish is known under the Russian name of butter (oil) fish. It is distinguished for its exceptionally tasty, attractive and fat meat. During the fattened period the meat of this fish contains from 14 to 22% fat, and this level evidently rarely drops below 7-8%. The protein content is 16-18%.

AzcherNIRO carried out experimental work on various methods of processing oil fish. It was confirmed that this fish can be used in the production of high quality balyk (cold-smoked and dried).

According to data obtained at the VNIRO Standards Laboratory, the amount of meat obtained from an oil fish weighing from 0.8 to 3.0 kgm averaged 50.3% (47.5-53.8%), head - 16.6% (13.1-21.4%), and viscera averaged 15.2% (9.3-21.2%).

FAMILY BRAMIDAE

The true pomfret (family Bramidae) should not be confused with fish of the sparid family, which are also called pomfrets in many African countries. The true pomfret is sometimes called the long-finned pomfret. It has a high body which is compressed laterally, like that of the bream, very long dorsal and anal fins, exceptionally short snout and steep forehead,

and a very deep notch in the caudal fin. The lower jaw protrudes forward. The skin cover is dark, the back is almost black (fig. 92). It grows up to 50-60 cm in length, but the minimum length in fishery is 17 cm.

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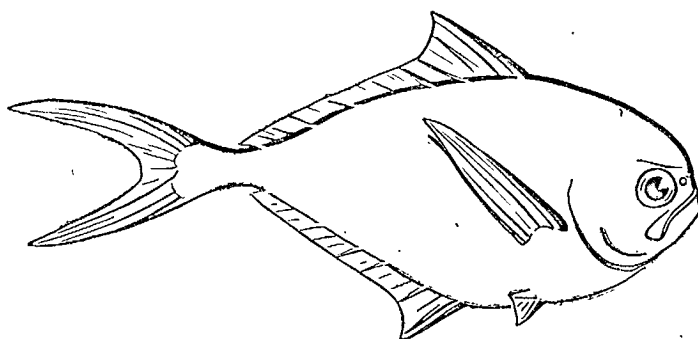


Figure 92. Pomfret.

Table 34

Substance	% content according to	
	AtlantNIRO	AzcherNIRO
Moisture	65.5-75.0	65.2
Fat	8.5-13.5	21.9
Protein	19.1	13.4
Ash	1.3	1.3

A pomfret averaging 46.2 cm in length (from the tip of the snout to the fork in the caudal fin), weighing 1957 gm, yielded the following (in %) when cut up: trunk 66.5, fillet 60.1,

head 26.2. Pomfret meat is distinguished for its excellent taste. The chemical composition of raw pomfret meat, according to data provided by AtlantNIRO and AzcherNIRO, is given in Table 34.

This fish is an excellent source of raw material for cooked products. In many countries the pomfret is produced as a frozen fillet which is an import item in the USSR.

FAMILY POMADASIDAE.

In the systematic sense, the fish in this family are close to the snappers (sparid family), but they have a dull silvery skin covering with longitudinal rows of dark strips.

The main species are Otoperka (open-mouthed grunt ??), pristipoma, parapristipoma and ronco.

Otoperka. This fish has a short, rounded snout; the first dorsal fin is high and almost tapers out at the back, it is prickly, whereas the second one is soft. The gill covers each have a dark spot (fig. 93). It is a small fish, measuring 12-16 cm and weighing 50-100 gm; however, the meat is tasty and contains (in %): moisture 73-75, fat 3.5-4.0, protein 19-20.

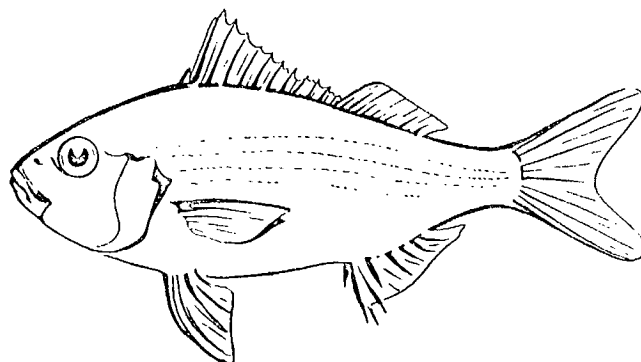


Figure 93. Otoperka.

Pristipoma. This fish has an elongated body, pointed snout, eyes positioned high. There is a large number of dark speckles forming wavy lines on the back and sides. Specimens measuring over 50 cm are landed and the average weight is about 0.5 kgm. Its meat has the following chemical composition:

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<u>Substance</u>	<u>% content</u>
Moisture	76.7-77.2
Fat	0.3- 2.0
Protein	19.1-19.5
Ash	1.3- 1.7

Parapristipoma. It has a dark violet skin covering, with four light longitudinal bands on both sides of the body. The length of fish found in the catch is normally 35-40 cm.

These three fish are of little commercial importance.

Ronco (grunt fishes). These fish are an important object of fishery in the Caribbean Sea and the Gulf of Mexico.

Among the pomadasid fishes are the striped and black-finned grunts, as well as the yellow and black roncós, ronco-haemulon (in Cuban, ronco-arara) (fig. 94) with bright-aloé (a colour) mouth cavity and throat, and also the ronco-héniguano.

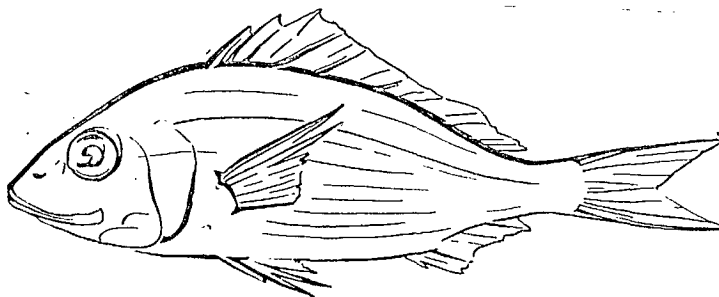


Figure 94. Ronco-arara (haemulon).

The characteristic length of ronco in Cuban fishery /189 is 15-20 cm, and the body weight is from 100 to 125 gm. Ronco meat is fairly good. The average chemical composition, according to Yu.A. Korzhova is:

<u>Substance</u>	<u>% content</u>
Water	76.6
Protein	20.6
Fat	1.4
Ash	1.4

The heads are very large (average 41.5% of body weight). The average yield of meat and skin is only 34.5%.

According to their food and trade properties, the ronco can be compared with better-quality small fry of the cyprinid family (according to GOST 1368-55 this is small fry of II group, and according to the proposed new GOST "length of fish" it is small fry of I group).

FAMILY POLYNEMIDAE

The polynemus is included in the polynemid family. The meat of this fish, taken at the end of 1965 from the Indian Ocean, specimens measuring 50-80 cm, contain (in %): moisture 77.5, fat 1.7, protein 19.5. The meat is tender and tasty. The yield of heads average 24% and trunk 61%.

It would not be expedient to freeze this fish with the head on.

The polynemid family includes the fish known under the commercial name of "Indian salmon" (see page 192 of text).

FAMILY RACHYCENTRIDAE

Cobia. This family includes the cobia or canadus (Rachycentron canadus) or sergeant fish. This is a large and

beautifully coloured fish (with broad longitudinal silvery bands on a black "velvety" background) (fig. 95). It measures up to 2 m and weighs up to 70 kgm.

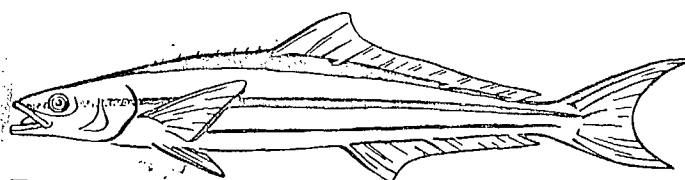


Figure 95. Cobia.

The meat of the cobia is tasty, aromatic, beautifully white in colour and has a pleasant, firm consistency. Cobia dishes can be the pride of any table. This fish is a valuable material for balyk, particularly if it is very fat.

The meat of cobia taken from the Red Sea had the composition shown in Table 35 (AzcherNIRO data) (Yaroslavtseva).

Specimens weighing 2.2-12.5 kgm and measuring 57-107 cm yielded 63.5-71.5% trunk and 19.6-22.4% head. A small cobia caught during September (Indian Ocean), whose length was 55 cm and weight 1.8 kgm, contained only 2.8% fat in the meat.

Table 35

Substance	Month	% content
Moisture	March-April,	75.9
	July	69.20
Fat	March-April	3.80
	July	9.95
Protein	March-April	18.94
	July	19.67
Ash	March-April	1.26
	July	1.28

FAMILY MULLIDAE

The most widely used international trade name for these fish is Surmulletts. The head is massive, of short profile, mouth small, two thick long barbels on the chin, eyes ride high on the head, the first dorsal fin is with spines and the second is soft. The skin cover is a reddish silver colour, with longitudinal yellowish bands on the sides, and the live fish flashes with all the colours of the rainbow. Over 50 species of this fish are known.

The fish in this family reach a length of 40 cm. There are particularly large surmulletts in the Indian Ocean, and their meat is excellent.

In our country, the surmullet is caught along the Black Sea coast of the Crimea and the Caucasus (Mullus barbatulus L.). This fish is of secondary importance in terms of volume of

catch, but its meat has a unique aroma and taste and a particularly pleasing consistency. This is one of the most popular fish along the Black Sea coast. In this area, it normally measures 12 to 20 cm and, rarely, up to 33 cm. The aroma of surmullet meat is conditioned by the peculiar properties of its oil.

The surmullet is excellent when skillfully prepared, either smoked, dried, or as canned products in oil. The oil in which the canned product is submerged acquires a remarkable aroma and exceptionally attractive pink colour (it becomes stained by the skin cover of the fish).

These canned products are so unique that the misnomer "Black Sea sardines" should be eliminated as quickly as possible and the fish given its proper name.

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Raw surmullet meat and various products prepared from it (except canned goods) are characterized by instability in storage.

The edible part of the surmullet body averages about 54% (according to data found in foreign literature).

The surmullet may become an important object of our fishery in international waters in the near future.

FAMILY OF RED-EYED FISH

The red-eyed fish has a spindle-shaped body. The back is a violet-red colour. The sides and belly are silvery-pink. It has very large red eyes, lips and bright-red fins. There is a powerful keel on the caudal peduncle. The length of the red-eye taken in fishery normally is between 40 and 50 cm. This fish is of comparatively small commercial importance.

GENUS DREPANE

Fish of this genus have been found as rare admixtures in the catch during recent years. Those most frequently occurring are the spotted, long-finned and speckled drepane. It is customary to call this fish the "shovel-fish", after the shape of its body (the flattened rear part of the trunk is nearly rectangular, while the head is rounded almost like the nose of a shovel).

The meat of a speckled drepane, measuring 30 cm in length and taken during September in the Indian Ocean, contained 1.1% fat and 18.4% protein.

FAMILY TRIGLIDAE

Fishermen usually call this fish the searobin; its meat is excellent. However, cutting up this fish is a difficult

process and results in a large amount of waste. It is found as an admixture in the catch. The world catch is about 200 tons annually.

FAMILY CYCLOPTERIDAE

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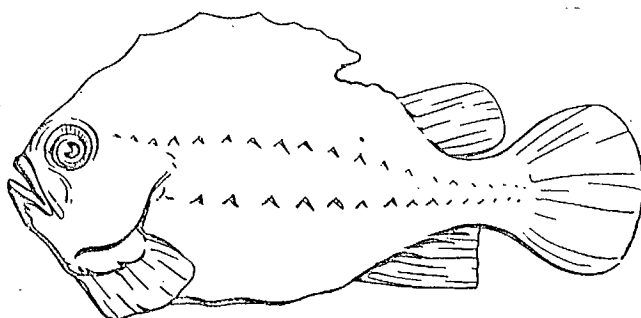


Figure 96. Lumpfish.

The lumpfish has been taken in the Barents, White and Baltic Seas as an admixture since antiquity. In the North Atlantic countries, it is known by the name of sea sparrow.

Soviet fishermen encounter the lumpfish in all the northern regions of the Atlantic and Pacific Oceans.

At least 26 species of fish are known for this family.

The meat of the lumpfish is rather gelatinous, poor in protein, and lacking in taste. The very thick skin of the lumpfish is most frequently covered with bony tubercles (fig. 96).

FAMILY DACTYLOPTERIDAE

Our Far East fishing fleet on the open seas in the regions around Australia and New Zealand has recently begun to take several new species of fish, particularly those known in international trade by the name of jackass.

An outstanding feature of this family is the very elongated ray in the caudal fin. The catch contains the grey jackass (measuring 30-40 cm and weighing 0.5-1.2 kgm), and the blue jackass or ocean carp (the back is blue, it measures 50-70 cm and weighs 4-6 kgm).

The meat of the grey jackass is entirely suitable as a food product, and that of the blue jackass is delicious.

The besugo is a fish very close to this family. It normally measures from 21 to 28 cm and weighs from 0.3 to 0.6 kgm. It has very tasty, white tender meat. This fish is excellent when cooked or hot-smoked.

The jackasses and besugo have a protruding mouth, and there are unique formations or "wattles" behind the gill covers.

FAMILY ARRIPIDAE

Our national fishery has begun taking the so-called "Australian salmon" in its catch. The length of the two fused

fins is $3/4$ the length of the back. The back and sides are greenish, the belly is light coloured. The shape of the body of this fish is similar to that of the salmon, but the caudal fin has a deep notch and the adipose fin is absent.

The fish measures up to 80-90 cm and weighs up to 10 kgm. It is a food fish, but the meat is of ordinary quality, coarsely-friable, lean, and light grey in colour (without pink and red shades).

Like the "Indian salmon" from the Polynemidae family, this fish has nothing in common with the salmon. It is necessary to find a good commercial name for these fish in order to avoid confusing them with salmon.

SURVEY OF MARKET PRODUCTS

One of the main tasks confronting the Soviet fishing industry is the greatest possible supply of live, fresh and first-class frozen fish to the population. Much material and technological equipment and effort ~~are~~ directed towards the solution of this problem. No other country in the world freezes as much fish as does the Soviet Union.

Freezing is the chief method of processing fish in the Soviet Union, frequently at great distances from consumer points, and under fishery conditions on huge water bodies.

Frozen fish is a first-class and high-quality product when progressive technology for processing, packing, storage, shipment and defrosting is strictly observed.

The fish inhabiting the interior water bodies of our country which have the highest food qualities are: white-eyed bream, great sturgeon, Black Sea mullet, Caspian salmon, Siberian muksun, Atlantic navaga, Baikal omul and the even fatter and larger omul from the lower regions of the Great Siberian rivers, sturgeon, peled cisco, vimba, cisco, black-back shad, tugun, sevriuga, Atlantic salmon,

various whitefish, Black Sea mackerel, surmullet, eel, trout, grayling and shemaia.

There is good reason why the sturgeon, which is taken mainly in the waters of the USSR, is called the noble fish. This fish is truly unique in its gourmet properties and is prized as the "source" of black caviar.

Many fish delicacies have been developed during the years of Soviet rule. Some of them have centuries of history behind them and are universally known. Russian sturgeon balyk and pressed caviar were well known in the XVIth and XVIIth centuries, not only here at home, but also far beyond our borders. Lightly-salted balyks of ocean perch are delicious. The lightly-salted Amur River fall keta salmon prepared in the salmon fashion is more tender and tastier than the more heavily salted Atlantic salmon. Lightly-salted herring of good quality is more pleasing to the taste than the fatter but heavily-salted herring. Our price lists and Standards strongly encourage production of lightly-salted fish. In spite of the fact that heavily-salted herring loses more of its mass than the lightly-salted fish, the price for heavily-salted goods is much higher than for lightly-salted products. There is a noticeable increase in / 194 production of lightly-salted fish delicacies due to the introduction of artificial refrigeration in industry, on transport,

in the trade and in everyday life.

There are excellent hors-d'oeuvres made from
smoked small herring, Baltic herring, kilka and tiulka.
The production of smoked small fish will be expanded.

Frozen flounder is excellent to the taste. This is
an expensive fish in many parts of Europe. Unfortunately,
many of our consumers have not been told how this fish
can be quickly and easily cut and prepared in order that it
will not emit an unpleasant odour during frying and will
not disintegrate during cooking.

The assortment of fish food products must be
sorted according to species (kind), technology, size of
container and variety.

The specific (kind) assortment is taken into account
mainly in those trade names that are used in the price lists.
For example, all zoological species of flounder taken from the
Pacific Ocean Basin (where many flounder species are caught),
are given, except for the halibut, under the common trade name
of Far East flounder. All species of shad from the Caspian
Basin (except the black-back shad) are combined under the
common name of Caspian shad.

On the other hand, the same species of fish sometimes
occupy several positions in the assortment according to kind.

For example, Atlantic and Pacific herring are each divided into two groups according to fattiness category (Pacific Ocean fat and Pacific Ocean, Atlantic fat and Atlantic).

The assortment according to kind may be divided on the basis of geographic properties within one and the same zoological species. This division was widely practised earlier and was taken into account in the trade names of products, in the price lists, and even in the standards. It has been preserved for very few fish in this country; only in those cases when fish of the same species but taken from different water bodies differ so much in the commercial-food sense (for example white-eyed bream, goby, silver bream, mullet, vimba, blue bream, mackerel, shemaia) that the products obtained from them differ essentially in properties and value.

The technological assortment divides the product according to types of processes (according to methods of salting, smoking, freezing). It includes live, iced, frozen, salted, spice-salted, dried, smoked, filleted and cooked fish products, roe, canned products and preserves.

The salted products are distinguished according to heavily, medium and lightly-salted goods. The smoked products include those that are cold, hot and semi-hot-smoked. Frozen

products include those that were frozen by artificial (mechanical) means, natural and ice-salt refrigeration. Artificial refrigeration includes dry (air), wet contact, and wet without contact. All frozen fish can be refrigerated separately or in blocks (when individual fish have been fused into a common slab).

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Fish sorted according to method of cutting include round, pharynx off, gills off, gutted, gutted and beheaded, gutted and cut in the salmon fashion, half-split, split and beheaded, "Klipfisk" cut (split and dried codfish), split and filleted, filleted, back (balyk, small balyk) with and without the head, belly, side, trunk, sliced, and in chunks.

The size and packaging assortment takes into account, on the one hand, the length of the fish and in some cases the weight, divides them into large, small (sometimes into medium); and, on the other hand, the types and methods of packaging the goods, which is often of decisive importance to both the trade enterprises and the ultimate consumer. The way in which the frozen fish is packed is of vital significance, whether it is in boxes or mat-bags; whether salt herring is packed in barrels or in cases; whether cooked products and caviar are put up in small packages or sold in bulk; and furthermore, it is important to know the volume of the containers used for canned and preserved goods.

Canning containers are distinguished according to their construction (cans, tubes), the presence of suitable devices for opening; according to their decorative-advertising shape; according to the material (glass, tin plate, aluminum, polyethylene and other plastics) from which it is made; and, most important, according to the weight of product per unit container.

The volume of containers used for transportation (barrels, cases) is also of vital importance for shipment, transshipment, storage and convenience in trade, particularly if it is considered that, for example, barrels for fish products are made in various volumes from 15 to 250 liters.

For a long time the USSR had in effect standards and price lists which classified most of the commercial fishes according to trade categories depending on the size, i.e. the length or the weight. There were frequently 3 or 4 and sometimes more categories for fish of each trade name.

Fish were classified according to choice (black-backed shad), large, medium, small, rejects and unsorted.

The unsorted category usually did not consist of product of any particular length or weight. For example, unsorted Caspian shad was a mixture of large and medium sized fish.

Before that, there was widespread use of trade categories such as standard (cod, Atlantic 7), regular, graded, semi-graded; or for example, for specified trade groups of large run-of-the-mill fish, there were such names as Volga pike-perch (because of the similarity to the pike-perch), flipper-carp (the pectoral fins on the small carp are so large that they suggest flippers), slab, and even smaller carp whose back contour was the most curved. Another type-category was the albino-bream, which consisted of young bream, and was so named because it is much whiter than the mature bream. Small catfish also had this type of classification.

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In addition, Siberia, and other regions of secondary importance in fishery, used their own classifications which were sometimes even more detailed. Although it could not be said that such trade names were unexpressive or lacked detail, they were discarded as cumbersome, unduly complex for trade classification, and resulting in difficulties in marketing.

As an example of the great detail with which some fish was sorted and priced (particularly delicatessen product) depending on its size, we should recall that Kerch' salted herring, during the 1930's, was divided into 17 trade categories or numbers (from 2-pood to 18-pood) (one pood equals 36 lbs)-i.e. from number 2 to number 18, depending on the weight of 1,000 herrings).

Later this was reduced to 5 weight categories, then in 1956 it was reduced to 3, while at the present time all the Black Sea-Azov herring is divided into 2 categories, large and small, according to length and not according to weight.

Fish does not necessarily become more valuable, from the point of view nutrition, with increase in size. Among the majority of fish of the same kind, the difference in the chemical composition of the meat, its nutritional value, aromatic-gustatory properties, the ratios between the edible and partially or completely inedible parts, difficulty of culinary processing, and suitability for portioning ~~are~~ not so important that trade categories should be maintained within the same species of fish in relation to its size. This applies to most of the marine fishes taken commercially.

The food value of many of the fish taken from interior water reservoirs, for example the pike-perch, pike and burbot, remains practically unchanged with the age of the fish (naturally this applies to the lower limit of permissible length), or it may even be found that the older the fish the lower its quality. As an example, the best market pike normally weighs between 0.4 and 2.0 kgm. The gastronomic properties of pike decrease with increase in weight and age.

For other fish such as the mullet, for example, at the present time large specimens of this fish are cheaper than

medium sized ones.

It is a fact that comparatively recently the meat from large ("mother") great sturgeon was priced considerably lower than the more tender meat from small great sturgeon. In many countries, the same attitude is taken towards edible shark meat, the smaller the shark the more expensive the meat.

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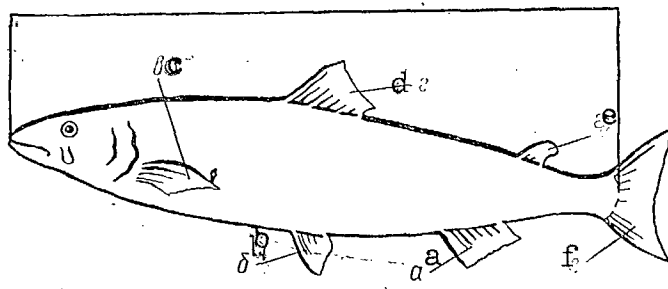


Figure 97. Sketch of standard measurements for length of fish and arrangement of fins: a- anal; b- ventral; c- pectoral; d- dorsal; e- adipose; f- caudal.

Experienced housewives and professional cooks know very well that not only cod and pike but also many other fish are much tastier and more tender when of medium size than is the case for very large fish. In this case the regularity is observed that, in reference to beef, the meat of an old animal is tougher, coarser, has less flavour and aroma than the meat of a young animal. Nevertheless, there are many fish for which, within the same species, sub-species, race or stock, increase in size is accompanied

by a significant increase in trade and nutritional value (for example, the salmon, herrings, sea perch, halibut and most carp fishes).

The GOST which was in effect up to the end of 1955 contained 67 trade-species names of fish which were divided according to length or weight, and did not foresee such a division for 37 other brand names of fish in the standards and price lists.

Now, GOST 1368-55, which came into effect at the beginning of 1956 and was still in effect at the end of 1967, divides fish into 22 brand names according to length, and 19 brand names according to weight as being large, medium and small (sometimes only large and small); and 76 names of fish are not sub-divided into trade categories according to length or weight in this standard.

The USSR has in effect Rules of Fishery in which are established minimum lengths at which the majority of fish may be taken. An exception is made only for those few fishes for which it is not expedient to maintain reserves (for example some predatory, economically valueless fish which destroy the young of valuable species, the so-called trash fish, or those fish whose reserves are not threatened with depletion by the present level and equipment of fishery).

Furthermore, there are definite limits on catch of fish on the open seas where the fishery is regulated by various international conventions or other agreements.

The length of most fish is measured along a straight line from the tip of the snout (with mouth open) to the base of the middle rays of the caudal fin (fig. 97)¹.

The length of the beheaded fish is also measured along a straight line from the edge of the head-cut at the spinal column to the base of the middle rays of the caudal fin (except those fish enumerated in the footnote). /198

In the case of a trunk on which some part of the caudal peduncle has been cut off, it is measured like a beheaded fish, but the length is taken to the edge of the caudal cut at the spinal column.

The Rules of Fishery allow the catch of most objects of fishery to contain a strictly limited amount of admixture of fish of that species but which are shorter than the minimum length established for the given species (most frequently this admixture is limited to 8-10%). As a rule, this admixture is separated from the main mass of the commercial fish of acceptable length if it exceeds the permissible amount by 2% (according to number of fish), and if this sorting is practically possible under the particular conditions of fishery and technology of processing.

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Cod, haddock, hake, turbot and all the Atlantic flounders, as well as the river eel, are measured along a straight line from the tip of the snout to the end of the caudal fin. Sturgeon fishes are measured from the tip of the snout to the deepest part of the notch in the caudal fin.

Such individual sorting of the admixture for very small fish and during the height of the fishing season is practically impossible; therefore, there are individual inter-Republic agreements under which the permissible size of the admixture of commercial product is separately regulated. In addition, there may be other agreements between industry and the trade concerning the permissible amount of admixture in commercial fish (for example, 15% for Atlantic navaga, 10% for scad and ocean mackerel).

In the case of fish taken from interior water bodies which are protected by the Rules of Fishery, ^{in the case of} those specimens that are less than the established permissible length but which are taken as a permissible admixture among the bulk of full-sized fish, it is required that such admixture (if it exceeds 2%) must be separated as rejects and marketed at the price of rejects. According to the current price list, the price on rejects is 25% lower than the minimum price established for fish of that trade name, processing and grade (this is the price for small fish if the given species is divided into small and large).

Some small fish that are lower than first grade are marketed under the name and at the price for small fish of a certain group.

Those fish for which exceptions have been made according to geographic features because of their higher gastronomic properties

are selected, priced and marketed under their own specific geographic trade names.

It is intended that small fry fish of II-group should include the cheapest fish, such as atherinid, loach, caplin, gudgeon, sand lance, lumpfish, arctic cod and bleak, as well as all the fish found in interior water bodies which measure less than 12 cm in length, the catch of which is not limited and which are not included among small fry of I-group.

Most fish food products, except canned products and preserves, are presently divided into first and second grade.

Only the delicatessen products (caviar and some balyk-salmon goods) are divided into three grades; premium, first and second. Some fish products are not sorted. Of the canned products, only sprats and sardines are divided into two grades (standard and premium grade). Preserves are not graded at all.

The decision to decrease or increase the grade divisions requires that the convenience of not having excessive detail on the price list (multiplicity of prices) be weighed against the fact that the lack of divisions according to grade in most cases has a negative effect on the quality of the product and weakens economic stimulus in production.

Proper planning of the assortment and meeting the requirements according to assortment of product is now just as important as

fulfilling the plan according to volume of production. When planning and providing a certain assortment of fish products, the first consideration in production is the interest of the consumer, taking into account the traditional and newly-acquired taste and demand, as well as the technological aspects from the point of view of physiology and food hygiene, and the actual raw material and equipment resources. At the same time, consideration must be given to the necessity for sufficient product stability during shipment, storage and marketing; to economic requirements, demand for the product at existing prices, the amount of technological losses and actual possibilities for utilizing waste.

These problems must be solved by the combined efforts of wholesalers, fishermen, technologists, including cooks, economists and salesmen, i.e. the specialists in the fishery, processing, wholesale and retail branches of the trade and communal feeding, as well as the directors of each of these branches of the economy, who clearly understand the problems confronting them.

The great variety and complexity of the assortment of fish products requires development and enforcement of correct and orderly classification.

Combining fish products according to general or similar basic specific and technological properties reduces them to a

comparatively small number of groups.

There are still some outdated trade-group terms in use which should be dropped. For example, the noble fish is a fish of the sturgeon family. Since antiquity in Russia, sturgeon have been called noble fish in the sense of being costly, rare and the most excellent. / 200

White fish includes Siberian and Pechora River fish of the genus Coregonus of the Salmonidae family (Siberian cisco or "Ob' River herring", muksun, "peled", "omul", "pizhyan" and others) and, in addition to the whitefish, the nelma.

Run-of-the-mill fish is a term which was applicable at the time when it only included cyprinid and percoid family fishes, as well as catfish and pike. This term came into use a long time ago in the Caspian Basin where the salmons and sturgeons (whitefish and Caspian salmon) were caught in netting gear with a large mesh, while the cyprinid, percoid, pike and catfish were taken by means of nets with smaller mesh. The fish caught in this smaller-mesh net came to be known as run-of-the-mill, (Caspian shad was not called run-of-the-mill since it was not utilized as a food fish in the Caspian Basin at that time).

The term has long been out of date. It causes confusion in the specific classification of commercial fishes, but it continues to be in use even at the present time.

All the fish landed are still divided into the following groups: herring, sardines, Baltic herring, kilka, saury, anchovy, tiulka, tuna, sardella (sprat), vobla, eel, lamprey, wolffish, large and small run-of-the-mill, sturgeon (noble fish), salmon, whitefish, flounder, cod and other fish. Regrettably, such nomenclature raises doubts regarding accuracy and exactness; it is in direct contradiction to the international nomenclature, and with the task of specific or generic accounting of catch in science, industry, trade, planning organizations and statistics.

This nomenclature for the specific composition of the catch came into use a long time ago and has no scientific basis. It was established at ~~the~~ time when our national fishery was concentrated mainly on interior seas and freshwater reservoirs. It in no way reflects the fundamental changes in the distribution and specific composition of the catch taken by the USSR fishing industry which have occurred in later years. A particularly undesirable and completely unjustified feature is the loss of identity in groups of large and small run-of-the-mill freshwater, diadromous and marine fishes; this includes such fish as the ocean perch, the catch of which reaches 300 thousand tons annually in our country. On the other hand, there is individual accounting of such a low-value and insignificant fish as the Black Sea sardella (which for some reason is also excluded from the small herrings).

Large run-of-the-mill fish officially includes the pike-perch, chub, slab, gilthead, mullet, striped mullet, rockfish, ocean perch, pelamid, Pacific mullet, mackerel, scad, ling cod, coalfish, bluefish and snakehead. The small run-of-the-fish includes atherinid, surmullet, goby, stickleback, smelt, caplin, gudgeon, sand lance, garfish, stint, Black Sea horsemackerel under 22 cm in length and lumpfish. This /201 nomenclature even contains such obviously unjustified names of fish as "tarashka" (white bream), "merlanka" (Black Sea whiting), and even "spichak".

The nomenclature used for the specific composition of the catch must correspond to the requirements in planning, economic direction and scientific research; it must be constructed on a scientific basis and include, in the same group, those objects of fishery that are related according to their systematic properties, or are similar according to environment and fishery. This nomenclature must correspond to or, wherever possible, approximate, the nomenclature used in international statistics for fishery, and include those objects of fishery which play an important role in our national fishery, or which are sufficiently promising objects of fishery.

VNIRO in cooperation with other institutes has already developed branch nomenclature for raw materials and products of the fishing industry to be used for All-Union classification.

of industrial and agricultural products. The work was done as part of the preparation for utilizing computer technology in the solution of problems in planning and direction of the national economy. For this purpose, an All-Union card index of raw materials and finished products was prepared.

This branch nomenclature combines, into specific groups, objects of fishery according to their systematic and geographic properties as well as according to conditions of fishery. The finished products are grouped according to methods of processing and types of raw materials used.

According to data provided by S.I. Gakichko (VNIRO), who directed this work, the nomenclature of raw materials and products was coordinated with the Gosplan for the USSR and the Ministry for the Fishing Economy USSR. It contains 2,675 names (excluding canned goods, preserves and grade subdivisions of raw materials and products).

The plan of this species-group nomenclature differs somewhat from contemporary international nomenclature, it clearly reflects the character of modern Soviet fishery and takes up 9 headings in all:

- 1) Cyprinidae, Percidae, Siluridae, Escocidae, Ophicephalidae, and Bagridae;
- 2) Group I and II small-fry fish of all families;

- 3) Salmonidae, Thymallidae, Osmeridae, Anguillidae
and Betromyzontidae;
- 4) Gadidae;
- 5) Clupeidae and Engraulidae;
- 6) Scombridae;
- 7) Order Hetersomata;
- 8) Acipenseridae;
- 9) Scorpaenidae (ocean perch) and other marine fishes.

The following trade name nomenclature is in effect
for basic conditions of supply: sturgeon, salmon, run-of-the-mill,
cod, flounder, herring, small herring including anchovies and /202
other small fish.

When making a survey of domestic trade nomenclature
for fish products, it should be borne in mind that a great deal
has already been done in this direction. Up to 35-40 years ago,
we had an extremely complex and unbelievably cumbersome nomenclature
and trade terminology for fish products, which sometimes resembled
the cattle-buyer's market.

The rich natural assortment of fish, the variety of
technical advances and decisions associated with determining
the traditions and tastes, the rise in material and cultural
standard of the people, all made it possible to significantly
expand production and variety of fish products.

This is associated with an immediate requirement for a fundamental improvement in the trade classification of fish industry products in order to streamline and expand the nomenclature. It is a combined problem for industry, trade and standardization.

The complexity of this task rests in the requirement that the assortment of fish products should be further increased and diversified, rather than diminished, to produce fish products with a view to satisfying the most varied taste and demands of the consumer, to do this without detriment to production but at the same time to classify all the diversified goods in order to reduce them to a comparatively limited number of trade categories and, consequently, prices.

The author has his own point of view and recommendations on this matter. It is first of all necessary to establish the appropriate number of groups of fish products according to their technological assortment, taking into account the method of processing the fish (12-18 groups). Next, each of these groups should be divided into its specific composition of commercial fish according to categories reflecting the consumer trade-nutritional value of any fish processed by the given method and, then, to establish a single price for each of these categories.

By starting with an objectively established, true consumer value for fish of each separately taken specific name, with consideration for the method of processing, then the fish of the same species will be priced fairly high (for example, pike or crucian carp in the live fish group and Atlantic navaga in the frozen fish group,) or very low even, in comparison with the rest of the output for the given type of processing (for example, pike, crucian carp and navaga that were forced salted in comparison with salt herring).

A truly negative index such as, for example, the presence of small inter-muscular prickly bones in fish meat, cannot be discounted when determining the trade-nutritional value of live, iced, frozen, fried, baked or hot-smoked fish (vobla, taran, carp, bream, asp and many other cyprinids). However, /203 when the same fish, cold-smoked or dried, is utilized in canning or cooking, it is not necessary to price it with regard to boniness, since the given methods of preparation completely eliminate this shortcoming in cyprinid fish, and they become a first-class product. Moreover, the presence of sufficient quantities of softened bonelets enriches the product with mineral substances.

Evidently, the composition of each of these 12-18 trade groups, based on the technological assortment, would each contain 8-12 species-group positions.

With a system like this, the price list would clearly reflect the specific properties and some graduations according to geographic or seasonal index (for example, vimba separately for the Black Sea-Azov and the Caspian; Amur autumn keta on the one hand and all other keta on the other hand, etc.), and also according to categories of fattiness (for example, ocean herring).

Classifying fish according to consumer value is intended to avoid identification with group statistical nomenclature.

Thus, the entire technological and species-geographic-seasonal assortment of fish food products is placed in 150-200 positions, without division according to length and sort. It is to be expected that the total number of different prices, when such a system of categories is used for fish products, could be reduced to 300-400, and certainly not be over 500.

This number of prices is much smaller than the one we have at the present time. At the same time, this prevents the loss of identity of products among the assortment in the trade.

It is proposed to reduce the entire assortment of food products to a restricted number of categories, according to trade classification and tasks of codification, and to unify prices. A concrete trade name such as herring, for example, which is marketed at a single price but has consumer differences, would remain unchanged, or else it would be further expanded.

This type of classification by trade assortment would prevent further liquidation of trade divisions among products, which has already gone too far, and would also make it possible to reestablish these graduations for some types of fish product, for which the sub-divisions according to variety were eliminated rather hurriedly and without foresight. This applies not only to state standards, but also to the technical conditions in production which are not included in the standards. Over and above all, it applies mostly to the types of canned and preserved fish, which are a very essential part of production in the fish industry, and which are not graded.

Some authors are of the opinion that fish must be called fish only as long as it has not undergone any sort of technical processing (i.e., raw fish, live fish and fish caught for sport). In all the remaining cases, it is assumed that the fish is already converted to a fish product (iced, frozen fish, fish goods).

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Others maintain that iced and frozen fish is still fish, and not a fish product.

Yet another group postulates that, as long as the fish preserves the shape of its body, whether it be frozen, salted, smoked (even if gutted and beheaded), it must still be called a fish. However, if the fish has been converted to fillet, pieces,

flank, chunks, fish cake, preserves, canned goods, balyk products, etc. then, in the trade sense, it is no longer a fish but a fish product or fish goods.

Nevertheless, the names of most of the standards in effect for canned fish, or the names of technical specifications for culinary preparation, read as follows: "Canned goods. Smoked fish in oil", "Canned goods. Fish in tomato sauce", or "Fried fish", "Fish cake", "Fish packed in liquid".

V.I. Meysner, G.F. Drukker and A.A. Klykov, in the first marketing book to be published in our country, "Fish and Fish products", call all marketable fish (except raw fish stock but including live fish), fish goods, and they have called their publication a book on ^{marketing} of fish goods; in it they write about prices in reference only to fish goods, including live fish.

In most of the latest marketing books and texts on technology, when the discussion refers to the finished product and not to the raw material, they talk exclusively about fish goods and fish products, and not about fish.

Insofar as the author's personal point of view is concerned, with the exception of live fish, he includes all market fish among fish products.

TECHNOLOGICAL ADVANCES AND GROUPS OF MARKET PRODUCTS

The Soviet fishing industry processes raw fish materials into food products mainly by the methods of freezing, salting and smoking. Special attention is given to the production of canned goods, which has reached a high level.

During 1965-66, Soviet production of frozen fish amounted to at least 35% of the total world output. Although frozen fish output is continually rising in many countries of the world, the observable rate of increase in volume of this product is much greater in our country. Nevertheless, our production of fish fillet is still not sufficiently developed.

The Soviet Union is the chief producer and consumer of salt herring. At least 2/3 of our salt herring is now light or medium salted, and the importance of lightly-salted herring continues to rise. The economic convenience of production, improvement in refrigeration technology, and enormous demand for this product, all insure the continued growth of light and medium salted herring production.

The main undertaking in the utilization of fish in our country is the production of food (including delicacies) products which have the highest possible nutritional, hygienic and gastronomic

properties. Industry has an obligation to make products that are most suitable and attractive to the consumer, and which are free of inedible parts.

An important task to be undertaken is the complete and rational utilization of the landed fish. This includes the preparation of the most valuable and useful products from both the meat of the fish and the roe, milt, liver, fat, scales, bones, air bladders, skin and heads. This problem will be completely solved by bulk production of fish fillet, other frozen fish semi-products, the preparation of fish stock, canned products, preserves from herring fillet, as well as cooked products.

The effectiveness of bleeding has a vital influence on the quality of the fish and the products prepared from it. In many countries, this aspect of primary processing of the catch is widely practiced, and in some others it is even included in /206 the regulations (and is extended far beyond production of fillets).

In Norway, for example, all marine fish landed on board ship is immediately bled (except for eel, herring, Baltic herring, mackerel, salmon, diadromous trout, spiny dogfish and skate). Fish taken from the gear in a state of torpor is also bled, but it is laid aside.

The arteries are severed with a knife by bringing it under the throat from both sides, as close as possible to the head. The knife is inserted up to the spinal column in order to cut

through the large arteries (double-stabbing method), or else the arteries are severed between the heart and the gills (single-stabbing method). After the arteries have been cut, the fish is laid aside in a single row until the blood has drained from it.

The fish is not considered to have been bled if blood appears during subsequent gutting or neck incision.

Before shipping fresh ocean fish to market,
both the vendor and the buyer (wholesale) sign a written declaration that the lot consists of bled fish.

According to regulations in force in Norway, fish intended for salting and drying must also be bled by the same methods "whenever circumstances permit".

Delivery of large amounts of round fish to the retail networks and communal dining enterprises results in non-utilization of most of the useful but unedible waste which has been paid for by the consumer. Only part of this waste from large communal feeding enterprises and fish processing combines situated at consumer centers is utilized for fodder purposes in the raw state, and then under conditions which normally do not have strict control to insure prompt, complete and economic utilization.

Organization of production of the greatest possible amount of cut fish insures the greatest economy by reducing losses in shipment, processing, packing, storage and handling of such products.

It has been estimated that, in our country, we yearly process, pack, ship and store at least 200,000 tons of fish waste among the processed commercial fish. Naturally, this does not include fish that does not have to be cut (for example, kilka, spiced or light-salted Baltic herring, most herring, frozen navaga, whitefish, dried and cold-smoked fish).

The main types of cuts made on fish before the raw material is dispatched for salting are: pharynx-cut, gill-cut, gutting, beheading, splitting, cutting into back, belly and flank cuts, as well as filleting.

Naturally, there is more to cutting-up fish. /207
To solve this problem, it is necessary to fully supply industry with high-capacity fish-cutting machines capable of operating at sea, and also shipboard equipment for processing the waste.

Complete processing and cleaning of fish products on board ships fundamentally changes the conditions, methods of processing and assortment of product. Although such a solution is accompanied by considerable difficulty, it creates conditions for improving the

quality of products, and insures higher economic indices than does primary processing at sea with final processing of the fish on shore.

Future technological advances in processing raw fish will increase the production of live, iced and frozen fish, smoked, dried (including balyk products), as well as light-salted, fat marine herring and canned products (in particular sprats, sardines and saury in oil).

Herring, small herrings and anchovies can be used both as salted hors-d'oeuvres and as main food products (quick frozen, reliably packed semi-products in the form of ground meat, for the preparation of a wide variety of fish cakes, as well as protein sauces). This is a progressive method of insuring the expansion of the assortment of fish products, and a more rational utilization of the raw materials.

Filleting will be more intensively developed on board ships capable of freezing large fish.

It is planned to use kilka, tiulka, Baltic herring, anchovies and gobies for bulk freezing, production of canned products, preserves and fish flour, in the basins of the Caspian, Azov, Black and Baltic Seas.

On board refrigerator ships engaged in fishery on the open seas, the main advance in processing raw material must be filleting of

cod, haddock, coalfish, ocean perch, halibut and many other marine fishes and even herring. However, preparation and packing of frozen herring fillet can give excellent results only when measures are taken to prevent oxidation and spoilage of the extremely unstable herring fat.

Fish that are of low food value, such as some small herrings or, for example, walleye pollock, will be processed as frozen fish paste for a wide variety of fish cake and fish sausage, as well as protein sauce and, in due course, into food autolysin and hydrolysate. Straight salting of kilka, Baltic herring, anchovy, and the occasional forced-salting of gobies will be completely halted in the near future.

It is planned to rapidly expand production of fish-vegetable /208 canned goods, canned and concentrated fish soups of the chowder type, cooked products and semi-products made of fish and in a great assortment (not only in the retail network but also in the fish industry).

The USSR is developing technology for producing food fish flour from such fish as the Caspian kilka and the walleye pollock.

The urgency in organizing large scale production of food fish flour is associated with the task of achieving the most rational utilization of fish of certain species, to provide the

greatest physiological efficiency for the human organism, by using them in the bread-baking industry as an admixture to enrich bread with the first-class, readily digestible animal protein so abundant in this flour.

The addition of fish or whale flour to bread provides a complete complex of irreplaceable amino acids, and increases the assimilation of vegetable protein, since this flour contains almost all the biologically necessary microelements, mineral salts and irreplaceable amino acids, including available lysin.

Flour made from the meat of the baleen whale is very promising for this purpose. Fish and whale flour for use as a fortifier in bread is being given a great deal of attention in the USA, FRG, Canada, Poland, Peru and some other countries. However, production is hampered by the necessity to devise a technical process that could be relied on to completely remove the fish odour. Consideration must also be given to the probability that the fish odour would return to the fish flour used in baking, and also the possibility of the so-called aftertaste which may develop some time after the bread has been eaten.

It is expected that production of salted cod and ocean perch will be completely halted by 1975.

It is planned to stop production of heavily-salted products made from small herrings by 1970, from salmonids (including whitefish) by 1972, and from herring by 1975.

A project for the near future would place greater importance on fat ocean herring salted and packed by new improved methods in the assortment (delicatessen products). These products will be given special trade names.

The meat of a wide variety of fresh fish is, as a rule, less distinctive and more monotone in taste and odour than the meat of warm-blooded animals. Because of this, a continual fish diet results in extreme negative reactions from consumers. However, such products as, for example, well-matured salt herring, dried vobla and taran, smoked fish, spiced kilka, sprats and sardines in oil do not become boring. Special methods of processing fish, which not only protect it from spoilage, but also impart a specific gastronomic quality, give it such a distinct, unique and pleasing aromatic-gustatory bouquet that dietary banality of fish is practically eliminated.

In connection with the foregoing, particularly under conditions where the population is adequately supplied with meat of warm-blooded animals, it has long been a tradition to convert the maximum possible amount of fish into gastronomic products (well-matured salt herring, light-salted fish such as,

for example, kilka and Baltic herring specially salted without spice, Atlantic salmon, salmon, keta salted salmon-fashion, cold, semi-hot and hot-smoked fish, balyk products, dried fish, spice salted and cold marinades, a fairly wide assortment of cooked products, canned goods and preserves).

At the same time, it should be noted that the possibility for developing and widely introducing new, most suitable variations and recommendations in culinary processing, in both fish-cooking and in canning-preserving operations, is, regrettably, far from fully exploited.

The problem of least importance at the present time is production of a small number of hors-d'oeuvres masterpieces. The main problem is dependable organization of the production of large quantities of fish products that are sufficiently nutritious, definitely hygienic, moderately priced and satisfying to a wide variety of consumer tastes. The most pressing problem is mass production of fish food products. The main technological direction in utilization of fish raw materials will be directed towards this end.

Raw material that cannot be fully processed directly within the fishing industry will be delivered to consumer centers in the frozen and iced states, in order that trade enterprises and communal feeding centers or the consumer may cook it according

to their own capabilities, needs and tastes.

Of course, this does not excuse industry from delivering the required amounts of ready delicatessen products and special semi-products for processing at consumer points into balyk products, smoked products, preserves and other types of delicacies.

The sanitary rules in effect in the USSR do not permit artificial colouring of fish or its products. Colour may be introduced into the product by food and gustatory substances having natural colouring (for example coloured spices like sandalwood bark, as well as vegetables, fruit, berries).

Aromatization of fish products by means of synthetic / 210 substances and essences is not permitted in the USSR. It is permissible only to use spices and other aromatic substances of vegetable origin, natural extracts, liquors, broth, and natural juices, purée, and paste made from vegetables, fruits and berries.

Fish which, because of its consumer and technological properties, should be used immediately, (i.e., it should be eaten immediately after cooking), is conventionally called "table" fish. The inaccuracy of this new term is obvious, because canned fish, preserves, smoked and salted fish are used as a main course, like "table" fish, and also as a snack.

It would perhaps be more correct to classify fish according to its primary purpose:

- 1) food fish (not "table") - fish intended for cooking;
- 2) fish intended for commercial processing - food raw materials and semi-products (for salting, smoking, drying, canning and preserving);
- 3) fish for fodder and industrial purposes.

It is also customary to remove certain parts of the body
(for example the liver or other glands) from some species
of fish for processing for medicinal or veterinary purposes.

Economic epochs are distinguished, not by what man produces, but by the technical means he uses in processing a certain product.

If the rapidly growing production of autolytic-seasoning products and hors-d'oeuvres made of small and low-value fish in many countries results in a product which is similar to the fish seasonings used in the distant past, such as were obtained in the Khersones-Tavrik Period by means of autolysis, for example, this certainly does not mean that people are returning to the level of that ancient period in the technological sense. Modern autolysates are produced on a strictly scientific basis using intelligent control of thoroughly studied biochemical

processes, and the process does not take place in stone chests buried deep within the ground, nor is the product packed in amphora and urns, but in very convenient tubes made of plastic or sterilized, thoroughly modern ceramic jars.

When reviewing the indicated perspectives in the /211 assortment of fish industry products it is also necessary to touch on the problem of mechanizing production processes.

At the present time, the vibration method is the most advanced means of mechanically placing fish in containers. We have successfully solved the task of packing in barrels small and medium sized salted fish ranging from anchovies and kilka to herrings and large fish such as cod and ocean perch. The problem of vibrational and row packing of salt herring and frozen fish in boxes and raw fish stock in drip pans for freezing has also been solved.

Advanced automation methods in our fish industry will first of all be implemented in the mechanization of such processes as loading and transporting raw material, semi-products and finished products, quantitative reception and sorting of fish, aligning it in space, cutting, packaging and packing fish. We shall automate such thermal and physical-chemical processes as chilling, freezing, defrosting, blanching, sterilization,

salting, dehydration, drying and smoking of fish.

The achievement of all this will definitely eliminate the present difficulties and bottlenecks and will improve the assortment and quality of fish products, but it will require us to drop certain traditional notions, requirements and opinions, concerning food products made from fish, which now hamper progress.

LIVE FISH

This trade group is unique among the other fish products whose production is associated with the organization and implementation of specific technological processes.

Live fish is the freshest type that can be had in cookery. This is particularly true of the fish that has not lost weight and become exhausted because of a long period in captivity. The aroma, taste and consistency of dishes prepared from live fish cannot be compared with even perfectly prepared dishes made from quick-frozen, expertly packed and properly stored frozen fish.

Anyone that has compared the properties of chowder made from fresh-caught fish with that prepared from frozen fish, particularly fish that has been in long storage, can well appreciate the advantages of chowder made from live fish.

At the present time, the domestic trade in live fish has only fresh water, catadromous and diadromous fish. Commercial live fish is divided into product from fish-rearing economies, the so-called pond or cultured fish (at least 2/3 of which is carp or a hybrid of carp and wild Amur and Kura river carp) and wild fish (carp, crucian carp, pike and catfish).

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Generally speaking, the assortment of live fish can include a considerably greater number of fish species, particularly from among those which have a lower requirement for oxygen in the water, which are less sensitive to temperature fluctuations and which have closely adhering, spineless scales. When excellent conditions for shipment and maintaining fish in tanks have been created, and there is sufficient knowledge and experience among the staff, successful trade can be carried on with even such a relatively sensitive live fish as trout, practically all the whitefishes, smelts, sterlet and sturgeon.

Trout, whitefishes, smelt, sterlet, bream, and even nalim and pike are less able to withstand compact tanking, oxygen starvation and the presence of chlorine in the water. However, they are all suitable for live-fish trade although it is necessary to have excellent, strictly controlled conditions for their environment.

Among the cyprinids the Amur carp, asp, tench, roach, silver carp and ide are also suitable for the live-fish trade. The pike-perch, freshwater perch and ruffe all withstand captivity quite well, whereas the bass is far less hardy in captivity.

The most hardy and stable to temperature, oxygen and food regimes are the wild carp, carp (particularly hybrids of carp and Amur River carp), crucian carp and tench.

In order to ensure that the fish does not doze (remain motionless) in the tanks and during shipment, provisions are made for minimum environmental conditions from the instant the fish is caught until it is brought into the kitchen, taking into account the biological features of the fish. The degree of survival of the fish under live-fish tank conditions depends on the species of fish to a very great extent.

The oxygen requirement varies among fish species, and their hardiness to oxygen starvation also differs.

Breathing is an extraordinarily important function to the fish organism. Some species of fish can live for months (up to a year and more) without feeding, but they will endure oxygen starvation for only a few minutes, and a few hours in rare cases. This is an indication of the important role played by oxygen in the physiological processes of fish.

Some fish inhabit well-aerated water and suffer when there is a deficiency of oxygen dissolved in the water whereas other fish live in poorly aerated water.

Other conditions being equal, fish require a greater amount of oxygen in flowing water than they do in stationary water. All fish have a greater requirement for oxygen in a stream of water.

In order to breathe, fish require definite amounts of oxygen dissolved in the water (normally at least 4 ml oxygen per one l of water, and 5.5 ml for trout). Trout have the greatest requirement in this regard; salmon, smelt, bream, bass, roach and pike are less demanding. Some of the least demanding fish are carp, wild carp, and particularly tench and crucian carp.

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Fish take more oxygen from water when the temperature of the latter is higher. Thus, the demand for oxygen for breathing increases exactly at the same time that its content in the water decreases (the warmer the water the lower the amount of oxygen that can be dissolved in it).

The greater the fish population and, consequently, the greater density per unit of water and dissolved oxygen, the more rapid and pronounced will be oxygen starvation. Oxygen starvation has a particularly strong effect on the fish organism

in motionless water that is too warm. Agitating the water on the surface facilitates oxygen absorption.

But excessive oxygen super-saturation of water has a destructive effect on fish. Cyprinid fishes survive an excess of oxygen much better than do salmonids.

Live market fish after it is taken from its natural environment (for market purposes) is normally not fed even if it has to remain in the tanks for up to half a year (the usual period is from late fall until early spring).

Whereas the optimum temperature encourages maximum life activity, a reduction in temperature causes it to gradually slow down (under these conditions the fish stop feeding even under natural conditions and its metabolism is significantly lowered).

The optimum water temperatures (in degrees C) are given below in which fish should be maintained in tanks, aquariums and other reservoirs and during shipment at various times of the year:

Cold-loving fish (trout, whitefishes, smelts, nalin, etc)

summer	6-8
spring and fall	3-5

Heat-loving fish (carp, wild carp and other cyprinids)	
summer	10-12
spring and fall.	5-6
All fish in winter	1-2

It is equally necessary to provide appropriate environmental conditions for fish being shipped by road or rail, as well as by water transport or by air.

In the USSR we have designed and built improved railroad cars and trucks for shipping live fish which have equipment for oxygen-enrichment and cooling of water.

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At points where the fish is stocked and sold it is best to keep them in ground ponds where the environmental conditions are close to the natural ones. This is particularly important during the warm time of year.

When fish are kept in artificial conditions every effort is made to avoid moving, shocking and frightening the fish. It is necessary to immediately sell lethargic fish in order to prevent massive dozing and infection with saprolegnias.

For prevention of shock and infection to large live fish it is proposed to use improved carriers with removable canvass baskets.

Motionless fish must be removed from the water before it

becomes a "floater" (it is necessary to inspect tanks at least twice a day during the summer months).

The most important fish in our live fish trade is the carp, because, among the fish that are hardy, resistant and stable to temperature, oxygen and food regimes, it is the most valuable in the trade-nutritive and gastronomic senses and is also a very productive fish. Its rapid growth is a valuable property of carp. The cultured carp differs from its wild ancestor by more tender, much fatter and very tasty meat and also by its faster growth (rapid maturing).

In the USSR, the mirror forms of cultured carp predominate, but the scaled and, occasionally, the leather carp are found.

Although the carp is distinguished for its longevity (it can live up to 30 years and achieve a length of 1.5 m and weight of 30 kgm), it is economically most expedient to utilize 2-year old carp as a trade fish.

When inspecting live fish the first thing to be noted should be that the fish is in good health, alert, without peeling scales, scratches or other injuries, with a clean digestive tract, swimming in the natural position and did not

have an odour of slime, petroleum products or other bad odours associated with its environment (verify by trial cooking).

Bad odours associated with the environment are removed by keeping the live fish in clean flowing water (normally for 1-3 weeks).

The live fish trade has a seasonal character (in the temperate zones of the USSR live fish is sold from the beginning of October until April inclusive). Live fish can be successfully handled during the summer only when ground tanks are used and with a sufficiently large staff of experienced specialists who have sufficient knowledge of modern, live-fish handling technology.

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ICED FISH

Iced fish is the name applied to fish whose body temperature was immediately lowered and is continually maintained at a level close to the cryoscopic point, but not below it (without formation of ice crystals in the body of the fish). The GOST on iced fish allows that the meat at the spinal column be at a temperature within the limits of -1 to $+5^{\circ}\text{C}$.

An irreproachable condition of iced fish is insured best of all when each specimen is kept at a temperature between $+1$ and -1°C from immediately after death until it is delivered to the consumer or for processing.

Since the mineral and organic substances contained in a dissolved state in the tissue juices of the fish lower the cryoscopic point for raw fish, such fish begins to freeze at a temperature somewhat lower than that for freshwater. The cryoscopic point for all species of fish is different and normally is between -0.5 and -1.6°C (for sharks and skates it goes down to -2°C). The freezing point for tissue juice of freshwater fish lies normally between -0.5 and -0.9°C , while the freezing point for tissue juice of ocean fishes is most frequently between -1.0 (flounders) and -1.6°C (saury).

Quite naturally, the less time the fish has been kept after it was caught, even under optimum conditions in the iced state, the more aromatic, tasty, hygienic and usable will be its condition.

Shipment and storage of iced fish packed in ice in wooden cases at temperatures below the permissible levels is attended by risk of spoilage of the fish. The ice in which the fish is packed freezes and forms cavities above the carcasses, thereby forming air bubbles between the ice and the fish (the contact between them is broken). This retards cooling of the product and exothermic processes begin which are accompanied by self-warming of the fish, lowering of its quality and eventually complete spoilage.

It is necessary to insure that the ice is in contact with all the surface of the fish and that the melt water does not remain in the box with the fish but drains off immediately.

It has been found that raw, round fish with slime on (unwashed) keeps considerably better until canning. Therefore, slime should only be washed off round fish immediately before it is processed. When off-loading iced, round fish at the consumer points it is not washed before its processing begins, and this type of reception is fully justified until the slime shows the first signs of rancidity.

Under normal temperature conditions, iced fish packed on all sides with ice can be preserved (depending on the species and other conditions) in excellent condition normally for 216 from 5 to 15 days from the time of catch until processing. Baltic herring and other herring fishes normally will not keep for more than 5 days in the iced state.

Planned increase in the speed of railroad trains and improvement in all types of refrigerated transport are opening up great possibilities in the supply of iced fish to the population.

Methods of extending the storage period of iced fish are being developed.

In order to keep cod fish in the fresh state on ships at sea it is permissible, under Murmansk conditions, to use ice containing the antibiotic chlortetracycline (in other countries it is normally called aureomycin, while in the USSR it is called biomycin).

The antibiotics used in the food industry must have a sufficiently broad spectrum of effects on microorganisms present in the food product and, when taken in small quantities together with food, they must not cause undesirable phenomena in the human organism, they must become inactivated within the product itself or during cooking.

Biomycin fully meets these requirements during processing of iced fish. However, the health authorities have established limits for amounts of biomycin present in the processed or raw product.

In the USA, Canada and Japan it is permissible to have a maximum of 5 mgm antibiotic per 1 kgm of fresh raw fish product, whereas in the USSR it is permissible to have a maximum of 0.25 mgm per 1 kgm of product (20 times less).

Biomycin helps to extend the storage period (shipping time) of iced fish, particularly when it is used on freshly caught and immediately gutted fish.

In such cases the antiseptic solution is applied to both the outside covering and the abdominal cavity of the gutted fish.

The use of biomycin is not a satisfactory measure when processing round fish with a strong fermentative system (for example, herring and salmon).

Biomycin in the ice in a ratio of 5 mgm antiseptic to 1 kgm of ice increases the possible storage period for fish by 50-60%.

Treating fish with biomycin does not affect the colour, taste and odour of fish and fish products, including canned and cooked products.

Cyprinids, percids, pike and small catfish are iced whole, and the raw material must be delivered live for processing. Cod and ocean perch are gutted and beheaded before icing, large catfish is gutted.

Large salmon and sturgeon fishes are practically never iced, with the exception of fish intended for immediate, local sale.

Various types of assembly lines are in use for preliminary icing and packing in the northern part of the Caspian

Basin, as well as in the Azov Basin, Murmansk area and in Estonia.

The charge of ice in the container with fish depends on the duration and conditions of shipment and is usually between 50 and 75% of the weight of the fish.

A negative feature is that the net weight of iced fish in relation to the gross weight normally is no more than 50-60% and that the wholesale and retail trade outlets for iced fish require special facilities for storage, processing and resale. Traditions and worthy customs in proper preparation of one of the most delicate commodities, iced fish, in our country must be revived and developed on a wide scale.

FROZEN FISH

The Soviet Union is the largest producer of frozen fish products in the world, Japan is second and the USA is third.

In 1950, our output of frozen fish was 23%, and in 1966 it had reached 60% of total food production from fish materials.

Production of fresh-frozen fish (conventionally including market live and iced fish) reached 1775 thousand tons in 1966 in our country. This amounts to over 65% of the total food production from fish materials.

Frozen fish production in 1950 came to 236 thousand tons, 442 in 1955, 674 in 1960 and 1775 thousand tons in 1966 (it had increased by 7.5 times).

The main advantage of frozen fish in comparison with fish preserved by other methods is its remarkable stability during storage and greatest similarity to fresh fish in gastronomic and hygienic properties according to consumer requirements).

Practically all the commercial fishes of nutritional importance are processed (or they can be processed) into frozen product. Only a few species of fish are excluded. As an example, the northern wolffish is not frozen since it is considered to be suitable as food only when salted. Frozen "sosvinskaya" herring is not produced, since it has delicatessen properties as a spice-salted product.

The first 24 places in volume of frozen fish production / 218 in our country are occupied by the following fishes: cod, haddock, hake (whiting), navaga, rockling, Atlantic and Pacific herring, Baltic herring, Caspian and Baltic kilka, Far East flounder, keta and pink salmon, ocean perch, gilthead, mackerel, scad, goby, sturgeon, sevriuga, bass, pike, bream and wild carp.

When fish is frozen its body temperature is lowered to such an extent that the water contained in the fish is converted to ice. This process slows down many biochemical processes, and the

vital activity of microbes is completely or almost completely halted. This provides the necessary conditions for prolonged storage of frozen fish (from 1 to 8 months and even longer).

The amount of water removed from fish by freezing, in relation to temperature, is given below:

Temperature degree C	Amount of water removed in % of its total content in the fish
-6	71-82
-10	80-85
-14	85-89
-18	88-90
-30	90-96

Naturally, the hardness of the fish increases as the amount of water converted to ice in it is increased.

The condition of the fish immediately before the start of freezing has a direct influence on the quality of the frozen product. This, in its own turn, depends on the duration and the conditions in which the raw fish stock was held before freezing and on the degree of stability of the fish of that species, the season and fishery. Raw fish that has not been frozen promptly will not give a first-class frozen product.

However, the rate of freezing has a decisive influence.

This is explained by the fact that during immediate and sufficiently rapid freezing (in fast-action fish freezers) the ice

crystals formed within the muscle fibers are very numerous and small and therefore they do not destroy the walls of the fibers (they do not damage the tissue structure).

During freezing of fish and its subsequent storage (including long shipment) the protein becomes denatured to some extent, there is a change in its ability to dissolve, its moisture-retaining properties and its property of swelling are decreased. As a result of this the fish meat frequently becomes dry, tough, occasionally coarse-fibered or watery, and lacking in aroma and taste. This is discovered during cooking, smoking and canning.

However, these phenomena are dependent on conditions /219 and duration of storage, shipment, on the methods of packing fish (including glazing), and are manifested in different degrees, sometimes they are clearly shown and sometimes they are practically undetectable.

Consequently, it is both expedient and necessary to expand frozen fish production in our country, but measures must be taken to provide maximum safeguards against loss of quality in the products.

In our country, fish is frozen mainly on board refrigerator ships and in shore refrigeration facilities. By 1970, the capacity of shipboard freezing equipment should have been brought

up to 80% of the total capacity of all freezing facilities in the fishing industry.

In order to carry on large-scale fish-freezing operations on ocean fishery, construction has begun on industrial floating fish factories that are equipped with non-stop, automatic, fast-freezing equipment (ASMA), and these ships will occupy the foremost position in the fishing fleet.

Freezing on shore is frequently still carried out in rack-equipped freezing chambers (racks consisting of 5 or 6 layers of cooling tubes). The air temperature in these freezers is not over -23°C . The fish are placed in trays on rack-shelves or else the shelves are overlaid with zinc-plated iron and the fish placed on top of it. Particularly large and valuable fish are hung for freezing. The normal freezing time in such freezers fluctuates between 8 and 48 hours depending on the species of fish and other conditions. Freezing in quick-freezing plants or fast-action equipment insures a product of higher quality.

Types of quick freezers include air, brine and plate, of which the brine type are divided into contact and non-contact freezing plants. In the first case the fish is in direct contact with the cold brine, and in the second it is in a wrapping that is impervious to the liquid.

In plate equipment the fish is frozen between the faces of two plates.

In the air-type quick freezers, with which almost all our refrigerator ships are equipped, the fish is frozen in a strong current of cold air (chambers, tunnels and conveyor plants). Conveyor equipment is the best.

In plants and equipment using a strong current of air, the fish is usually frozen in blocks, but it is sometimes placed on trays or suspended. The usual thickness of the block is about 6 cm. The air temperature in this type of freezer is between -27 and -38°C depending on the design.

Brine freezing (by submerging in brine or spraying) is used very little because of layering of the skin-scale cover of the fish and its unsuitability for storage, whereas /220 the non-contact method is not used because of difficulties associated with flow and maintenance, as well as other vital shortcomings.

The most advanced recognized method of freezing fish is in plate apparatus (highest rate and productivity of freezing, particular compactness of the equipment, best shaping of fish into blocks, minimum technical losses and best sanitary conditions). The product frozen in plate apparatus is normally of the very highest quality. Among the

shortcomings associated with plate freezing are the unsuitability for use of the apparatus when freezing products that are of irregular form (for example, large fish, fish not cut into fillets or into steaks), certain difficulties in mechanization and the necessity for a considerable amount of manual labour.

The introduction of plate apparatus onboard Soviet fishing ships will probably be greatly increased if filleting of fish at sea will be mechanized.

Fish which must undergo long term storage and which is required by the standards, TU and technical specifications to be so processed regardless of storage period is glazed immediately after freezing.

Glazing is the term applied to the transparent, smooth and uniform ice casing which protects the outside of the fish, fillet, piece (steak) or block of fish from harmful effects of the atmosphere (drying, fat oxidation, mould formation).

The glaze is applied to fish by submerging adequately frozen fish in pure water that was first cooled to a temperature of 1 or 2° C and then is periodically warmed up to this temperature as required (in order that ice crystals, or "crust", do not form on the surface of the water).

A heartily recommended and thoroughly proven method of applying a protective coating against fat oxidation on frozen fish is to glaze it in water to which has been added sodium glutamate (0.2% concentration) and a mixture of ascorbic and citric acids (also 0.2% concentrations).

If the results of insufficient protection against fat oxidation spoilage of frozen fish is taken into account then it cannot be denied that such glazing of fish must be introduced in industry and the retail trade.

The cardboard box is the most suitable type of container for frozen fish processed on modern refrigeration equipment.

Natural freezing is normally used during the winter, in ice fishing, directly at the place of catch (on the ice of the reservoir). The advantage of this method is that the fish is frozen live and, as a rule, immediately after catch. This insures an exceptionally high quality product. Also, /221 the method is very tempting in the economic sense (there are no losses on construction and operation of refrigerators). Live-frozen fish is said to be "flash" or "splash" frozen.

However this method is practical only for freezing fish taken by the winter ice-fishing method on interior water bodies that have steady frost during the ice-fishing period (Aral Sea, Northern Caspian, Northwest and North European part of

the USSR, Siberia and many regions of the Far East).

If it is not possible to quickly pack the frozen fish into containers and ship it, it is stacked and then covered with snow or ice for protection.

Ice-salt freezing is used when there is a shortage or lack of equipment for artificial freezing (refrigerators) and under conditions when natural freezing is impossible (climate, season of the year). Contact and non-contact methods of ice-salt freezing are used.

Ice-salt freezing of fish is most frequently carried out in brine chambers (vats, bins, tubs, and sometimes in stacks), by placing the raw fish stock in an ice-salt mixture. This mixture should consist of four parts by weight of acceptably clean ice (pieces measuring up to 4-5 cm in diameter) and one part by weight of standard table salt mill No. 3. The dose of ice depends on the air temperature (season), condition and properties of the raw material and certain other causes. However, the expenditure of ice will usually be between 100 and 125% of the weight of frozen fish.

The layers of cooling mixture and fish are alternated. The success of the freezing operation depends mainly on having the correct ratios, adequate mixing of salt and ice, prompt removal

of brine formed during freezing by the non-contact method, circulation of the brine during contact freezing and, finally, prompt packaging of the fish after freezing.

The vats (bins) used in the non-contact freezing method and the stacks with fish and ice-salt mixture are promptly covered with mats or other insulating material.

It is absolutely necessary in this process to ensure high speed, continuity and promptness of all operations.

A variation to the ice-salt contact freezing method is that of Makarov, which is still fairly widely used in the North Caspian region. It consists of placing the raw fish in ordinary wooden boxes (shipping boxes) and freezing it in vats and bins through a fairly thick layer of wood, this results in the formation of a fairly large block (up to 18-20 cm). This product rarely keeps satisfactorily, particularly up to the time of sale.

When the non-contact freezing method is used in /222 brine chambers, the fish is placed in metallic forms or in stacks, and a sheet of zinc plate ("zinc freezer") is placed between the fish and the mixture.

In the contact method the fish is in contact with the ice-salt mixture and the brine formed by melting. In the ice-salt contact freezing method, coating of the scale-skin

covering and surface layers of the meat frequently takes place. Such fish becomes tarnished, its fat oxidizes more rapidly, the product acquires "old" odours and some species of fish even smell of salt.

Ice-salt freezing can sometimes be an urgent but reliable method of protecting fresh (or thawed frozen) fish from spoilage. This is preferable to forced salting which normally results in a lower quality product and lower prices along with large technological losses. When there is a sufficiently large amount of mixture and excellent covering for the stacks the frozen fish can be preserved in it during warm weather for up to one month.

The re-equipment of the fishing industry in progress in our country at the present time is proceeding at such a rapid rate that fishing enterprises in the North Caspian and Siberia will probably be able to completely forego this very laborious and uninspiring method of freezing fish in the near future.

Repeated freezing has a negative effect on the quality of frozen fish (occasionally fish is refrozen after forced thawing mainly in refrigerator cars and the storage facilities at retail and communal feeding enterprises).

An external sign of refreezing is the appearance of rime on the surface of the fish (frosting) and tarnishing or

darkening of the surfaces.

Continuity in refrigeration must be dependably organized at all stages, including the railroad and in the trade, from the instant the fish is placed in the freezer until it is defrosted before use.

At the present time, the USSR uses cold-processing for more than 80% of fish products intended as food.

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An intermediate product between iced and frozen fish is partially frozen fish which is sometimes called deep-chilled fish.

Deep-chilling is a process in which the temperature of the body of the fish is lowered to a limit very close to the cryscopic point, but not below it, i.e., just before the product begins to freeze.

Consequently, deep-chilled fish does not include / 223 that fish which was frozen at some time and then later had thawed.

Fish that has immediately undergone deep-chilling and remains in this condition right up to the time when it is used, never having been partially frozen at any time, is normally fish of the highest quality, the most stable during shipment and storage, and is the very best type of iced fish from the point of view

of nutrition. It is generally best to strive for maximum deep-chilling of fish when it is a matter of processing, shipping and marketing iced fish.

It is a somewhat more complex matter with accidentally partially frozen fish or fish that was intentionally partially frozen and which is sometimes misleadingly called deep-chilled fish.

During the past few years, work has been done in several countries on the development of reliable methods of processing and shipping partially frozen fish. These methods are mainly intended for extending the storage period of fish, caught during long ocean voyages, without fully freezing it.

Interesting work has been done by the FRG and Portugal on partially freezing fish on board ships at sea. The holds are specially equipped for storing the catch at a temperature of -2°C , and the entire hold is kept at exactly the same temperature by means of special equipment. Some of the moisture contained in the meat of the fish freezes and the fish seemingly becomes covered with glaze. Such fish will keep for 30-32 days.

Experiments on partially frozen cod were carried out at the Torry Research Station (England) Laboratory. Although the histological damage to its tissues, as a result of freezing, were insignificant, and the gustatory evaluation of the quality of partially frozen fish was excellent, nevertheless, the market appearance of the fish was consistently unsatisfactory

and, in addition, great losses of muscle juice from the fish were observed. These indices were obtained by experimenters in 20 days, during which time the fish was partially frozen at temperatures between -1 and -2°C with tissue water loss of $\frac{1}{2}$ or $\frac{1}{3}$ due to freezing. The fish was suitable for processing into fresh fillet and smoked product.

An infrequent practice in our fishery, particularly in Murmansk, and carried on during the early spring and late fall, is to brine or ice-salt and partially freeze cod, haddock and ocean perch by lowering the temperature of the fish carcass to -3 or -4°C .

The quality of fish partially frozen by this method /224 is normally unsatisfactory when it reaches the consumer points, the fish turns dark, the consistency of the meat in many specimens is flaccid, and the meat smells "old" after cooking.

Although N.A. Golovkin and L.I. Pershina have described¹ a completely different result, long term market experience in wholesale handling of partially-frozen Murmansk fish in Leningrad and Moscow (called deep-chilled fish in the records) always confirmed the unsatisfactory quality of this product.

1

Golovkin N.A. and Pershina L.I. Post-mortem mechano-chemical changes and their role in conserving fish by means of cold. Proceedings of the Scientific-Research Institute for mechanizing the fishing industry VNIRO, Volume 1, Issue No. 2, L., 1961.

Partially frozen fish is still absent from the market assortment in our country. It has not been standardized and is not described in technical specifications. The author is convinced that there is no justification for standardizing and introducing a technological assortment for partially frozen fish before there is reliable technical organization of production, transportation, storage and marketing of such fish (initially in strictly limited quantities), and not before there has been a universal, objective and profound evaluation of its qualitative indices and economic value.

The best all-round method of processing fish on the high seas is to completely and promptly freeze the product in quick-freeze equipment.

Our present policy of broad development, consolidation and improvement of production of frozen fish should be continued into the future, while the definitely negative attitude towards the market and food properties of partially frozen fish, established by the Soviet refrigeration expert V.Kh. Ozoling², should remain in force.

2

Ozoling V.Kh. The effect of partial freezing on the properties of fish. Proceedings VNIRO, Volume 13, Pishchepromizdat, 1940.

SALTED FISH

It is expedient to salt only those fish which, when salted, are tasty, nutritive products of the hors d'oeuvres type in great demand among the population. Such fish include herring, small herring and anchovies, and also salmonid fishes. The practice of salting cod, ocean perch, run-of-the-mill and other species of fish is unprofitable and should be reduced to a minimum corresponding to the requirements for semi-product for smoking, drying, processing into balyk products and filling special orders.

The USSR output of salted fish is 1.5 times /225
greater than such output in five countries with large fishery,
taken together, such as Japan, USA, Canada, Norway and
Spain (where a considerable part of the catch is salted).

This is explained by the well-developed herring fishery in the Soviet Union and the great demand for excellent salt herring.

Production of salt herring in the USSR is growing rapidly in association with the development of ocean fishery.

With the exception of herring, the fishing industry presently salts no more than 15% of all the fish products intended for food purposes.

It should also be kept in mind that salted fish includes

a large number of semi-products intended for processing into cold-smoked products by smoking enterprises in the marketing system. Such goods include balyk products and much salt herring, kilka and anchovies, which in most cases are fully acceptable and inexpensive hors d'oeuvres products. Also, this 15% includes such famous delicacies as semga, salmon, Pacific Ocean salmon, and also lightly salted omul, muksun, peled and other ciscos.

The main raw materials for production of salted products are such fish as herring, small herring, anchovies, salmon (including semga, Pacific Ocean salmon and Siberian cisco), some carp fishes, cod, scad, mackerel, gillthead and perch.

On certain interior water bodies, where there are still no continuous refrigeration facilities it is frequently permissible to salt fish which would otherwise be included in a better technological assortment. Ships which do not have refrigerators or refrigerated holds and which conduct fishery in distant regions are naturally obliged to either convert their catch into fish flour or salted products.

However, there are species and even whole families of commercial fishes which are not processed into salted product. Such fishes are lamprey, all the sturgeons (with the exception of salted balyk semi-products), smelts (smelt, caplin, stint), navaga, bass, flounder, eel and goby.

We have clearly stated conditions for determining the expediency, permissibility or prohibition of salting. It is strictly prohibited to use highly nutritional and gastronomic raw material in the production of lower quality salted product in our country, except under extreme circumstances. This policy is reflected in price determination and in all the aspects of material and moral encouragement to production.

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Although there is a general tendency to reduce the amount of salted fish in the total production of fish products, the total amount of fish put through salting processes in our country has still not been decreased.

Salting is the term properly applied to the process of impregnating fish with salt. This period ends when the concentration of salt in the tissue juices of the fish becomes equal to the salt concentration of the brine. Sometimes brining can be discontinued before this equality is achieved. Such brining is called interrupted brining (herring brined by the interrupted method).

The processes associated with the presence of salted fish in brine can be called maturation processes (when the fish is suitable for maturation and actually does mature) or simply storage of fish in brine. This is associated

with qualitative and quantitative changes in the fish.

The current standards divide salted fish into light, medium and hard salted, according to the amount of table salt in the product. However, only one of these indices is not enough to describe the degree of saltiness and the product properties associated with it.

It is necessary to take into account the salt concentration in the tissue juices of the fish, i.e., the amount of both salt and water contained in it. The salt concentration in tissue juice is determined according to the formula:

$$\frac{a \times 100}{a + b} \% \quad (1)$$

where a - salt content in %;

b - moisture content in %.

The amount of moisture and salt is determined analytically.

This method of expressing the degree of salting of the fish accurately describes the stability of the product. In addition, it allows a proper determination of the temperature regime for storage and to select the required density of the brine intended for pouring over the salted fish.

It is recommended that salted fish of all species, including herring, be classified into four groups according to the degree of saltiness (Table 36).

Table 36

Fish	Salt concentration in tissue juice, %	Coefficient of saturation of tissue juice with salt K_n
Light salted	up to 15	up to 57
Medium salted	15-18	57-68
Saltiness above medium	18-22	68-84
Hard salted	over 22	over 84

The saturation coefficient K_n given by Dragunov¹ // 227 gives the salt concentration in tissue juice in % of the saturated concentration (where a concentration of 26.4% is taken as 100%).

The fact that the true salt concentration will always be a little higher than that computed by means of the formula (because the fish meat contains a certain amount of combined moisture which does not take part in the salt solution), can be ignored.

¹
Dragunov A.M. Saturation coefficient when brining fish. "Rybnoe Khozyaystvo", 1951, No. 7.

Future standards for salted fish (including herring) will evidently include indices for saltiness, salt concentration and the coefficient of salt saturation.

Saltiness is the term normally applied to the amount of sodium chloride in the product, the concentration of salt or percentage ratio of sodium chloride in the tissue juices to the total moisture content and sodium chloride, whereas the saturation coefficient K_n is the concentration of salt in the tissue juices expressed in percent of sodium chloride solubility.

Light salted fish is the term normally applied to fish whose meat contains less than 10% salt; medium salted fish contains less than 14% and hard salted fish contains over 14% salt in its meat.

The minimum amount of table salt in the meat of salted fish has been fixed around 6% for the basic products, with the exception of Caspian salmon (2%), Far East salmon and semga (4%), salt herring (7%), spiced small herrings and anchovies (8%). It should also be kept in mind that for anchovies and small herrings the amount of table salt is determined for the whole fish and not for the meat alone.

Maturation is not necessary for salted salmon with red and pink meat because they become fully acceptable in the gastronomic sense immediately after the saltiness reaches 4% in all

the layers of the meat (and for Caspian salmon this figure is only 2%).

Salted fish products are divided into the following main groups:

1) herring (light, medium and hard salted; fat and lean);

2) spiced herring;

3) salted small herring (Baltic herring, kilka, tiulka, the smallest herrings and ordinary anchovies);

4) spiced small herring;

5) hard salted Far East salmon (pink, keta, coho, sockeye, chinook, and char);

6) semga, Baltic salmon, lake salmon, Caspian salmon, and also light and medium salted Far East salmon (the group of semga-type products);

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7) round fish intended for cold-smoking and drying;

8) balyk semi-products, salted after being cut into balyks;

9) other salted fish (cod, carp, ocean perch and many other fish among those intended for cooking after soaking).

Products of the V and IX groups are an emergency, extremely undesirable and obsolescent assortment.

Future introduction of cold at all stages of the industry and marketing (from the fishing trawler, shore factories and transport to the wholesale and retail trade) will annually reduce such fish products until they will be completely eliminated.

The practice of hard salting Far East salmon (when this fish is a delicacy in the light salted condition) is the result of insufficient supply of refrigeration equipment to the fishing industry. Far East salmon (Pacific salmon) is still produced mainly in the hard salted state in Kamchatka, but production of medium and light salted salmon is growing steadily. Far East salted salmon enjoys a volume approximately 100 times greater than semga and other salmon taken together (excluding whitefishes) on the USSR market.

The average chemical composition of salted meat of some fish which have great commercial importance is given in Table 37.

Table 37

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Fish Product	a				
	b	c	d	e	f
Keta	53,8	21,8	7,4	15,7	14,8
hard salted, Kamchatka	50,3	23,7	8,2	no data	15,6
" " , warm brine	54,3	22,3	9,0	ditto	12,6
medium salted, cooled brine	55,2	22,7	11,6	10,2	9,1
light salted, autumn Amur	58,4	21,8	10,2	no data	8,2
semga fashion	55,4	20,6	7,1	16,3	15,1
	54,3	21,7	7,8	no data	15,0
	58,4	19,6	8,5	ditto	12,6
Pink	57,8	23,5	9,8	9,0	7,4
hard salted, Kamchatka	67,1	19,2	5,7	7,9	6,5
hard salted, warm brine	63,2	17,1	2,8	17,1	16,0
medium salted, cooled brine	63,1	18,6	10,2	9,9	9,0
	59,7	16,7	17,0	6,2	5,2
Omul, Baikal, light salted	59,7	22,3	0,6	16,9	15,8
July catch	68,9	21,0	0,5	9,3	8,5
October catch					
Baltic herring					
spring, hard-salted					
autumn, spiced					
Semga, large, Pechora . . .					
Cod, Barents Sea					
hard salted					
light salted					

a - % content; b- moisture; c- protein; d- fat;
e- ash; f- sodium chloride.

There are fish which it is expedient to salt in the round. Examples of such fish are light salted round goods (semi-products for cold-smoking), dried fish or Siberian whitefish. They are all particularly excellent in this state. Insofar as fat and large herring is concerned, it should be salted half-gutted, particularly when the stomach

is filled with food. Half-gutting has been delayed by poor mechanization of the process.

Light salted herring is the best among the assortment of salted herring.

Large scale production of light salted herring was organized in our country, during the 1930's, using an excellent raw material - Pacific Ocean sardinops (ivasi). The product was brined in vats by the interrupted process, packed in crates lined with wax paper, and then marketed under the name of 48-hour brined ivasi. This product enjoyed great popularity. During the mid 1940's, light salted Pacific Ocean spring herring became widely known. This product was prepared mainly on the west coast of Southern Sakhalin using the same technological method as for ivasi.

A method of light and medium salting Pacific Ocean herring was developed along with the changeover from coastal fishing for relatively lean spring Pacific Ocean herring to active fishing for fat herring at sea.

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Large quantities of fat Atlantic light salted herring is now being produced packed in barrels and boxes after the pattern established for Pacific Ocean herring.

A serious problem requiring solution is subcutaneous yellowing, in light salted herring, which is associated with oxidation spoilage of the fat when the herring is packed in wooden boxes. There is reason to believe that this difficult problem will be solved by 1970. Excellent results will almost certainly be obtained by packing herring in impervious film under vacuum, as well as using boxes lined with wax paper and impregnated with anti-oxidants.

The technical assortment of herring increases every year, even without taking into account the canned goods. Production of hard salted herring has been sharply curtailed: in 1966 it consisted of about 20% (including about 10% in the Far East) in relation to all the ocean salted herring (excluding canned goods).

The remaining herring is light and medium salted. / 230
If consideration is given to the simultaneous increase in production of light salted canned herring from selected, specially "sweet" salted material (1965 - 87, 1966 - 118 million conventional cans), then the improvement in salt herring assortment will become evident.

Brining is still the main method of processing herring, and further improvement in quality and assortment of salt herring is therefore of decisive importance.

Improving the quality of salt herring requires elimination of brining very lean herring, introduction of continual refrigeration, interrupted brining, complete cessation of hard salting, creation of conditions for normal maturing of herring and protection from oxidation spoilage of the fat during storage without brine.

The main tendency in processing cod and other large cod fishes is preparation of klipfisk, exported by North Atlantic countries to many parts of the world in the salted (semi-product) and salted-dried (finished product) states.

Sorbic acid, which was widely known earlier as a method of protecting smoked and other products from mold spoilage, is a very effective means of protecting klipfisk from the effects of microorganisms which are a very serious menace to this product. Sorbic acid is very similar to natural fatty acids, it is easily assimilated by the human organism, it is physiologically harmless, and does not affect the odour and taste of the product. It is evidently capable of protecting any salted fish from fuchsin¹.

¹ VNIRO Compendium of scientific-technical information, 1965, No. 6, pp. 54-55.

The spice salting process includes salt, sugar and more or less complex combinations of spices. Such brining is used for small herrings, anchovies, and also other herrings and some whitefishes (cisco, tugun, including the famous "sosvinskaya" herring).

Spice brined fish is sold in weighed portions from barrels or it is delivered as a semi-product for canning. Spiced fish is a keen appetizer intended for consumption in small quantities immediately before the main meal. The main value and use of such appetizers is that they intensify the appetite, thus increasing the flow of digestive juices and, consequently, improving assimilation of the main course. Although the consumption of spiced products in small quantities as appetizers is very beneficial, their use as a main course is not recommended.

High quality spice brined products can be obtained /231 only in the event that the spices are introduced at the same time as the salt (at the start of brining) to the raw fish stock. When the product is subsequently packaged in containers additional spices are added, but this only gives excellent results when the main part of the spices and sugar were added during brining of the raw material.

The brine must be moderate, not over-salted, and without excessive pressure on the fish. The preparation of spiced products from hard salted fish is forbidden by the GOST, since, in this case, the spices cannot insure normal aroma and taste in the meat, while the absence of sugar, surplus of salt and great compression of the fish during straight vat brining excludes the possibility of obtaining a normally-matured delicacy. The art of spiced brining consists of the prompt introduction of various spices in specific quantitative ratios to obtain "the bouquet", i.e., the characteristic and pleasant combination of odours and taste which must be piquant and which must arouse the appetite.

The industry uses selected and tested spice recipes for spice brining fish. However, this does not exclude the necessity for further research and introduction of still better combinations by legitimate means.

It is particularly important that the spice products be constantly in contact with the brine, and this is mandatory for natural brines formed during processing of the particular fish. Therefore, particularly high quality of the barrels and special care in handling them is exceptionally important in this case.

The GOST divides spiced herring according to the salt content into light salted (with 6 to 9% salt content in the meat) and medium salted (with 9 to 12% salt content in the meat).

On the basis of the manner in which it is cut, spiced herring is divided into round, pharynx-cut, gill-cut, half-gutted, beheaded and trunk.

Small spice brined fish is prepared from fat round fish. Spice brined fish must have a clean surface without yellowing; it is permissible to have insoluble sediment consisting of droplets of protein substances both on the surface and in the spice brine. When the fish leaves the enterprise it need not be fully matured, but it must be matured before it enters the retail trade network.

In the West, they have long made wide use of excellent gastronomic sweet-brined fish products such as herring, small herrings, or, for example, salmon (semga), which we have unfortunately not produced until very recently (if the specially brined herring in 3 and 5 liter cans is discounted, this herring is actually processed by this same sweet-brining process, although it is called specially brined herring).

On the basis of long and multilateral experience
in work with imported Atlantic sweet-brined fat herring

packed in barrels, we can truly recommend the organization of large scale production of sweet-brined fat ocean herring packed in barrels onboard Soviet ships.

In addition, it would be fully justifiable to pack preserves in small containers (net weight 120-350 gm), using cut herring, as well as from kilka and Baltic herring that was sweet-brined (without spices) which would undoubtedly enjoy great consumer demand.

It must be taken into account that the majority of consumers prefer salted fish snacks in the form of well matured herring, Baltic herring, kilka with oily consistency, which have a natural fish (and not spicy) aroma. Therefore, sweet-brined products which meet consumer tastes must be produced both in barrels and in very small containers. There is no reason why such production should be limited only to large (net weight 3-5 l) cans and to large herring.

It is a known fact that the use of sugar in sufficient quantities makes it possible to give the product a more tender, softer taste and oily consistency, to speed up, strengthen and improve the maturing process, and, mainly, it predetermines the special piquancy and strength of the bouquet of the sweet-brined product. This is so because sugar ensures the development of the aroma causing bacteria in salted fish. Improvement in the

maturing of sweet-brined products predetermines and significantly increases their stability. Another desirable gastronomic effect is that the sugar tones down the taste of salt in sweet-brined fish.

Sugar added during spicing and sweet brining prevents excessive swelling of the fish product.

The introduction of sweet-brined products by means of careful advertising will arouse demand for barrel-salted herring and preserves, will achieve a great economic effect, and will satisfy the demands of those consumers who are allergic to spiced snacks or find them unpleasant.

Another important factor is that, after widespread introduction of sweet-brined product, it will be possible to significantly reduce expenditures on the import of spiced products.

CURED AND DRIED FISH

Cured and dried fish are normally combined into a single cured-dried group. However, these are principally different products that are entirely different in type of raw material, technical preparation and consumer properties.

Fully matured, ready-to-use cured products until recently were processed from the following species: white-eyed bream

(Aral and South Caspian), vobla, silver bream (Azerbaijan), /233 smelt, bream, roach (Siberian, Amur side) vimba, blue bream, Azov roach, shemaia, Chekhon and ide (Siberian).

A unique and very valuable, from the gastronomic point of view, maturing process takes place during curing. The essence of it consists of deep changes in the proteins and fat, in impregnation of the meat with oil, given it a rich, keen and entirely unique bouquet, firm rich consistency, translucency, amber colour and very pleasant, piquant and slightly bitter taste.

Real cured fish is a unique product that can be used under any conditions, for example, in the field and on expeditions, because it is light, highly nutritious, does not require further cooking and is stable in storage.

Naturally cured is not able to mature and therefore does not have the gastronomic properties found in true cured fish.

A product which is suitable only for cooking, even though it is called cured fish in the GOST price lists, is obtained from ruffe, crucian carp, tench, Balkhash perch, river perch, wild carp, zander, pike and naim.

The main source of cured product in our country is vobla (North Caspian, Aral Sea) and its variety the Azov roach,

and also the bream (cured Aral bream is particularly fine, it is distinguished by its high fat content and clearly expressed piquant taste and bouquet).

Raw material intended for curing must be kept for a suitable period before salting.

Other fish besides the readily maturing species such as vobla, taran and bream must be kept for a suitable period before drying. It is noted from foreign sources that, even with the latest and very effective methods of artificially drying unsalted cod, the fish dried in a state of rigor mortis was of lower quality than that processed after rigor mortis had relaxed.

In Japan, where natural and artificial drying of fish and other marine products is very well developed, they start drying fish only after the autolytic processes have sufficiently weakened the initial consistency of the meat.

Maturation of naturally cured fish is insured when it is moderately salted and contains an appropriate amount of fat. Excellent conditions occur when the fish is irradiated by the direct rays of the sun at a moderate air temperature (up to 20-22°C). Maturation is influenced by the fact that, under the stated favourable conditions, the hydrolytic activity

of the enzymes ((protease and lipase types) increases sharply, causing active hydrolytic processes and structural changes in the proteins and fats. Solar irradiation is desirable, /234 but it is not an absolutely necessary condition for producing first class cured fish.

Cured fish is produced mainly in the Volga-Caspian region (Astrakhan'), to a lesser extent in the Cis-Azov region, at the Tsimlyanskoye water reservoir, in Kazhanstan, and a very small amount in Siberia.

The total output of cured fish, naturally dried (unmatured) and hot dried product is about 15,000 tons (8-9 times less than smoked product), including the true cured fish which evidently amounts to no more than 8-10 thousand tons.

The national tastes of most of the peoples in the Soviet Union are such that the demand for cured fish, even for very mediocre, fairly low quality product (made from very small and insufficiently fat raw material, oversalted and inadequately matured), is exceptionally great.

Production of cured fish is founded almost exclusively on natural curing and is associated with manual labour. The utilization of mechanized processes will permit sufficiently large-scale organization of cured fish production by artificial or natural curing processes, because the raw materials and technical conditions exist for this application.

The curing process can use halibut, ruffe,
ocean perch and some other flatfishes (including Pacific Ocean varieties), sardine, scad, Atlantic mackerel, white croaker and some other croakers, wolffish, smelt and caplin, herring (mainly the Atlantic varieties), Baltic herring, tiulka, most whitefishes, grey mullet, butterfish, ocean perch and gilthead, as well as many fish of the cyprinid family (bream, silver bream, blue bream, white-eyed bream, redbfin, chekhon from all regions, and small fishes such as silver carp, Amur carp, barbel, kutum and ide).

Herring, scad and other herring fishes, flatfishes, mackerel and horse mackerel, whitefishes, as well as very fat vimba and shemaia, are extremely unstable fish in the dried state. They are therefore utilized as a salted semi-product or frozen raw material for processing into cured product in consumer areas or near them, in order that the product can go directly to the stores, dining rooms and restaurants. Work with these cured products is facilitated by the availability of cold storage and refrigerated transport equipment.

A many-fold increase in production of cured (matured) fish in our country is assured by both great raw material and technological resources. The matter rests on mechanization of production and the initiative of specialists.

It is necessary to abandon the long established but incorrect notion that "true" cured fish can be obtained only under conditions of natural curing and, therefore, production of this particular product has a seasonal character and can be reliably developed on a large scale only in the Caspian, Aral, Azov and Black Sea Basins.

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In reality, it is possible to produce excellent, fully matured cured product throughout the entire year in covered and heated accommodation with forced air ventilation.

This is exactly the principle that is being applied at the present time in production of cured fish from the fattest fall vobla, particularly at the Combine named after Kuybyshev on the North Caspian.

Small experiments in curing silver bream taken during the first voyage of the NPS "Academik Knipovich", utilizing simple drying processes with forced ventilation, and carried out by the author during the winter of 1966, have shown that, in spite of the 9-10 month period of storage at insufficiently low temperatures preceding curing, and fat content of the meat not over 3%, marine fish can yield high quality cured product by an artificial process.

S.I. Gakichko is one of the first men to have made a deep study of the possibilities of obtaining dried product under

artificial conditions and he came to the conclusion that such processing was practically feasible and expedient.

Fish is dried by the hot and cold methods, artificial hot-drying is carried on at a temperature between 80 and 200°C, the cold method is mainly by natural means in the open air but sometimes artificial means are employed; in both cases the temperature does not exceed 40°C, while for fat and medium fat herring it does not exceed 25°C, in this case without the direct effects of the sun's rays.

The method of hot-drying in the atmosphere is used mainly for stint and, unfortunately much less, for smelt and all other small and lean fish (ruffe, very small river perch, bleak, goby etc.).

Salted-dried stint is prepared in the lake regions of the Baltic (mainly on the Pskov-Chudskoye Lake).

Stint, smelt and other small fish are dried in ovens operating on the periodic or continuous principle (primitive ovens of old design, Batanov system ovens with take-out fire boxes and small drying chambers, as well as the most modern and productive steam conveyor dryers model PKS-90).

Whenever smelt cannot be delivered to the consumer in the fresh and frozen state or preserves cannot be made from it,

it is better to organize natural curing or fire drying (like stint). Lightly salted and then cured smelt is made into an excellent product on the lower reaches of the Amur River. Salted and dried stint has been processed in ovens for at least 4 or 5 centuries and even today it is a universally recognized valuable, palatable, nutritious and very convenient fish product. Practically all the stint is processed by the hot-drying method. Evidently, it would be expedient to universally apply this technological method in the processing of small smelt (it should be noted that stint is a dwarf lake form of smelt).

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Cured and dried fish is normally stored in dry, bright, well but moderately ventilated and cooled storage. The maximum permissible duration for storage of cured fish under such conditions is not over 2-3 months, while for naturally dried and hot-dried fat fish the period is up to 4-6 months.

When long storage of cured fish is necessary, it must be kept in refrigerators at a temperature not over -5°C (it can be considerably lower).

SMOKED FISH

Smoking fish consists of saturating it with aromatic volatile substances (alcohols, acids, aldehydes, ketones, carbohydrates, phenols and ethers) emitted during slow burning of wood. These substances give the fish a specific and pleasant odour and flavour and have a destructive effect on microflora. A mixture of phenol, wood alcohol and tar particles colour the surface of the fish a golden brown.

Smoked fish is a nutritious, palatable product that does not require preliminary cooking before consumption. Hot-smoked fish meat is tender, juicy and tasty. This type of product is in great demand.

Cold-smoked fish is a stable, dehydrated and matured product with a pleasant aroma of smoke.

Smoking the fish at consumer points makes it possible to turn out a juicier product with lower production losses, this increases the profitability of producing smoked goods.

Wood fuel is used exclusively for the real smoke method of smoking fish. The best fuel for smoking is oak, beech, alder, aspen, and birch without the bark. Spruce, pine and fir, which contain a large amount of resin, spoil the taste of the fish and their use is therefore limited. Shavings of coniferous species must

be kept for several months in order to evaporate the aromatic resin substances.

In the USSR, both cold and hot-smoked fish / 238
are produced. In addition, in future the assortment may again include fish processed by the semi-hot-smoked process, this is an ancient Russian product of the kipper type.

In addition to balyk products and balyk-type products, the cold-smoking method is used in processing the following: grass carp, surmullet, butterfish, white-eyed bream, goby, skygazer, vobla, char, pink salmon (fig. 98), drums, silver bream, dace, zheltoshek (a cyprinid), asp, snakehead, wolffish, flounder, gilthead, keta, mullets, coho, kilka, redbfin, sockeye, kutum (a cyprinid), lenok, bream, bluefish, marinka, oilfish, muksun, nalim, inconnu, rock perch, ocean perch, omul, halibut, bonito, peled, haddock, pizhyan (Siberian whitefish), vimba, cisco, coalfish, saury, Baltic herring, garfish, all kinds of herring, whitefish, mackerel, catfish, scad, Azov roach, taimen, silver carp, cod, tiulka, sablefish, barbel, anchovy, grayling, chinook salmon, chekhon, broad whitefish, shemaia and ide.

The fish processed by the cold-smoking method that are produced in the greatest volume and most widely distributed are as follows: vobla, pink salmon, keta, mullet, bream,

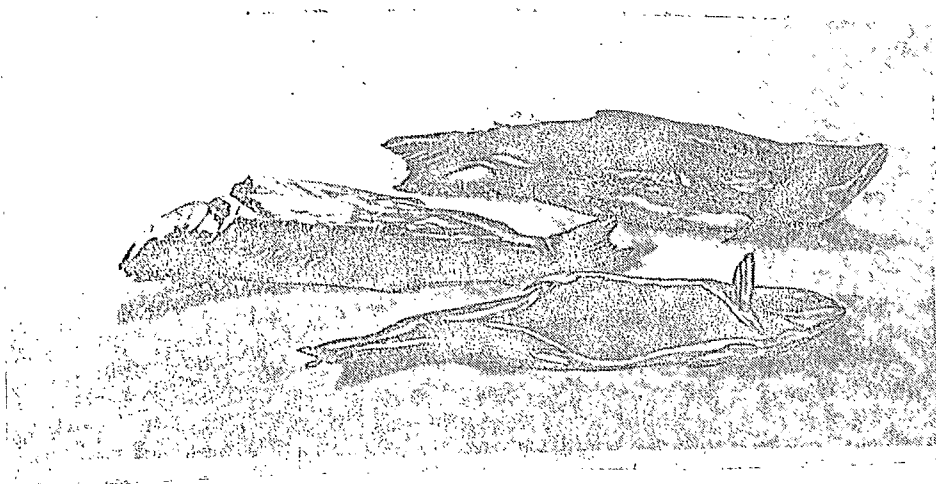


Figure 98. Cold-smoked gutted pink salmon.

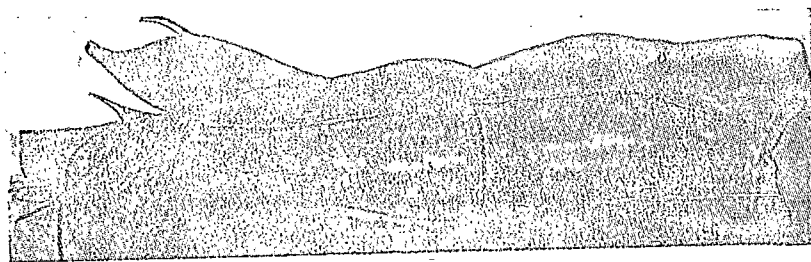


Figure 99. Hot-smoked cod.

haddock, Caspian, Atlantic and Norwegian herring, Siberian whitefish, mackerel and cod. Baltic herring is also smoked by the cold method, but presently in much smaller quantities than the available raw materials and technological capabilities would permit (the technology has not been sufficiently mechanized and the processes are extremely laborious).

Products made by the cold-smoking method from semi-products containing salinity of 9-12% are of higher quality than products made from hard salted semi-products. Excessive soaking has an adverse effect on the gastronomic and hygienic properties of the product.

The time required for preliminary drying (dehydration) in the cold-smoking method depends on the conditions and the duration of the anticipated shipment and storage of the smoked fish. The standard permits cold-smoked herring to contain 60% moisture in the meat (the lower limit is not fixed), and for all the other fish it is between 42 and 52% for some species and between 42 and 60% for other species of fish. When the smoking is done at consumer points it is often practical to keep the moisture content close to the upper limits, however, shipment of such fish from, for example, the Caspian or Azov regions far inland during the spring and fall frequently results in damage to the product by mould and saponification.

Processing pike-perch, pike, Balkhash and river perch, tench and gillthead by the cold-smoking method is not advisable from the consumer point of view.

The specific assortment of hot-smoked fish has been expanded so much that it is more convenient to list the species of fish that are not hot-smoked or should not be smoked. Among such fish are the cyprinids such as carp, shemaia, vimba, marinka and some Amur cyprinids; of the salmon fishes /239 these include the semga, Caspian, chinook, sockeye and coho salmon, sosvinskaya herring and generally all the tugun species, and of the other fish families the Northern and Atlantic wolffish, halibut, navaga, stint, tiulka, and lamprey. Carp, shemaia, vimba, the above-named salmonid fishes, lamprey and navaga are not hot-smoked, since such processing does not bring out all the remarkable, high-quality natural properties of these fishes, whereas these properties are brought out by the other methods of preparation. It is not in the consumer interest to hot-smoke such fish as keta and pink salmon, pike-perch and pike.

Kilka and tiulka make an excellent hot-smoked product.

The basic assortment of products produced by hot-smoking by the majority of smoking plants is often very restricted and is limited to cod (fig. 99), haddock (processed and marketed as cod), bream and wild carp. A prominent position in this assortment is occupied by vobla, pink salmon, mullet, ocean perch, and in

Siberia and the Urals, the Siberian whitefish, Baltic herring and kilka (mainly in the Baltic region), Caspian and Norwegian herring, Far East mackerel, catfish and scad. Besides Baltic herring and kilka, the following fishes are distinguished for their excellent gastronomic properties: surmullet, smelt, spotted wolffish, ocean perch, all the whitefishes, including the numerous Siberian whitefishes, small inconnu, eel, sevriuga, great sturgeon, mackerel, scad and all hot-smoked herring (if the raw material was without any signs of oxidation spoilage of the subcutaneous fat layer, appearing after heat processing).

For the semi-hot-smoking method, excellent materials are small herring, Baltic herring and small whitefish, particularly cisco, including the Siberian cisco, and when the smoking method is sufficiently mechanized then any kilka, tiulka or anchovy should be suitable.

It would be expedient to resurrect semi-hot-smoked fish products in the USSR. Such products are normally prepared in ovens intended for the hot-smoking process and using light salted semi-products.

The fish is soaked for 1 to 3 hours, as necessary, and then pre-dried over open flues (temperature about 20°C). When the skin has become "parchment-like", the temperature in the

ovens is raised to 75-80^o C, the burning wood is covered with shavings and the flues are closed. The semi-hot-smoking process continues for 3 to 6 hours (depending on the raw materials) and is considered to be completed when the fish meat becomes cooked, compact, and its surface acquires a beautiful golden colour. The best product is obtained by this method when the meat contains between 5 and 7% salt. The moisture content in the meat can vary considerably depending on its properties (mainly on the fat content), season, conditions of utilization (immediate use or anticipated storage, shipment) and market requirements. However, the traditional semi-hot-smoked product is quite dry and contains no more than 48-52% moisture in the meat. /240

Cold-smoking produces a product that is more stable under storage conditions. Hot-smoked products are prepared for immediate consumption or further processing (for example such canned products as "Sprats in Oil", "Smoked Cod in Oil", as well as for storage and long shipment frozen after smoking). Hot-smoked fish is processed whole or gill-cut, gutted, scales removed, and beheaded. Very large fish are smoked after being cut into pieces. With the exception of balyk products, cold-smoked fish is normally processed whole.

The production of cold and hot-smoked fish products is widely developed in the USSR and production continues to grow. The choice of smoking method is determined by the properties of the raw material, consumer demand and economic feasibility.

The USSR annually produces at least 170 thousand tons of smoked fish, which is over 1/2 the world production of such product.

Smoke enterprises in the retail system are showing greater interest in the hot-smoking method in preference to the unjustifiably curtailed cold-smoking of fish (except for herring), and, also, frequently due to the lack of suitable salted semi-products.

Hot-smoking consists of heat processing fresh fish (after flavour salting) at a temperature between 80 and 180 °C. The temperature normally reaches 70-75 °C within the mass of the fish. The meat of the finished product normally contains 1.5-3% salt. The smoking process and preliminary drying and baking takes from 1.5 to 2.5 hours depending on the greatest thickness of the fish in cross-section, its fat content and the moisture-heat regime used.

At the fishing grounds, hot-smoked fish is produced only for local consumption, for air shipment or for subsequent

freezing. The hot method is used mainly at consumer points.

Special control measures are necessary to insure that hot-smoked fish shipped and delivered in the frozen state would be frozen immediately after smoking, and at fixed (taking into account the anticipated storage period), sufficiently low temperatures, stored and shipped at uniform, also sufficiently low temperatures and should not undergo premature and extensive thawing. The technological regimes are given in the chapter "Storage".

Hot-smoked fish that is not intended for freezing must be sufficiently cooled immediately after it is discharged from the ovens, and this must take place before it is packed in containers.

Such cooling is necessary both to reduce technological losses and, consequently, to improve the economic indices of the product, and also for sanitary reasons. It must also be taken into account that, without such precautions, the fish will not have sufficient mechanical strength and will be damaged during packing, shipment, transshipment and slicing.

Cooling is necessary to insure that the meat will be gelatinized in time. Gelatinization of the glutin solution ("broth" in insufficiently cooled hot-smoked fish) gives the product a unique, sufficiently firm and elastic consistency as

a result of which the product is very able to withstand ordinary mechanical effects.

Cold-smoked fish when first smoked does not have the gastronomic appearance, aroma, flavour and consistency of the meat that is found in the product a few weeks after it has been packed in containers. During this time the fat continues to spread through the meat (the fat "drips" through the fish meat), the wood combustion products (from smoke or smoke preparation) pass from the surface into the interior of the meat, and an equilibrium of salt is finally established on the surface and within the fish. However, during the pre-drying and smoking processes the intermuscular bones are no longer detectable. This whole process is called maturation of cold-smoked fish.

Incidentally, the rule of hot-smoking only fresh fish and cold-smoking only salted fish is not always applied. There are exceptions to this rule. For example, in England and Norway the fresh cod fillets and those of other fish are first flavoured salted and then cold-smoked, after which the raw smoked fillet is frozen and stored in the frozen state until consumption. Cold-smoked fish fried in butter is delicious and suggests ham by its aroma. In Canada, such fish is cooked in milk.

The Murmansk Fish Combine demonstrated, by means of samples of its products presented to the All-Union Taster's Commission, that very thin, and therefore valueless when normally processed by cold-smoking, belly of salted wolffish and large halibut, which was sufficiently soaked, yields an excellent product in the form of hot-smoked rolls. The unique colour of the roll in cross section (layered from creamy to grey), although unusual, the very pleasing gummy consistency, the remarkable aroma and keen (but not sharp or strong) taste give these fat and tender rolls high gastronomic properties.

Until recently, the belly of such fish was best utilized as liquid waste.

The same kind of product can be made from shark belly.

The combustion of fuel in smoke generators in comparison with combustion of wood fuel in fires directly beneath the fish has many unquestionable advantages.

Smoke generators are powerful centralized sources of fumes for smoke processing. Operation of these plants creates favourable conditions permitting improvement of the technology and equipment of fish smoking production and simultaneously

to produce commercial smoked product of improved quality.

In particular, this offers the possibility of establishing and maintaining the necessary stable technical regimes in the operating space (oven), to mechanize and automate production processes for generating the smoking fumes, their path to and distribution in the smoking plants.

Technological and sanitary-hygienic conditions for smoking fish would be improved by utilizing smoke generated from wood shavings in smoke generators.

The time required for the smoking process is considerably reduced when the smoke generator PSM (VNIRO) is used and a product is obtained which is of high quality according to all commercial and organoleptic indices (hot and cold-smoked) due to the lowered humidity of the smoke).

There is a significant improvement in the quality of hot-smoked products when these are smoked in fumes from shavings (obtained from a smoke generator).

Air heaters, and other sources of heat used in modern fish smoking plants should be used in the hot smoking process.

It is advisable to use, as fuel, wood that has a minimum amount of tar, and to sufficiently frequently and thoroughly clean the tar off the inside surfaces of the smoking ovens, chambers and tunnels.

Efforts are being made at the present time to make smoked fish products above reproach in the hygienic sense. The problem of hygienic improvement of smoking fish by the hot process is undoubtedly an urgent and pressing one.

The North Atlantic countries whose fishery is advanced process herring by the cold-smoking method in a rather unique way. The technological assortment of smoked herring is wide, ranging from products that are flavour brine-salted and the so-called bright smoked products to goods known under the names of red, dark and hard herring, the smoking process for which sometimes lasts up to 2 or 3 weeks (an extremely stable product for African and South Asian markets), for example, Norwegian, English, Scottish and American Bloaters, English Kippers, Red-herring, and Black-herring.

The practice of preparing and using kippered herring in England is of particular interest. This is large, /243 split to the back, fresh salted and lightly smoked North Sea herring with the head on.

The brining process is for flavouring only (it is kept in saturated brine for 15-25 minutes). It is smoked over shavings and chips of a mixture of hard woods at a temperature not over 28°C for 12 hours, sometimes a little longer. The skin of

the kippered herring must be light gold in colour, while the meat must be a light bronze colour.

Kippers are intended for quick consumption, they are not suitable for long shipment. The maximum length of storage in England is considered to be several days. In England, the kippered herring is normally fried before eating. Kippers are used in many countries, including East Germany and West Germany.

Production of kippers was begun here, in Estonia, according to RTU ESSR 758-61. The product was called "choice smoked herring". These technical specifications fix the salt content in the smoked herring meat to between 2.0 and 3.5%, and moisture not in excess of 62%.

It is permissible to store this product for 5 days in the retail network and communal feeding enterprises when refrigeration is available.

Kipper production at large population centers in our country, providing there is proper organization and intelligent marketing, is promising and can be used to improve the assortment of choice fish products, and at the same time to increase the demand for frozen herring on the part of fish processing enterprises.

BALYK PRODUCTS

Balyk products are made from the fattest specimens of valuable sturgeon and salmon fishes (great sturgeon, sturgeon, inconnu, Baltic salmon, chinook, sockeye, keta (fig. 100) and coho salmon), these fish are specially cut, they are moderately salted, cured, and then smoked by the cold method and marketed entirely or almost completely edible. Excessive salting deprives the balyk products of their gastronomic properties.

Balyk products are most frequently made from great sturgeon (flank and belly) and sturgeon (back and belly). Some balyk products are made from sevriuga, but it is much more suitable for hot-smoking.

Balyk-type products are also made from some less valuable species of fish. Well known balyk products are made from Caspian black-backed shad, barbel, ocean perch, and also from the boneless parts of skinned spotted wolffish that has been cold-smoked.

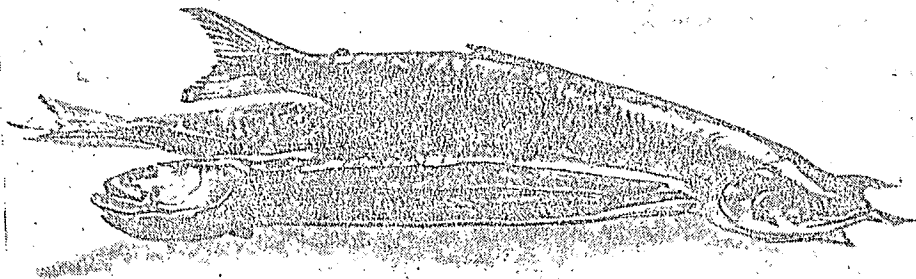
/244

Figure 100. Keta salmon balyk (back) cold-smoked.

Excellent first-class balyk is also obtained from some fleshy, fat and large fish caught on ocean fishery (for example, coalfish, oil fish, sergeant fish, halibut, large scombrids including mackerels, some tunas, swordfish, marlins, sharks, drums, giltheads and ocean perch). Production of this type of balyk product awaits organization.

Balyk products are classified, according to the method of cutting, into back (true balyk), flanks, belly (abdominal part) and flat fillets (half the fish without the spinal column, head or fins). Processing of balyk products can be described by the following sequence of events: incomplete defrosting of the frozen raw material, cutting, sorting, washing, salting, equalization

(redistribution of salt), sorting, soaking, cleaning, tying, checking, curing, cold-smoking, cooling, packing and storage. The backs of fresh sturgeons and large salmon are normally frozen before salting. When air-dried balyk products are processed, they are hung in towers for this purpose until mature.

Balyk products may be prepared only in special shops, and the sturgeon product is processed under very strict sanitary conditions laid down by the health authorities.

When planning, recording, accounting and marketing balyk products we include the true balyk products and goods of the balyk type, also hot-smoked sturgeon fishes, as well as semga and other goods of the semga type including lightly salted pink salmon. This artificial mixture of goods of three clearly distinct groups interferes with classification of goods and should be stopped.

Table 38 shows the maximum permissible salinity of the meat of true balyk products and balyk-type goods taking into account the standards that were renewed in 1965 and 1966.

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The upper permissible limit of salinity in many products has been lowered in the new standards. This has significantly improved the quality of balyk products. The minimum salinity

Table 38

(a)	b		
	c	d	e
Back and belly of inconnu . . .	8	8	10
Back, belly and flank of great sturgeon, sturgeon, ship sturgeon, sevriuga	7	9	11
Back of chinook, keta, sockeye, coho salmon	None	9	12
Belly of chinook, keta, sockeye, coho salmon	"	7	10
Flank and flat fillet of silurids, fillet chunks and belly of wolffish, back (small balyk) of ocean perch, omul, muksun, broad whitefish and scad	"	9	12
Small balyk of black-backed shad .	"	8	10

a - fish goods;

b - maximum permissible table salt content (in %) in meat of grade:

c - premium, d - first, e - second.

in the meat of cold-smoked balyk-type products is 5%. In the true balyks it cannot be lower because of practical considerations.

Balyk products are prepared mainly at large consumer centers to which the fish industry ships frozen raw material or salted semi-product. Unfortunately, over 90% of the balyk

products from sturgeon fishes are processed from salted semi-product that was prepared at Astrakhan and then stored in barrels of brine in which the semi-product swells and becomes oversalted, its quality being thereby unjustifiably lowered. Work is being carried out on storage of salted semi-product in plastic under brine.

Air-cured balyk products from sturgeon fish are superior to smoked products in quality, because the long curing of balyk products in special balyk-curing towers causes the fat in them to be redistributed and both impregnates the tissues of the product and also undergoes deep chemical changes that are favourable to the formation of aromatic-gustatory and other gastronomic features of the product (fig. 101).

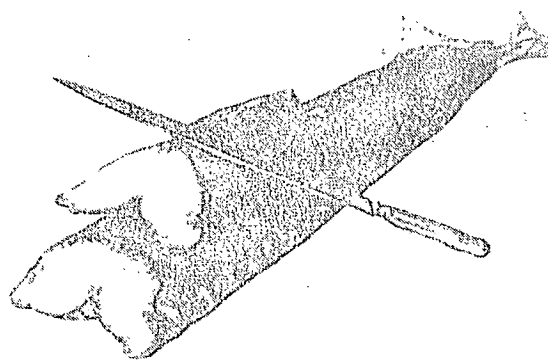


Figure 101. Sturgeon air-cured balyk showing cross section.

Air-dried (cured) balyk has, for practical purposes, not been produced for a long time, but such production should undoubtedly be revived. Evidently an economic stimulus is required (different prices).

When packing, shipping and storing balyk products, care must be taken to insure that they are not submitted to physical shock or damage. This is necessary in order to /246 insure that the meat will not disintegrate during slicing.

The rules for preparation of fish products, including balyk products, for the retail trade, the norms for waste and other indices are given in current instructions.

CONSERVES AND PRESERVES

Conserves are those products that are placed in hermetically sealed containers, heated according to a strictly defined regime insuring the destruction of those microbes and their spores which could cause spoilage under the conditions prevailing inside an impermeable container. The temperature and heating time are such that they will not lead to noticeable deterioration of the commercial and nutritional properties of the product.

Fish preserves are that group of hors d'oeuvres products which are packed and sealed in containers, but have not undergone sterilization. Therefore, fish preserves are a perishable product requiring cold storage.

Efforts are occasionally made in this country to change the name from preserves to semi-conserves, which is the term used in many countries. However, the term semi-conserves is applied to products that are different from those known as preserves in the USSR. Semi-conserves are primarily those products in hermetically sealed containers that were sterilized at a temperature normally between 100 and 105°C, or else they are products that were poured into hermetic containers hot, without sterilization, and therefore do not have the same degree of stability as true conserves.

Hot poured fish semi-conserves are produced, for example, by the Moscow Fish-processing Combine from fried fish poured over with tomato sauce; these semi-conserves are provided with labels stating the maximum permissible storage period.

There are very many hot poured fish semi-conserves in the German Democratic Republic (sterilized meat semi-conserves of limited stability are widely used).

In connection with this, it would not be proper to change the name of fish preserves (which do not undergo heat processing at all) to semi-conserves because these are basically different products.

Many species of commercial fish are utilized in the preparation of conserves or preserves. Fish of higher delicatessen properties, as well as the most suitable for main courses after cooking, "table" fish, or, more accurately, fish that are most suitable for cooking are not converted to conserves.

Modern fish conserving industry produces such basic types of sterilized conserves as conserves au naturel, fried fish in tomato sauce, smoked fish in oil, dried fish in oil, fried fish in oil, pastes and fish-vegetable conserves.

Au naturel conserves are processed mainly from Far East salmon, of which 50 or 60% is pink salmon, 30-35% is keta, and 10-15% is sockeye; a very small amount of this type of conserves is coho and char. Canned Far East salmon is the largest item of our national canning industry and is a very essential item of export. Nothing more is added to the Far East au naturel conserves besides the raw fish and salt.

Au naturel conserves of sockeye are the best among these conserves because of the particularly attractive bright colour

of the meat; conserves of pink salmon are valued for the particular tenderness of the meat. The cheapest conserves of this type on the world market are keta (the meat is coarse, and when cooked it has an unattractive greyish-yellow colour).

A very popular canned product in our country is made from salmon meat with an admixture of the very best, fat and tender parts of the body of the salmon remaining after the bulk of the au naturel conserves have been prepared from whole, first-class pieces of salmon trunk. This "ragout of Far East salmon", contains definite ratios of esophagus ("throat"), pieces from parts of the belly located opposite the ventral fins, and also the very tasty salmon heads (without gills, gill covers and the lower jaw). The conserve contains 16-18% of such parts. The remainder of the conserve is made up of small pieces of the trunk (nape, excrescences), as well as trimmings and pieces with mechanical damage.

Such conserves are not only delicious, they are also very nutritional (10-15% salmon truncal fat, increased amounts of calcium and phosphorous).

Au naturel conserves are also made from /248 sturgeon fishes of all species, from inconnu, large whitefish, grayling, ocean herring, Baltic herring, halibut, wolffish, scad, mackerel, saury, tuna, river perch, eel and cod liver.

Au naturel conserves from inconnu, whitefish, herring, Baltic herring and eel are often put up in jelly in order to improve the external appearance, consistency and aromatic-gustatory properties of the particularly tender meat of these fish, and also to improve the transportability of the conserves.

When preparing au naturel conserves from herring, whitefish, saury, mackerel, halibut, tuna and some other marine fishes, a small amount of spice is added, thus violating the principle that au naturel conserves are made of raw fish and salt, but this is to accommodate consumer taste and market requirements. Although such conserves are not truly natural, this addition is justified from the gastronomic point of view.

A very promising development for the near future is production of au naturel conserves made from tuna, and also tuna conserves in pork fat with garlic (stew type).

Au naturel conserves of cod liver are made without blanching. The cans containing raw liver are sealed without pouring over the contents; the large amount of oil contained

in the ready product separates during sterilization (it is rendered out of the liver).

Conserves in tomato sauce are prepared using fish that either has or has not been previously fried.

Fried fish conserves of this type are made in the USSR from a large variety of fish (whitefish, herring, carp, perch, mullet, flounder, mackerel, catfish, pike, goby and others).

The bulk of conserves in tomato sauce are made from cod, flounder, herring and small herring, goby, small cyprinids and percids.

Sturgeon and salmonid fish, as well as such fish as zander, wild carp, bream, catfish and other large fish that are suitable for storage in the frozen state, as well as fish that are more suitable for cooking, are not utilized in the canning industry or else they are used in strictly limited quantities.

The technological process of preparing such conserves consists of coating pieces of fish with flour, frying them in vegetable oil until a golden crisp crust is obtained, cooling, hand packing in cans, pouring over with hot tomato sauce, sometimes exhausting, after which the cans are immediately hermetically sealed, sterilized and cooled. The tomato sauce

contains, besides tomato (normally as a tomato paste), vinegar, sugar, onion fried in oil and a very small amount of spice (specified mixture).

About 100 trade names of fish conserves in tomato sauce are produced.

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The aromatic-gustatory properties and general approval by the consumer of conserves in tomato sauce depends mainly on the properties of the sauce itself, and not on the fish. It is therefore important to pay strict attention to the high quality of the sauce.

Fish conserves in tomato sauce are made from pieces and trunks of fish, and also as fish cakes, quenelle, ragout or, for example, sturgeon fish cartilage.

Conserves in oil are made mainly from previously hot-smoked, dried, blanched or fried fish. The classical conserve of smoked fish is "sprats in oil", these are made from Baltic kilka-sprat, Baltic herring and White Sea herring (measuring under 12 cm). In addition, conserves of the sprat type, but less satisfactory in the gastronomic sense, are made from smelt, cisco, capelin, small herring not of Atlantic origin and even from freshwater ruffe and bleak.

The conserves "sprats in oil" are made in the following manner: the fish (fresh raw material) is smoked by the hot method

with particular care (otherwise the skin will burst during sterilization and will slip off the carcass). After smoking the fish is cooled, sorted, the heads are removed, the caudal fins are trimmed and the fish are placed in cans, being sorted for each can according to size and colour of trunk. After inspection the cans are poured over with a mixture of mustard oil (25%) and sunflower seed oil (75%) at a temperature of 75-80°C (it is permissible to use a mixture of refined cotton seed and soy-bean oil). The cans are sealed immediately after filling with oil, then they are sterilized and cooled.

Fish conserves in oil made from smoked fish has become a large and rapidly growing group of the most expensive and popular fish conserves.

A specialty in the assortment of conserves in oil made from smoked fish are the sprats themselves, evidently, they are as popular as blanched saury in oil and sardines made from fish of the sardine species (but not from Baltic herring).

In addition to sprats, GOST 7454-66 takes into consideration the possibility of making conserves in oil from smoked fish of the following families and species: sturgeon (great sturgeon, sturgeon, sevriuga, sterlet); herrings (herring, Baltic herring, kilka, anchovies); cyprinids (dace, roach, bleak, ide); scombrids

(sailfish, marlin, tuna, pelamid, mackerel, Atlantic mackerel); scads; whitefishes (muksun, omul, broad whitefish, peled, pizhyan, whitefish, cisco); osmerids (smelt, capelin); flatfishes (flounder, halibut); gadids (cod, haddock, burbot); others (gobies, ocean perch, freshwater perch, garfish, saury, pickerel, greenling, eel and pike). However, the most /250 important production item is "smoked cod in oil".

The main index of quality of canned fish is the sterility, i.e., the absence of microorganisms capable of causing spoilage after the contents have been sterilized in the hermetically sealed containers. Fish conserves require so-called practical, and not absolute sterility, i.e., destruction of those microorganisms and their spores which are a real threat to the quality, stability and purity of canned products. If it was attempted to insure absolute sterility of the conserves (destruction of all kinds of microflora in the sterilized cans), this would unavoidably and sharply lower the general appearance, commercial, nutritional and hygienic properties of the product.

It is still frequently considered that sterilization must necessarily insure sufficient softening of the spinal column of the fish. It has become customary to think that the bones in conserves must crumble between

the fingers. Observance of this far-out-dated requirement results in totally unjustifiable overcooking of the meat in conserves made from fish with massive spinal column (this results in loss of market appearance, colour, consistency, taste, aroma, vitamins and assimilability). If it is realized that the bones can be chewed, even when they cannot be crumbled in the fingers, and that the main item of value in the conserves is the meat, and not the bones, it will become evident that this index for determining the sterilization regime and quality of the conserves cannot be decisive, since there are more modern and reliable indices for determining the degree of sterility of the conserves.

However, the finished product must not contain bones, scales, spines and other hard particles that could injure the mouth, digestive tract or get stuck in the throat or nasopharynx. Therefore, if the spinal column remains hard and practically inedible after normal sterilization of the conserve, then it is recommended that such fish be filleted before canning.

By increasing the strength of the fishing fleet by means of ships equipped with canning lines, capable of a large radius of independent sailing and outfitted with up-to-date equipment has made it possible to organize canning operations immediately on the fishery and also to produce preserves in the form of specially salted herring in tin cans (net weight

3-5 kgm) .

This has provided an opportunity to significantly improve the quality and expand the assortment of conserves and preserves, to improve technology, make wider use of mechanized production processes, to develop new types of high quality conserves such as "Atlantic sardines in oil", Atlantic sardines in tomato sauce", "blanched saury in oil".

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Simultaneously, production of conserves made from Caspian kilka in tomato sauce is being expanded. Production of conserves made from cut kilka with vegetables, kilka in oil, small meat balls, goby with vegetables, Caspian small and medium sized herring in oil and other types has still not been sufficiently developed.

Output of conserves in cans lacquered on the inside, although very recently greatly expanded, is still far from adequate.

The quality of conserves can be improved further by converting completely to cans with a strong protective film (inside the can), and also sealing the cans under sufficient vacuum.

At the present time efforts are being directed towards increasing production of conserves of the valuable species which are in great demand by the consumer (sardine, sprats and

saury, and also other conserves made from blanched, dried and smoked fish in oil and high quality preserves of sliced herring in various sauces).

Conserves in oil include a greater than necessary proportion of conserves made from fried fish which have, as a rule, low gustatory qualities, whereas conserves in oil made from smoked and dried fish, although they are also very popular, are still not being produced in sufficient quantities.

Preserves made from sliced fish are prepared according to the same principles that are used in the preparation of whole kilka and Baltic herring, these products are not only salted and spiced (without vinegar) but they are also marinated (processed with vinegar, salt, sugar and spices).

Production of marinated whole herring in barrels has been either stopped or almost completely stopped in our country in favour of marinated preserves of cut herring in jars, and this is fully justified.

The filled jars are sealed and immediately placed under refrigeration for maturation. Both tin and glass containers are used in the same way as for conserves.

When handling fish preserves it is important to insure constant storage in refrigerated facilities and prompt consumption,

the containers must be safeguarded from end bulging and overmaturation of their contents. The trade in preserves has recently very greatly increased.

Preserves are most frequently salted and spiced, sometimes they are salted and marinated and are made chiefly from kilka, Baltic herring and herring. Preserves are made from raw fish stock, but also from fish that are specially spice salted and straight vat and barrel brined containing not over 10% salt.

Baltic herring, as well as Atlantic, Caspian and White Sea herring are prepared as spiced preserves, marinated and also in mustard sauce (as well as in a marinade with mustard). Fish are usually cut into fillets (anchovies), fillet pieces and fillet rolls (roll-mops under the old nomenclature).

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It is permissible to use limited amounts of sodium benzoate as an antiseptic for spiced fish preserves and anchovies (i.e., besides preserves that are marinated and in mustard sauce). Antiseptic is not added when vinegar is used.

The contents of the containers with spiced fish preserves, and also specially (sweet) salted preserves, may contain 0.1% sodium benzoate similar to anchovies, and only the comparatively

lightly salted Tallin kilka may contain up to 0.26%.

Freshness of the raw material, painstaking production sanitation during processing of the fish, the necessary temperature conditions for maturation, storage and shipment of the product are all of great importance. When any one of these conditions is violated, the preserves swell in the containers and are frequently spoiled.

The basic factor in producing an excellent product is proper maturation. Successful maturation is insured by adding sugar, this causes development of lactic acid microflora which, in its own turn, destroys decay microflora.

It is very important to provide continual refrigerated storage for the finished product or sufficiently prompt utilization in order to prevent end bulging of the containers from overmaturation of the contents.

The main reason for end bulging and spoilage of preserves is non-observation of the temperature regime required for storage. In this case the vital activity of decay bacteria and spore anaerobes is intensified, they overcome the vital activity of the lactic acid microflora that is supposed to encourage maturation and increase the stability of the preserves.

When overmaturation has taken place, even when the abdominal walls of whole fish (kilka, Baltic herring, anchovy) are completely broken and the liquor has become dense, cloudy and whitish in colour, but the fish, pieces or fillets still retain their shape, in spite of the extreme softening of the meat, and the odour and taste of the preserves does not raise doubts concerning sanitary aspects of the preserves, there is no basis for completely condemning the preserves.

Although the specific assortment for the majority of the technological groups of conserves is fairly broad, the industry nevertheless places emphasis on a few species of fish which make up the main part of the assortment. For example, during the past few years the conserves of smoked fish in oil (excluding sprats) consisted of 17 species of fish (the GOST and TU permit 35 species of fish); of these, 5 species of fish were the source of raw material for production of nearly 93% of the total quantity of conserves in that assortment (cod- 42.8%, Baltic herring-18.2%, flounder- 13.7%, cisco- 9.5% and ocean perch with greenling 8.5%).

Taking into consideration the advisability of enriching the assortment of sauces and other liquors for fish and fish-vegetable conserves in response to the various properties

of the raw material and different consumer taste, the /253 sauces and other liquors should be classified in the trade names of the conserves according to the degree of acidity, keenness and piquancy. For example, the tomato sauces or marinades must be divided in technological instructions, recipes and on the labels of cans into mild, strong, keen, sweet, spiced etc. In this way, the consumer will find the type of sauce of his preference. The assortment of products as a whole must be even more varied and it must be enriched.

Vegetables are an important and irreplaceable part of the human diet. They have medicinal value against many illnesses, they act to improve digestion and increase the appetite, and they provide the organism with water-soluble vitamins and mineral salts.

This is exactly why expanded production of fish-vegetable conserves require special attention. The assortment of fish-vegetable conserves already exceeds 100 brand names. In order to insure excellent quality and a full assortment of these conserves it is obligatory that the canning enterprises be supplied with fresh, high quality vegetables.

According to output of fish conserves and preserves, the USSR is second in the world.

ROE

Roe is normally the most valuable nutritional and commercial part of the fish. It always contains more protein and fat than the muscle tissues of that fish, and its assimilability is high. Roe contains the most valuable substances and elements. Well prepared roe is a very palatable, aromatic and tender product which is very readily assimilated by the organism.

The only roe that is not a gastronomic product is that of herring, catfish, and the majority of gadid and percoid fishes (even lightly salted). Of the cod fish roe, the best is that of the walleye pollock. It can be used for a wide variety of caviar including smoked and cured ovaries in their membranes, and also lightly salted caviar.

Data concerning the maximum amount of roe found in the females of sturgeon and salmonid fish (which yield the most valuable roe) is given below:

<u>Fish</u>	<u>% content to weight of fish</u>
Sturgeon	34.5
Sevriuga	25.8
Keta	28.5
Pink salmon	23.8

Each egg consists of its casing, a semi-fluid protoplasm and the embryonal cell ("ocellus").

Salmon roe protoplasm consists mainly of protein, fat and pigment in the form of liposoluble lipochromes. The colour of this roe is orange of various shades (pink, keta, chinook salmon) or brownish-red (coho and sockeye). The casing on salmon eggs is colourless, translucent, monolayered, and covered with a thin film.

Sturgeon roe has a pigmented layer of considerable thickness that is situated on the edge of a triple-layered casing and the protein mass. Sturgeon roe is most frequently grey in colour (from light grey to almost black), but it is also frequently yellow, with brownish and khaki shades. Differences in colour of sturgeon roe are not associated with its quality, nevertheless, the lighter coloured the casing on the eggs, the smarter appearing is the product.

The essential difference in the structure of sturgeon and salmon fish eggs is that the sturgeon eggs have a casing which is much thinner, fragile and weaker than the eggs of salmon fish, and also the distribution of the fat inside the eggs is different. There is practically no fat at the centre of the salmon egg. Beneath the casing at a depth of 0.5-1.0 mm the contents of the egg consist of protein and appears to be a homogeneous mass. In salmon eggs, a disorderly accumulation

of fat droplets is found in the central layers of the egg. In sturgeon fish eggs the fat is concentrated in the central part of the egg.

The differences stated above have a decisive influence on the selection of methods for processing, packing, storing and marketing the caviar.

The chemical composition of salted caviar is shown in Table 39:

Table 39

a	b			
	c	d	e	f
Sturgeon				
soft caviar				
pressed caviar	48—55	25—27	14—17	3,5—5,0
	31—40	31—35	16—20	3,5—7,0
	42—46	30—34	9—17	4,0—8,0
Salmon, soft	54—59	22—25	4—6	9,0—14,0
	56—61	21—24	4—6	6,0—8,0
	59—60	24—26	2—4	4,0—6,0
Vobla, sieved				
barrel-packed				
light-salted				
Wild carp, pasteurized				

a- caviar; b- % content; c- moisture; d- protein;
e- fat; f- salt.

STURGEON CAVIAR

The best caviar is obtained from sturgeon family fish. This is the most valuable product among the nutritional fish goods and gastronomic products as a whole.

About $3/4$ of the total commercial sturgeon caviar is sold on the world market by the USSR. Of this quantity, over 90% of the sturgeon caviar is prepared in the Caspian Basin.

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The second largest world supplier of sturgeon caviar is Iran (12-15%).

Caviar from the noble fish is divided, according to method of preparation, into soft caviar canned, soft caviar in barrels, pressed caviar and ovaries with membranes. According to species of fish, caviar is known as great sturgeon, sturgeon, sevriuga and ship sturgeon (sterlet and "kaluga" are not of commercial importance).

The roe of the noble fish is first beaten and then washed in very clean and cold water two or three times, being stirred by hand, after which the roe is placed in a sieve. The entire washing process takes about 30 seconds. After that the granular roe is left to drain for 2-3 minutes and it is

immediately salted with the purest and finest evaporated salt which has been mixed with 0.6% borax and 0.4% boric acid in relation to the weight of the raw roe material. The salt mixed with antiseptics is screened through a fine sieve over the surface of the roe, after which the roe is thoroughly mixed.¹ The salting normally takes from 1 to 3 minutes. Granular sturgeon roe is partially pasteurized in small hermetically sealed glass jars. However, during pasteurization the eggs as a rule become excessively packed and the natural aroma of the caviar changes to such an extent that the volume of pasteurized roe produced has been somewhat limited. We have now found a method of overcoming these shortcomings.

Pressed caviar is made from raw material that is beaten by the same method as for processing soft caviar, but the roe is not washed, it is placed in boiling saturated brine at a temperature of 42-46°C. The salting takes between 2 and 3 minutes. After the brining, the caviar is pressed under a strictly controlled pressure and time regime,

¹

These antiseptics will evidently be replaced in the near future by others that are better from the point of view of hygiene.

then it is allowed to cool. Neither oil nor antiseptics are added to pressed caviar. It is packed in oak barrels that are lined with cotton cloth and wax paper, the caviar is gently stirred by hand during filling. After that it is immediately placed in a refrigerator and kept at a temperature below -7 or -8°C . The best pressed caviar comes from the sevriuga species. Pasteurizing pressed caviar deteriorates the aroma, consistency and even the taste. It is therefore forbidden to pasteurize such caviar.

On a regional basis in the USSR, the best sturgeon caviar is considered to be that from Azerbaijan (except for great sturgeon, which is practically non existent there). An excellent sevriuga pressed caviar comes from the Azov Sea Basin. Practically all the great sturgeon caviar comes from the northern part of the Caspian Sea Basin. The North Caspian sturgeon and sevriuga caviar is slightly inferior in natural properties to caviar prepared in the South Caspian Basin. Ship sturgeon caviar comes mainly from Azerbaijan.

Great sturgeon roe is the largest (normally many times larger than sturgeon roe), but very large sturgeon roe is also found and it sometimes is larger than small great sturgeon roe.

Sevriuga yields a very fine roe, but it occasionally is larger than the smallest sturgeon roe. Ship sturgeon roe is normally a little larger than sevriuga, but smaller than sturgeon roe.

The great sturgeon and sevriuga caviar always varies in colour from light grey to almost perfectly black, without yellow or brown tints and without the khaki colour. These shadings are natural only to sturgeon caviar. Ship sturgeon caviar is always grey or light grey and also without any other tints.

Nevertheless, it is not always possible to judge the species of sturgeon fish from which the caviar came on the basis of its size and colour. The caviar can be identified by the ocellus (embryonal cell) that is found on each egg. In great sturgeon and sevriuga it is always lighter coloured than the egg itself, while for sturgeon it is darker. Since great sturgeon caviar should not be taken for sevriuga because of great differences in egg size, the stated features of egg colour are reliable and convenient means of judging the species of sturgeon from which that particular caviar was obtained.

CANNED SOFT CAVIAR

This type of caviar is made from lightly salted roe (salt content in the ready product 3.5-5%), but since the product is dehydrated little, it is impossible to store it, even under refrigeration, for any length of time and therefore the roe is processed with antiseptics and stored under refrigeration. A slight amount of dehydration of the caviar takes place during this time, the antiseptics work on it and the permissible constant cooling (above the freezing point of the product) has an effect on it.

The caviar shops are kept scrupulously clean. Technological, sanitation and nutritional standards and discipline must be kept at a very high level in such shops.

Canned soft caviar is the basic type of sturgeon caviar. Tin cans lacquered inside with an edible lacquer and lithographed outside are filled with caviar, bound with a rubber ring, sewed into sacks, packed in barrels with the spaces between them filled with crushed ice.

Soft caviar must not be moist; also, it is important that each egg separates readily from the others, such caviar is called dry-pourable (the name is not entirely accurate, /257

since the eggs themselves naturally do not pour). It would be better to call such caviar "separable". The individual eggs must be sufficiently firm, separable, elastic and uniform in size and colour.

Special orders for small amounts of soft canned sturgeon caviar with pure salt and without antiseptics are also filled. This product is extremely unstable in storage and normally turns rancid after 2 or 3 months, even under the most optimum storage conditions.

SOFT CAVIAR IN BARRELS

Soft caviar in barrels is an extremely over-salted product and therefore, from the point of view of our national tastes, it can hardly be called a delicacy. It is only prepared for export in response to special orders. It contains 7-10% salt. It is no more stable in storage than canned caviar with antiseptics, since it is prepared with pure salt (without antiseptics).

Darker and smaller roe can be used in the manufacture of barrelled caviar than may be used for the canned product. The other requirements are the same as for canned soft caviar. It is packed (poured) directly into oak barrels.

OVARIES IN MEMBRANES CAVIAR

This type of caviar is made from fat, biologically immature roe, which must therefore not be beaten through a sieve to separate it from the membranes. It is salted in pieces in brine along with the fat layers found on the connecting tissues of the ovaries. Ovary caviar is not a high gastronomic product, since it is quite inferior to soft caviar in taste, it is unstable in storage, is frequently greatly oversalted and has a fatty aftertaste.

PRESSED CAVIAR

Pressed caviar is a wonderful, favorite product here in our country, it possesses high nutritional and gastronomic properties. However, in comparison with soft caviar, its production is not profitable (the technological losses are several times higher, while the price is lower than for soft caviar).

The best pressed caviar comes from the sevriuga species. Basically, it is packed in oak barrels that have been lined with cotton cloth and wax paper.

Excellent pressed caviar must have a uniform, soft, tender (but not fluid) texture, it must be very lightly salted,

have a very delicate taste and a unique fine aroma.

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VNIRO and KaspNIRKh (Makarova, Kalantarova and others) are successfully completing some interesting research on the improvement of processing technology for sturgeon caviar. The work is being carried mainly along 3 lines.

1. Utilizing other antiseptics in place of boric preparations in the processing of soft caviar. These are more acceptable in the hygienic sense and are a sufficiently effective means of conserving the caviar.

2. Utilizing a new preparation in the processing of soft caviar that is intended for pasteurization (this will not only make it possible to dispense with the boric preparations, but will also significantly reduce the pasteurizing regime and, consequently, it will improve the consistency and aroma of pasteurized caviar).

3. Organization of adequate preliminary treatment of live sturgeon having odours of slime and pollution in the roe (and the meat) in order to remove or significantly reduce these serious contaminants.

SALMON CAVIAR

Caviar made from Pacific Ocean salmon such as keta, pink, coho, sockeye and chinook salmon is produced mainly

as soft caviar (98-99%); the remainder is caviar consisting of ovaries in membranes of commercial grade and ovaries in membranes processed from the ovaries taken during cutting of frozen fish.

Small quantities of pressed salmon caviar was prepared up to the 1920's. However, the technological losses were so great (when there was a shortage of raw material), and the quality of pressed salmon caviar was so far inferior to soft caviar that the pressing methods of preparing salmon caviar were completely abandoned by the 1930's.

Soft caviar made from keta and pink salmon roe is distinguished by its higher gastronomic properties. Keta and pink salmon caviar normally make up 89-92% of the total salmon caviar output.

Although inferior to sturgeon caviar in gastronomic properties (aroma, taste, consistency of the egg casing and its contents), salmon caviar is equal or almost equal to soft sturgeon caviar in content of fat, the mineral salts most valuable to the human organism and other substances which have medicinal and preventive value, and has greater protein content than sturgeon caviar. Many consumers prefer salmon caviar to the sturgeon variety.

Soft pink or keta salmon caviar containing no more than 5% table salt and meeting all the requirements of a first grade product can be used as a substitute for sturgeon caviar for dietary purposes.

Salted soft salmon caviar normally has the chemical composition shown in Table 40: /259

Table 40

Substance	% content in salmon caviar	
	Pink	Keta
Moisture	45,2—45,4	42,7—45,4
Salt	45,3	43,7
	4,0—8,0	4,0—8,0
Protein	6,2	6,8
	31,6—33,2	30,6—33,8
Fat	32,4	32,1
	9,3—9,7	9,9—16,7
	9,5	13,3

The usual diameter of keta and chinook salmon roe is 4.6-6 mm, that of the pink salmon 4-4.5 mm, sockeye and coho 3-4 mm. Variations in egg size in fish of one species depends mainly on the size of the fish itself and the biological stage of development of the roe. In the frontal part of the ovaries the eggs are normally smaller.

The vital colour of salmon roe depends on the pigment in the form of lipo-soluble lipochromes and is dependent on the biological stage of development, salmon species, period and region of catch, degree of freshness of the raw material, degree of salinity and other processing features. Individual (fish-by-fish) fluctuations in the vital colour of salmon roe, in contrast to sturgeon roe, has less practical importance.

Amur and Sakhalin keta and pink salmon roe has the most attractive colour. When salted, it is brighter, more saturated, more pleasing in colour than Kamchatka or Okhotsk salmon roe, the grains of the fresh roe are amber-orange or yellow-orange in colour with bright and warm tones having a pleasing glance and appear to be semi-transparent.

The colour of lower quality keta and pink salmon roe is darker and duller; low quality roe is brownish-red or pale yellow, while defective roe is brown in colour.

Sockeye and coho salmon caviar, both as raw material and the salted product, are characterized by a very saturated brick-red colour and a light brownish tint.

Pink salmon caviar of the highest quality, but if it comes from fish taken at sea, when seen in the barrel can /260

have a light brownish liquor, but the individual grains when spread on bread or held on a spatula have an attractive bright colour.

Another vitally important index is that of durability, the elasticity of the eggs, i.e. the resistance offered by the egg casing when the eggs are crushed. This depends on the stage of biological development of the roe and on the degree of freshness of the raw roe before salting. The more mature the roe taken for salting and the sooner it is salted, the stronger will be the casing on the egg of the salted caviar.

Salmon roe that is less developed biologically is more highly valued as a product, however it must be sufficiently well developed in order that the eggs will readily separate from the ovary membranes when beaten in a sieve.

The high quality of salmon caviar is insured by prompt and correct processing of the raw roe, utilization of high quality auxiliary materials, careful packing into excellent containers and observation of the proper storage, shipment and transshipment of the caviar.

A particularly highly esteemed product is soft salmon caviar in which the grains are lightly salted (4-5% salt), large, elastic, attractive and uniform in colour, with a bright sheen, dry and separable (the grains easily separate from one another).

Furthermore, such product should not have a residue, noticeable bitterness or signs of spoilage (detectable in the taste and odour), and also foreign aftertaste, odour and inclusions.

Salmon roe should be processed within 6-8 hours after the salmon is landed, while the colour of the ovary membranes in pink and keta salmon is light orange, the casings of the eggs are elastic, the eggs are separable, and the fish itself is still clearly in the stage of rigor mortis. This is the basic contributing factor to a high quality finished product. The raw ovaries are sorted, washed (if they are delivered to the caviar section and not along the water chute), the eggs are separated in special sieves from the connecting tissue of the ovaries (they are beaten) and salted, then transferred into vats with boiling saturated table salt solution (brine). The salting usually takes between 8 and 18 minutes, after that the roe is drained, mixed with borax and urotropin, also with vegetable oil in a mixture with glycerine, and then placed in specially prepared caviar barrels. After the caviar has settled, the barrels are sealed and sent to the refrigerator. The industry is making strenuous efforts to convert to packaging the caviar in small and large (up to 5 litre) tin cans that are hermetically sealed.

Boric preparations (converted to borax decahydrate) are limited to a maximum of 0.3% in the prepared caviar and urotropin is limited to a maximum of 0.1%.

The borax and urotropin in permissible doses exert a certain bactericidal effect, which protects the caviar from spoilage, if they are used together in full doses and only when the established optimum temperature storage regime is observed for the caviar.

The weight of finished salmon soft caviar averages 2.0-2.8% of the weight of the salmon (females and males).

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The scale of actual and possible yield of commercial caviar is not realized because this excellent raw material is still not fully utilized. An example of this is the large-scale delivery to consumer centers of frozen round roe-bearing female keta, pink and other Pacific Ocean salmon.

The effect of freezing on the quality of salted soft salmon caviar is extremely varied: from practically negligible to significant, when the product is completely ruined, i.e., the caviar is converted to a mush (mixture of empty egg casings and residue). It depends on:

1) frequency of freezing, the first freezing is less dangerous than subsequent freezings;

2) firmness (elasticity) of the egg casings, caviar with elastic casings will better withstand freezing; the greater amount of mush in a barrel, the weaker the casings of the whole eggs in that barrel;

3) degree of salinity of the caviar (lightly salted caviar suffers more from freezing and is more easily converted during freezing);

4) duration and uniformity (smoothness) of the defrosting process.

Salmon soft caviar is now almost never pasteurized. Firstly, because the availability of reliable uninterrupted cold storage in the network (industry - transport - market - communal feeding - consumption) for successfully storing the product over long periods. Secondly, pasteurizing was discontinued because of the noticeable negative effect on the quality of salmon caviar (aromatic and gustatory properties deteriorate and, in contrast to sturgeon caviar, there is significant weakening of the egg casing).

GREY MULLET CAVIAR

There is still another, unique type of caviar which is made from the roe of the grey mullet (the grey mullet is a fish of the Mugilidae family), which is highly esteemed. Production of this caviar arose and is carried on in the Azov and Black Sea areas and is intended to please the taste of southerners.

The ovaries and membranes of grey mullet are moderately salted, cured for a long time, until the roe acquires a uniform brownish colour, resilient consistency (allowing the caviar to be cut like hard smoked sausage, into thin slices) and a strong unique bouquet. The product has excellent gustatory data. It is stored coated in wax.

//262WHITEFISH CAVIAR

Pasteurized soft caviar can be prepared from excellent fat and lean roe of whitefish. At the present time, Siberian whitefish caviar is being produced as a hard salted product of the sieved caviar type in sealed barrels with net weight of 0.5 tsentner. Salting in brine yields better results than does dry salting. It differs little in external appearance

from pike caviar (usually it is a little finer). When hard salted it loses its pleasing natural features, but it is still better than the caviar described below.

It would be useful to organize, in Siberia, production of lightly salted soft whitefish caviar that would be pasteurized and packed in small consumer containers (cans and tubes).

CAVIAR OF OTHER FISH

A comparatively small amount of caviar is made from cyprinid, percid, pike, whitefish, cod, herring, lumpfish and gobies (300-400 tons annually). The roe of these fish is treated with salt, mainly with the egg separated from the "screening", but it is called sieved caviar and not soft caviar. Particularly excellent caviar is obtained from pike and asp. A caviar of the ovaries in their membranes is made from vobla, taran, pike-perch and Balkhash perch ("Taram" of the Cyprinidae family and "Galagan" of the Percidae and Esocidae families).

Methods have been developed and are now being used and improved for pasteurizing sieved caviar of any fish. These

methods of conserving will be continually more widely applied for extending the storage period of the most likely salted soft caviar even under conditions of no refrigeration.

Pasteurized caviar can be stored for short periods in cooled and dried warehouses (like sterilized conserves) when refrigeration is not available. Freezing pasteurized sturgeon caviar is beneficial in that the consistency (after defrosting) becomes even more tender and almost like it was before pasteurization.

According to TINRO data, grenadier caviar is reminiscent of soft salmon caviar but with a weaker casing on the eggs. It has a bright orange colour, the diameter of the eggs is 2-3 mm. When fishery for grenadiers is put on a commercial scale there will certainly be a new type of fairly valuable caviar available.

It can be expected that, when our tuna fishery is developed and established, there will be organized full and varied utilization of tuna roe and that of some other fish of this family for the production of cured, smoked and salted caviar. The roe of these fish can be put up on tuna fishing boats as frozen stock and salted as a semi-product for subsequent processing on shore, and also as a beaten, lightly salted finished 263 caviar (pasteurized and non-pasteurized).

In Italy, for example, tuna caviar made from ovaries and membranes by the dry salting method and subsequent natural curing has long enjoyed great popularity as a delicacy (it is sliced into the food in thin slices like grey mullet caviar).

Many ocean fishes, for whom ocean fishery has already been well developed, contain reasonably good and sometimes excellent roe.

At the present time, the greatest part of roe of the new commercial fishes is not utilized for food purposes even in those cases where the fish is gutted on board ship.

Undoubtedly, it would make sense to organize production of pasteurized lightly salted caviar of cyprinid, cod, whitefish, herring, pike and many other new fish that are the object of ocean fishery, both on board ships at sea and also at conserving, filleting and cooking plants.

COOKED PRODUCTS AND SEMI-PRODUCTS

Fish-cooking shops are normally located at consumer centers and produce basically the products and semi-products of the assortment given below.

Fish products. Raw cut fish of various species (cooking

semi-products), raw and fried cutlets (semi-product), fried, baked, boiled, pickled and stuffed fish, meat-jelly, Siberian cisco, fish roll, stuffed fish, sliced herring, shashlyk (semi-product) of sturgeon fishes, sausage, Paris sausage and various other sausages.

Fish-vegetable products. Spiced fish chowder, fish and vegetable hash, fish and vegetables in marinade, fried fish in marinade, fried meat balls in marinade, stewed cod in marinade, fish cakes and sticks.

Caviar products. Baked caviar pudding and caviar-vegetable pudding, puddings, caviar "Provencial", lightly salted caviar and marinated caviar.

Fish meal products. Layered patties, rasstegai (a small tart-shaped pie without top crust), kulebiaka (pie with meat, fish or cabbage filling), pie made of leavened dough with fish stuffing, fried tarts, vol au vent with soft caviar, Siberian fish meat patties (frozen raw).

Pastes. Made from herring fish (keen, salted and spiced), cod, fish paste (made from small fry fish), herring and salmon "butter", protein sauces and their concentrates.

Semi-conserves cooked and packed in hermetically sealed cans. Fried fish, in tomato sauce (run-of-the-mill, cod,

ocean perch); cooked fish of the same species and keta salmon; fried meat balls in tomato sauce and pickled delicatessen fish (with vegetable garnishing). Such products are very close to conserves in gastronomic properties, but they must be used within a specified time and therefore the trade is limited exclusively to shops with refrigeration facilities.

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Ready-cooked frozen dishes. Recently, production of ready-to-eat frozen fish products has acquired enormous volume in the USA, Canada and other foreign countries and has prospects for development in the USSR. The essence of preparation of these products consists in wrapping fully cooked meals in an impermeable wrapper and freezing at low temperature. Packed and frozen ready-to-eat meals with garnishing, sauces and all types of flavourings can be kept at fixed temperatures in refrigerators for 2-6 months. A widely used product is the so-called "fish sticks", it is an original and palatable product.

Meals offered in the frozen state are pike-perch and other cooked fish in egg and oil sauce, fried fish with vegetables, fish pilau (of cod), fish head soup, sockeye and inconnu chowder.

The main requirements for fried fish are: unity of the pieces (trunks, fish), golden colour to the crust, variation in weight of pieces within specified limits, succulent and

firm consistency, pleasant taste and odour (without strange aftertaste and odours), normal salinity (1.5-2.5% salt content in the product). Fried products must be promptly and adequately cooled and packed in containers which meet sanitation requirements and reliably protect the product from mechanical damage.

Fish cakes and other individual items must have a standard guaranteed weight, regular shape (round or oval), uniform wine-red full crust, homogeneity of the stuffing, consistency varying from succulent to firm, pleasant taste and odour with an aroma of spice and a slight aftertaste of onion. The consistency of raw fish cakes (semi-product) must be viscous.

In stuffed fish, chief importance is given to succulence, tenderness and sufficient viscosity of its consistency. It has been established that when the product is cut into slices from 0.7 to 0.8 cm thick it must not crumble or fall apart.

In the manufacture of fish sticks from cod the main points which insure their high quality are: strict observation of uniform thickness of the sticks, uniformity of their temperature when raw before being immersed in hot oil (which is at a temperature of about 200 degrees), uniformity

of composition and density (viscosity) of the mixture, strict observation of optimum time of frying (to insure that the product is not kept in the frying oil after tests show there is no raw material present). It is absolutely /265 necessary that these conditions be observed in order to insure the most tender consistency of the cod meat and the friable condition of its crust.

The fish sticks that are not immediately frozen after frying must be used within 48 hours of the time the technological process of preparation has ceased, or else they must be immediately frozen at a temperature of -18 degrees inside the stick and placed in cold storage at the same temperature. In any case, the fish sticks must be eaten hot.

Keeping the fish sticks in the retail network and communal feeding enterprises at incorrect temperatures or consuming them cold will nullify all the specific properties of these remarkable gastronomic products which are made, at the present time, only from frozen cod.

Fried fish is prepared from frozen or iced fish of almost all species with the exception of sturgeon, salmon, eel and a few others. Besides navaga, the new fish such as hake, rockling, argentine, ronco, butterfish, gilthead etc. are excellent when fried.

Baked fish is most frequently prepared from frozen and iced cyprinids (bream, vobla, taran, tench, and many others), ocean herring, cod, ocean perch and fish of many other species from among the new objects of fishery.

Pickled or jellied fish is prepared from sturgeon, salmon, cod, ocean perch and other meaty fish with white or pink flesh without fine prickly intermuscular bones.

Fish cakes, like all fish stuffing, are normally prepared from meaty fish with few bones. Large cod fish are very suitable for this purpose; the stuffing for Siberian fish cakes is made most frequently from sturgeon, cod, catfish and keta salmon.

Among the raw fish semi-products, the most popular are: trunks of any edible fish weighing over 300 gm, but mainly cod, carp, perch, flounder, wolffish, ocean perch, catfish and pike; sections of sturgeon fish, mainly great sturgeon and sturgeon; fish stuffing of large fish with few bones such as cod, haddock, coalfish, ocean perch, catfish and pike-perch (kitchens sometimes utilize frozen cod and ocean perch fillets prepared by the industry for making stuffing).

It is not recommended to refreeze, before cooking, semi-products prepared from frozen fish (after it had been

defrosted). Individual specialists at some of our enterprises and a few abroad hold the opposite point of view. Nevertheless, the author is convinced, on the basis of his own experience and observations, that repeated freezing of raw fish /266 unavoidably leads to lower quality.

The semi-products are suitable for the preparation of fried, stewed, baked, cooked, jellied and stuffed fish, fish in marinade and various sauces, as well as cakes, sliced herring, fish and potato hash, stuffing for pies, tarts, kulebiaka, rasstegai, fish soups, salads, mish-mash and many other types.

Soup stock for the preparation of fish soups and chowders are made from raw edible fish waste such as meat trimmings, cartilage and heads of sturgeon fish, belly, heads and spinal columns of ocean perch, cartilage, backbone, fins and skins of wolffish.

The Moscow Fish Combine has had considerable success in developing and producing soup stock of the following composition:

1) sturgeon fish heads (cut and cleaned)-70%, cartilage and meat trimmings obtained during cutting sturgeon fish-30%;

2) sturgeon heads-50% and sevriuga heads-50%
(both cleaned and prepared);

3) sturgeon heads-50% and ocean perch belly-
50%;

4) various edible trimmings obtained during
cutting of wolffish, in specified ratios.

Rosmyasorybtorg (Republic Bureau for Wholesale
Trade in Meat, Oil and Fish, Ministry of Trade, RSFSR)
has developed and approved several stocks for fish chowder
made from cut halibut, ocean perch, cod, haddock and the
heads of halibut and ocean perch in specified ratios, as
well as (another version) of ocean perch, haddock and
flounder.

It is known that the most delicious and aromatic
chowder, soup, rassolnik (soup with pickled cucumbers),
fin soup and others are obtained when the stock consists of
several species of fish (wherever possible not similar to
one another).

It is well known that soup from small fry fish of very diverse species composition is richer and tastier than soup of the more valuable fish of one species.

Nowhere in the world are there such great possibilities for species combinations of raw materials and semi-products as are found in fish-cooking kitchens at large consumer centers, but these are still not fully exploited.

The purpose of organizing the production of raw fish semi-products is to relieve a multitude of small, medium and large communal feeding enterprises of the very laborious manual task of removing scales, fins, heads, viscera, cartilage and peritoneum of fish. Such work would be done by means of centralized, specialized, mechanized processes for cutting fish.

Raw fish semi-products include gutted, portioned, and even breaded fish.

Selyanka is made, as a rule, from fresh fish (admittedly with the addition of dilled cucumbers), and such soups do not contain salt in excess of the normal taste requirements for keen first and second courses. The proper name for these dishes is "selyanka" (from the Russian

word for village). Evidently, selyanka was originally a village chowder and later on, as a result of culinary improvements, it became a much more refined thin soup made from sturgeon with tomato products, olives, capers, lemon and after that even a pan-made soup.

The best raw fish semi-product is, naturally, fillet made from fish immediately after it is taken from the fishing gear. When such fillets are being produced in sufficient quantities it will become virtually unnecessary to cut frozen fish in the kitchens of fish processing plants located at consumer centers. The fish industry is confronted with the problem of organizing large scale production of fish semi-products from very finely ground fish meat for the production of noodles, fish dumplings, protein sauces and similar foods made by combining raw fish paste (fish dough), all the way through to sausages, Paris sausages, wieners and a variety of ready-cooked, quick-frozen dishes.

Culinary semi-products are not limited to raw, cut and even portioned, breaded, or fish ground to a stuffing. These also include raw Siberian fish cakes, ordinary fish cakes, shashlyk, all of which are fully-ready for cooking and other

similar semi-products. In this connection, it would be worthwhile finding a more precise name for raw gutted fish.

Since we are now approaching a period of direct technological utilization (including cooking) of objects of specialized tuna fishery (various species of tuna, sailfish, marlins, swordfish, pelamids etc.), it would be useful to discuss some observations made during the conduct of experimental work.

The frozen meat of the majority of commercial tuna species is an excellent raw material for the manufacture of sausage products. In the final product the white meat has an attractive colour and consistency, it does not have a fishy odour and has the excellent property, increasing with maturation (autolysis) of the raw meat, of great ability to retain moisture (important in the production of cooked products from ground meat). Tuna sausage stuffing made from white meat was supplemented with onion, garlic, eggs, margarine and spices, and also the experimenters successfully added 25-30% water. Such a mixture is fully justified if account is taken of the great amount of protein in this meat.

It is recommended to make sausages from frozen yellowfin tuna according to the method developed by AzherNIRO (Yakovleva).

Ready-made little sausages have high gustatory qualities, light pink colour of the meat, succulent consistency and pleasant aroma free of fish odour.

The storage periods and time for utilization of generally all cooking products and semi-products (except the frozen ones) are determined by sanitary regulations for perishable products and approved by the All-Union State Sanitary Inspection Service.

Fully qualified evaluations of various cooked products made, in this country, as samples from dogfish and herring shark have convincingly shown that these are suitable as food and, in most cases, highly suitable. This was the evaluation given to, for example, fried and stewed shark meat in the natural state when served with various sauces, marinade and in batter.

This meat yields attractive, tasty and, when properly prepared, tender cutlets and thin pieces of meat resembling beef roast.

The tougher meat of large sharks can be used in the production of acceptable quenelles, croquets, noodles, fish cakes, rolls, breads, baked fish products and fish and vegetable mixtures.

Broth, soup and other liquid dishes made from shark fin with or without the usual fish liquor (soup) are very unique and high quality foods. The exceptional gastronomic qualities of shark fin soup stock is conditioned mainly by the remarkable aroma which very strongly suggests white mushrooms, and the unusually pleasant consistency of the greater body of the broth, giving a unique tactile sensation and, particularly, it is without the unpleasant sensation of stickiness.

This also applies to the broth made from salted and dried fins that were later boiled to the consistency of concentrated broth and marketed as sterilized conserves.

Since the broth made from fins that have undergone many stages of processing are so excellent, there is reason to suggest that soup stock made from raw fins converted into conserves, or stock prepared directly from salted and dried fins (not sterilized) are even more interesting and first-class in the gastronomic sense.

The edible, gelatinized part of boiled fins is also a very unique product with very pleasant tender consistency, bright aroma and distinctive taste.

The volume of output of cooked fish products must be increased in the very near future many times (evidently

by tens of times) and the variety must definitely be expanded and enriched.

The products made by such enterprises should /269
surpass the products of the same type made by communal feeding enterprises in terms of gastronomic properties, price and also stability.

Other decisive factors are the degree of mechanization and the introduction of modern packaging for cooked fish products. All this requires a sufficiently high level of competence in all the branches.

We shall now cite a number of examples of the fish-cooking processes used in foreign countries.

The Canadian Department of Fisheries has released a cookbook containing much valuable advice, examples in preparation and original recipes.

For example, it recommends using a bread stuffing for baked or fried fish consisting of bread crumbs, onion, celery, a specific selection of spices and fat for frying the stuffing. Variations in this type of stuffing are suggested under the names of tomato, green pepper, and apple.

A nut stuffing for fish consists of chopped sweet almonds fried in butter, onion, celery, pepper, bread crumbs and beaten eggs.

A stuffing is recommended which is made of rice with olives or lemon, an apricot stuffing (one part dried apricots and four parts soft bread crumbs, fat, celery and pepper).

Canadians like their fish plate garnished with golden brown fried halves of almonds.

In Canada, a fish fillet is usually soaked in salted milk for 3 minutes before baking, or else it is baked in a mixture of cream, much onion, dried lemon peel and other spices.

All this has a terrific gastronomic effect.

Before baking halibut, it is recommended that pieces be marinated in lemon juice with salt and spices and cooled for an hour.

A widespread practice is to soak fish in milk before rolling it in flour, dipping it again in milk and then rolling it in dry crumbs.

A traditional method of cooking smoked fish in Canada is to boil it in milk. This evidently applies to fillets that were smoked, after salting to taste, by the cold method and then frozen.

A very interesting dish consists of cod in combination with pork, for example tarts made of salted cod and bacon with onion, sweet pepper (green and red), eggs, milk and spices.

Salt cod is first soaked and then cut up, dipped in beaten egg whites along with the garnishing, and then fried by /270 submerging in fat heated to a temperature of 190°C ("cod puffs").

A very large number of recipes are suggested for fish sauces, including egg sauce, cheese, capers, olives, dill, lemon and parsley.

It describes the preparation of fish soufflé, original and beautifully shaped cakes, potato cakes made of fish and ground potato, fish pudding, round loaf, sandwiches, salads and various other items made of fish.

Equally interesting are the fish dishes of France, Italy, Bulgaria, Romania and Yugoslavia.

A much more careful and universal study of cookery, experience and practice in other countries in the utilization and processing of fish is an urgent matter, since this will make it possible to make wide use of cuisine most adaptable to our tastes and conditions.

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The near future will see a significant increase in the supply of live and iced fish, fish fillet, as well as frozen fish in the gutted and cut states (fully ready for cooking), to the population.

There will be a very great increase in the production of smoked and cured fish, light salted delicatessen herring, highly gastronomic conserves and preserves.

On the 11th of June 1966, a resolution was passed by the CC CPSU and the Council of Ministers USSR concerning the "Measures for further development of the fishing economy in the country, improvement of the quality and assortment of fish products"¹.

The resolution foresees increases in the catch of fish and production of fish food products in a wide assortment and high quality to a level that will allow consumption to reach, by 1970, a per capita average of 20 kgm (as oppose to 12.5 kgm in 1966).

Simultaneously with the increase in overall catch of fish, whales and other products of the sea to 8.7 million tons by 1970,

¹

"Pravda", 1966, No. 1833.

the target for output of fish food products was set at 4.3 million tons.

At the same time it was foreseen that, in comparison with 1965, output of live market fish should increase by 4 times, iced fish by more than 2 times, frozen by 2 times, smoked, balyk and air cured fish product by approximately 1.5 times and cooked products by 3.3 times.

Frozen fillet production will increase by 17 times, while the output of salted fish (excluding herring) will be reduced from 9 to 3.7% of the total volume of fish food products. /271

In order to stimulate local production of cooked products and semi-products, smoked and balyk products, it was resolved to build complex fish-processing enterprises at Leningrad, Kiev, Minsk, Alma-Ata, Tallin, Novosibersk, Sverdlovsk, Volgograd, Donetsk, Kemerov, Sevastopol and Mineral'nyy Vody.

The resolution places the responsibility with the Ministry of Trade USSR, Tsentrosoyuz and the Councils of Ministers of the Republics together with the Ministry for the Fishing Economy USSR to fundamentally improve the supply of fish products, particularly live and iced fish, fillet, balyk and cooked products to the population of the cities and towns.

SHIPPING CONTAINERS AND CONSUMER PACKAGING.

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PROCESSING AND PACKAGING FISH

Proper selection and intelligent use of containers reduces the amount of losses during storage and shipment of fish goods, protects them from mechanical damage, from harmful effects of the atmosphere, sun rays, wind, precipitation, from dust, sand and dirt.

Containers not only insure the technological and sanitary protection and preservation of the product, but they facilitate and economize on loading and offloading operations, the transportation processes and storage of goods, shipping and receiving, and also accounting operations.

The containers must be simple, light and strong in construction and of the lowest possible cost.

Reusability is a very valuable feature in containers.

The design of the container must insure the preservation of the product, the required technological conditions for storage and shipment, for example, containers for salt herring must not leak brine; containers for iced fish, on the other hand, must allow the melt water to run out; containers for smoked and cured goods must provide for air circulation.

Domestic and foreign market requirements are taken into account in the determination of container sizes.

The container in contact with the product must not give it an odour, change its colour or cause chemical changes to take place in the product.

Transportation containers are hard, semi-rigid and soft.

Containers for fish products are usually water-tight and dry barrels, fish and conserve boxes (cardboard and wooden), wicker baskets, lath crates, mat bales and bags, and occasionally paper and cloth sacks.

Standardization of container sizes has recently been given special attention.

Standard sizes for shipping, receiving and transportation facilities, as well as standard sizes for pallets and packets that conform to container sizes definitely simplify, hasten and economize loading, offloading, stacking and issuing goods. Therefore, the problem of standardizing the sizes of transport and consumer containers is of great importance and requires very strict attention.

Hard containers, such as barrels, boxes (excluding cardboard boxes which are included with the semi-rigid containers), must withstand the pressure of the product on its walls and external loading (stacking), and also it must withstand shocks and vibration, and it must not lose its shape and appearance during shipment and transshipment.

Soft containers, such as bales, bags and sacks, do not protect the goods from mechanical effects, and the product shows through the container. An important feature is that empty soft containers occupy a small amount of space, are easy and convenient to transport.

Semi-rigid containers, such as wicker baskets, lath crates and cardboard boxes have properties intermediate between hard and soft types. There are standards or technical specifications for all types of fish product containers.

The main type of barrel used in the fish industry is still the watertight wooden barrel, but work is being carried out on the design of cast watertight barrels made from synthetic materials.

The chief property of watertight barrels is their ability to hold the brine during storage and transportation of fish products. This property is assured, firstly, by the use of certain species of indisputably high quality wood; in

the second place, by suitable binding after the wood has been sufficiently and properly dried. The excellent condition of watertight barrels is also insured by careful manufacture and binding of the barrel staves with hoops. The advantages of corrugated hoops is indisputable and their substitution for smooth hoops should be accelerated.

Besides high quality materials and careful manufacture, the full utilization of all the possibilities of watertight barrels requires appropriate wetting of the barrel immediately before filling it with the product, competent corking of full barrels, storing the filled barrels under normal conditions and careful handling during movement and transportation.

Inexperienced coopers that are not equipped with the appropriate tools or who cork the barrels carelessly can nullify all the best properties of watertight barrels and, by the same token, spoil the product. It is not only important to insure that the bottom is properly inserted and that the hoops are on correctly, but the hoops must also be properly fastened in place with nails, the bung holes must be plugged with bungs of the appropriate diameter made from dry linden or aspen.

Leaving excellent watertight barrels with product under the burning rays of the sun, in a strong wind, in extremely high

stacks, roughly handling the barrels during movement, all this can result in the barrels leaking brine.

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The current standard allows watertight barrels of 15 to 250 liters for fish products. These include drum-tight barrels that are intended for packing large fish that do not exert much pressure (for example, the bast of salted sturgeon or lightly salted semga and chinook salmon).

All technological, marketing, economic and commercial factors should be taken into account when selecting the size of the barrel for each type of fish product. Some fish products need not be poured over with brine, and these are packed in strong dry goods barrels holding from 50 to 250 liters. Dry goods barrels are used for cod, ocean perch, most marine fishes (excluding herring), and also most of the hard salted cyprinid fish (particularly when long shipment and prolong storage are not involved), air-dried, iced fish and cold-smoked fish (except herring and other fat and tender fish). Any type of salted fish is packed in dry goods barrels during the cool season of the year. Salt fish packed in dry goods barrels must be sufficiently packed or compacted by vibration means.

Besides the watertight and dry goods barrels, there are special barrels such as those for caviar.

Boxes are used for conserves and preserves, iced, frozen and smoked fish (cold and hot-smoked), lightly salted fish (for shipment over short distances in isometric boats and freight cars or during the cool period of the year, and also for short term storage in refrigerators or during the cool period of the year), tender cured product and, sometimes, hard salted fish of the large varieties.

The requirements for quality of wood used in the manufacture of wooden boxes, their design, capacity and degree of cleanliness will depend on the type of goods for which they are intended. Boxes for such goods as smoked and cured fish, and also for conserves and preserves must be made from sufficiently dry wood.

The moisture content of wood intended for the manufacture of boxes that will hold iced or frozen fish is not important.

Standards and technical requirements for each type of fish product specify the permissible types of containers, their dimensions and capacity.

Cardboard boxes are now widely used, this is a very suitable type of container particularly for frozen fish, conserves and preserves. The particular properties of these containers are their light weight, strength, economy, thermal

insulating qualities and they meet the requirements for food sanitation. The only real shortcoming is the insufficient resistance of cardboard to the effects of moisture. This /275 type of container is being very rapidly improved and will soon replace wooden boxes, particularly with increased production of cardboard boxes from improved waterproof cardboard (a smooth outside layer).

The group of soft containers for fish products include bast, cloth and paper products (bags, sacks, and also matting for baling fish products). Bags and matting are examples of bast-woven material that is used for packing air cured fish, and also cheap and stable frozen fish during winter shipment. Also, matting is used for packing frozen sturgeon, for lining boxes; baskets and crates without lids are wrapped in it. Cloth sacks are used for packing air-dried and frozen fish. Besides matting, such packing materials as wrapping paper, bitumenized and ordinary craft paper, and also fat and gas impermeable or slightly permeable parchment, wax paper and cellophane are used.

Besides shipping containers (barrels, boxes, bags etc.), a wide variety of consumer containers, i.e. the packaging for

fish and fish products in which the consumer receives them, is being continually more widely introduced. Up to the present time these have mainly been cans, but in the future there will be a vast quantity of packages, sacks, wrappings, containers, tubes and pails constructed mainly of polymer materials.

Such containers will also be made from synthetic film materials, from water resistant paper, aluminum foil, and also proven films in combination with cardboard, paper and foil.

The main type of consumer canning container is the hermetically sealed white tinplate can. White tinplate is thin sheet soft steel that is plated on two sides with tin. Such properties of the tinplate as uniformity of the tinplating on the sheets and porosity of the coating, minimum variation in plate thickness, and also elasticity of the tinplate all play an important role in determining the quality of the cans.

The manufacture of containers, including barrels, from sawdust, shavings, reeds, straw etc. will save a considerable amount of lumber. This is technically feasible and very promising.

Much greater reuse of barrels and boxes of some types is also possible. Work is being carried out on the design of

long-service boxes made from wood, other fiber materials, aluminum and plastics (take apart, folding and nailless). Such containers are already being made and tested under production conditions.

The design of certain types of modern containers for 276 fish products is associated with the selection of known and tested materials, development of technical requirements for plastics having specified properties (that are required for preservation of the quality of the fish product), and also with sufficiently responsible design decisions and well coordinated advances in mechanization and automation.

High pressure polyethylene of low density in the form of film is the most widely used material in the manufacture of consumer packaging for fish products in the USSR and abroad. Large plastic containers (barrels, boxes, crates) are also made from polyethylene in some countries (cast and pressed), although many countries use a wide variety of other plastic materials under a very diverse variety of names.

A desirable quality of the film is that it should be quite reliable as a gas, steam, fat and moisture proof wrapping,

resistant to puncture, that it should withstand the temperature conditions under which the product is stored, be irreproachably sanitary, elastic at any season of the year, and also readily take paint stamping required in marketing of the product.

Other countries make widespread use of film for consumer packaging of fish products with various liquids (spices, marinades, brine, various sauces). The liquid additives normally are introduced by means of mechanical syringe-dosers through the open end of the package immediately after the fish is placed in the package and before it is vacuum sealed.

Films having a high shrinkage coefficient are desirable for vacuum packaging.

A very promising type of returnable container for shipment and storage of iced, frozen, salted, and smoked fish and cooked products, deserving special attention, is that made from plastic, aluminum or plasticized wood into trays, boxes and barrels. Such containers have high durability, low weight, are easily washed, sterilized and loaded.

The criteria for positive sanitary and hygienic evaluation of containers and packaging materials is their ability to prevent substances harmful to health penetrating them to the product, and also to keep out substances which would change the organoleptic

properties of the product (odour, taste, colour, clarity of the liquids etc.), and the absence of visible changes in the studied specimens of containers and packages when they are in contact with the product.

Workers engaged in the introduction of new types of containers and packaging must know the current instructions for hygienic testing of new types of food containers, packages and other goods made with synthetic lacquers, enamels, glues, gums, caulk and plastics (approved by the State Sanitation Inspection Service USSR, 29 May 1962 as No. 401-62).

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When decorating the consumer package, a good combination of colour and thoughtful design and figures should create a favourable impression, attract the attention and interest the consumer to the product, i.e., it should serve as an advertisement. However, the decoration must not be too bright, sharp or loud.

Insofar as transparent packaging is concerned, the printed colour design must be in excellent agreement with the external appearance of the product showing through.

It is generally desirable that new containers should also be accompanied by artistic market decoration for the product.

It should be realized that some types of film packaging create anaerobic conditions under vacuum. This type of packaging creates a botulism hazard in products that are stored at insufficiently low temperatures. In the USA, cases have recently been reported where fatal poisoning resulted from consumption of smoked fish that had been bought in film packages under vacuum.

Placing smoked goods in packages that are impermeable to air and under vacuum is forbidden everywhere at the present time.

When introducing film type vacuum packaging in the fish industry and trade, it is necessary to responsibly verify its suitability for specific types of products from the point of view of health.

The introduction of new types of containers and packaging must not, nevertheless, stop or delay work on further improvement of wooden watertight barrels and the other types of traditional transportation containers.

Workers engaged in the fish industry are frequently criticized for using the term "dressing" when they should use the term "packaging". The term "dressing" is associated with a very complex process including packaging itself and a whole series of preliminary preparatory operations. Dressing fish

products is a complex and responsible technical process, even though it is frequently underrated.

The term "dressing" includes the prompt cessation of processing (freezing, salting, curing, smoking etc.), washing, cleaning, wiping, removing twine and spacers from the product, draining, glazing and some other steps. At the same time this includes chilling and individual sorting of the fish according to species, length and grade. Finally, after all these other operations, the packaging process itself begins, i.e., the product is placed in containers (pressed, vibration packed, corked, weighed, pour over with brine or salt, individually wrapped etc.). The final step in dressing is commercial marking. Consequently, /278 packaging is only one of the operations in the whole dressing process. The concept of dressing, in the fish industry, now includes organization of carload lots of goods (appropriate assembly according to assortment) and even the preparation of the initial commercial documentation (invoice, description, weight).

Fish goods are placed in containers immediately after they have been technologically processed, i.e., as soon as the fish has been salted, smoked, frozen etc. The ready product

must not await the container, the container must await the product. However, incompletely processed goods must not be packaged. Such materials must be fully salted or to the required level of salting, frozen to the temperature required in the current standards, technical specifications or instructions, cured, dried or smoked until fully ready and, in particular, until the moisture content is within the maximum permissible limits.

The possibility of random vibration packing, into barrels, of even such comparatively large salted fish as cod, haddock and ocean perch has already been proven and is being done at Murmansk.

Salt herring can and should be added to the barrels at certain stages of the processing (including the start of maturation), it should be packed as tight as possible in order to have the lowest possible ratio of fish to brine. In relation to this, our industry unjustifiably ignores the centuries-old experience of Scotland, England, Norway and Holland.

It is very useful and simply unavoidable to compress both the so-called dry-packed (packed without brine) salted fish and many species of fish that are frozen loose, cold-smoked, dried and cured. It is sometimes better to use compression techniques, and sometimes vibration packing. This requires prompt measures to reliably safeguard the quality of perishable products.

Glazing frozen fish is a process which, although it is unique, is included in the notion of processing. Considerable efforts are being made to provide industry with glazing equipment which would be sufficiently compact and suitable for operation both on shore and at sea.

Compressing salted fish by mechanical presses is now widely used. This is often dual equipment (two presses mounted on one frame and operating from one electric motor). The productivity of labour is greatly increased on such presses. Hydraulic presses are also used for compressing fish.

There are mechanical corking benches for corking 279 barrels of fish.

Apparatus for processing salted herring are in use on large ocean-going herring factory ships.

Even the natural brining of herring has a rather undesirable effect on its maturation, on the aromatic and gustatory

properties, consistency of the meat, nutritional value and physiological effectiveness when eaten as an appetizer immediately before a meal. This is accounted for by the fact that the brine removes protein and extractive substances from the herring and partially replaces them itself (moisture and salt).

The positive value of brine is only that it protects the herring from contact with the atmosphere. In this way the brine slows down the process of oxidation spoilage of tissue fat.

The best quality herring is that processed by interrupted brining and packed in hermetic containers without brine. Such herring matures wonderfully, does not change weight and possesses the very highest gastronomic, nutritional and other important physiological properties.

As has already been stated, when storing brined salt fish (including herring) part of the salt and water go from the brine into the fish, while part of the nitrogenous substances leave the fish and enter the brine, therefore the weight of salted fish stored in brine will, as a rule, increase noticeably, and the quality of the product deteriorates. Furthermore, the lower the density of packed fish in the barrel or can and, consequently, the greater amount of brine in relation to the fish, the greater will be the exchange.

This is precisely the reason why technologists (researchers and leading producers) are striving to find and implement such methods of brineless packaging and storage of salted fish as would remove the danger of oxidation spoilage of the fat contained in the fish.

Such packing methods consist mainly of using special synthetic films which are practically impenetrable to gas, fat and brine, with simultaneous evacuation of the film packet or large polyethylene container, and also the application of sufficiently active and hygienically safe anti-oxidants.

Until the work begun in this direction is terminated in large scale implementation in industry of new methods of packing salt herring, it will be necessary to make efforts to achieve maximum possible packing of the product and, consequently, a minimum amount of brine in the container.

The minimum accepted norm of packing in a 100 liter barrel is 95 kgm and in a 120 liter barrel 114 kgm salt herring.

To reduce swelling of salted fish it is necessary to minimize the amount of brine in the barrel and to store the salted product at low temperatures (the closer to the freezing point the better the effect), however the temperature must not

be brought to the freezing point since this could break down the histological structure of the tissues.

Enterprises at Murmansk still continue to occasionally pour salt over cod, haddock, ocean perch, wolffish and other salted fish when packing it in barrels.

This practice should not be continued. In this case, the additional salting takes place after the final processing and determination of net weight of the finished product. It is impossible to determine, for each carload lot and for individual barrels, the true scale of technological losses arising from further salting and depending on many causes which are difficult to evaluate. Therefore, whatever may be the variations from the actual weight of fish semi-product which were unforeseen by the trade organizations, the true weight of the fish on arrival at the consumer point and during sale will almost always be considerably different from that stated by the supplier.

When one considers the undesirable and harmful results of additional salting of fish during packing into containers, such as the unavoidable settlement of the fish in the container as a result of further salting, the formation of "slime" on the product or the adherence of undissolved salt crystals on the fish (sometimes clots are formed as a result of errors in salt dosing),

it will become even more evident that this method must be forbidden.

The product packed in shipping containers is marked, sorted into carload lots, and immediately loaded for shipment from the enterprise or else it is stored under appropriate conditions until offloading. It is not permissible to keep packed goods for long periods at the production point.

Care in handling containers is mandatory in both industry and trade for all workers who are involved in with reception, unpacking, storing and transportation.

Reception, opening, storage and transportation of the wooden, burlap (soft), iron or glass containers arriving with the goods must be carried out with observation of the following rules.

It is forbidden to throw full or empty containers from the shoulder, truck, or freight car, to drag, roll or push it over an uneven surface.

Raising and lowering containers with product or empty must be done on vertical and inclined lifts, roller tracks, other mechanized means or at least hatches with sloping gangways and flooring for lowering barrels, as well as springboards for rolling barrels onto the scales.

All types of containers must be opened only from the side of the lid, bunged end, neck or seams.

Each enterprise must have a supply of tools for opening containers: special steel crowbars or other suitable tools for removing the ends of filled barrels, nail pullers, clamps, hammers, and also steel and wooden handles for the tools.

Containers should not be opened by means of axes, mallets or weights, since their use can damage the container. It is forbidden to break off the lid of a box after having pulled the nails from only one end of the lid, to knock off wooden hoops by means of steel handles, remove the bottom of a barrel by means of an ax or to knock out or break out the bottom without having first removed the binding hoop and loosen the next two or three hoops.

Goods should not be stored loose, nor should wooden barrels or baskets be kept in places that are not protected from the sun and precipitation, or in unsanitary conditions.

The maximum height of stacking the containers must correspond to the norms for maximum loading, while during transshipment, stowing (at sea) and stacking freight it is necessary to handle the containers with care.

STORAGE

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Among the food products that are of animal origin, fish products display the lowest stability during storage, and this is due to the susceptibility of fish fat to spoilage.

Fish muscle tissue structure is considerably more friable than that of warm-blooded animals, due to the lesser development of connecting tissue (sarcolemma) in fish, also contributes to the lower stability of fish meat.

The myosin content (75-80%), distinguished by high instability, also has a negative effect on the stability of fish meat in storage.

The most widely occurring and important spoilage effects are oxidation spoilage of the fat (normally more intensive with lower fat content) and denaturization of protein (change in its solubility, lowered ability to expand and contain muscle juices).

Storage at sufficiently low temperatures is a very reliable means of preventing protein denaturization.

The formation and accumulation of free fatty acids, which are directly related to oxidation spoilage of fat, lead to deterioration of colour, odour and taste of the product and also encourage protein denaturization.

Oxidation spoilage of the fat and denaturization of protein arise and progress faster and more intensively the higher and more unstable the storage temperature, the longer the condition lasts and the less protection there is from contact with atmospheric oxygen and evaporation. The latter condition does not apply to air cured and smoked products, for which it is desirable to have contact with the atmosphere.

The moisture content of many fish products is one of the essential indices from the point of view of regimes, possibilities, periods and results of storage.

When stored in accommodation that is extremely humid, dry and hygroscopic goods absorb moisture and spoil, while storage in extremely dry air causes them to dry out, which leads to both loss of weight and of quality. To eliminate these phenomena, each type of product must be stored under the recommended temperature and humidity conditions.

Post-mortem autolysis in fish tissue can be accelerated or delayed.

Optimum temperatures for accelerating the autolysis process normally occur between 35 and 40°C. These processes cease at a temperature of 65°C.

At low temperatures (down to -14°C) autolysis is not completely halted, but at reduced product temperatures the processes and effects associated with autolysis proceed more slowly.

It is of great importance in the storage of fish products to maintain the most favourable and constant temperature for the product. Maintaining constant temperature is required for storing iced or frozen fish, conserves or lightly salted delicatessen products, and also when storing such goods as, for example, hard salted or air cured fish.

Preservation of fish products depends mainly on the initial properties of the raw material and the methods of processing (extent of conservation), temperature regime and shipping conditions, as well as the extent to which the containers and packaging protect the product from the influences of the external medium. Of great importance is the extent to which optimum technological and sanitary storage regimes were maintained, how carefully and with what degree of care the product was handled (for example, whether the barrels

were subjected to shocks during handling, whether barrels containing soft caviar were rolled instead of offloaded from the freight car by means of fork lifts or on dollies, or, for example, whether the reception of frozen noble fishes was extremely long and accompanied by its unpacking, sorting and weighing on the open platform of the refrigerator during the warm season of the year).

A vital influence can be exerted on preservation by the methods of placing and distributing the product in storage, as well as various special measures for improving storage conditions. For example, it is highly desirable to organize storage of frozen noble fish (if it has not undergone thawing during shipment) without opening the bales, to glaze the stacks of bales, or to use special arrangements for reducing the pressure on the bottom layers of the stacked fish, when it is packed in sacks or bags. It is very important to insure prompt, intelligent and multilateral technological care of the goods, to prevent extremely long storage and observe the proper sequence in consumption of individual lots of goods.

Storage results depend to a great extent on 284
proper loading of the goods, technical and sanitary condition of the refrigerator (warehouse), degree and manner of management, specialized preparation, experience and expertise of the management personnel.

Iced fish, preserves, marinades, smoked goods, spiced and all lightly salted fish, as well caviar, are best stored at the lowest possible temperature which is just above the freezing point for that product. The freezing point is not the same for all products and depends mainly on the concentration of table salt in the cell juices: the higher the salt concentration the lower the freezing point.

This is the reason why there is risk of freezing when soft sturgeon caviar is stored at -3 or -4°C , whereas hard salted fish whose tissue juices are saturated with salt, can be safely stored at temperatures down to -20°C .

Workers in fishing industry enterprises should be guided by the reference text for the fish industry (Chapter "Using Cold for Storage and Shipment of Fish and Fish Product")¹.

The extent to which drying takes place depends on the flow of heat in the cold chambers. When the temperature is lowered, the surplus moisture separates out of the atmosphere. This accounts for the condensation of surplus

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Published by "Pishchevaya promishlennost'", M., 1964.

moisture (formation of dew) on the walls, shelves and other surfaces in enclosed spaces where the temperature is suddenly and considerably lowered, or the formation of a snow coating on the coils in cold chambers. The cooling devices (stacks of coils) remove heat from the surrounding moist atmosphere, as a result of which the atmospheric moisture condenses and the air dehydrates, which results in qualitative and quantitative changes in the products.

Hydration and dehydration of the atmosphere in the chambers of any modern refrigeration facility present no difficulties nowadays and are normally regulated according to order.

Depending on the properties of the load and the type of packaging, the height of the stack is regulated to insure that there will not be excessive pressure on the lower rows of containers or on the product, should it be in soft or semi-rigid containers or stored loose. The goods must be properly stacked in neat and handy stacks that are stable and the freight must be placed in a such a manner that the marking can be easily read and the number of items in the stack can be counted without disturbing them. It must also be insured that any item in the assortment is available without disturbing the whole stack.

Smoked, cured and dried fish, as well as
conserves and preserves are stored under conditions insuring
adequate (but not excessive) air ventilation among the
packages.

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If a barrel or box with salted fish or caviar has been opened or is stored partly empty, such goods must be issued from the warehouse first, taking into account its lower stability.

A very important shortcoming in fish processing technology is the absence of prompt, adequate and complete

cooling of the product after thermal processing (cooking, hot and cold-smoking). This has a negative effect on the quality and stability of the product during subsequent storage and increases product losses.

The quality of fish products suffers to a considerable degree from unjustifiably long storage.

The quality of product could be preserved and losses reduced in goods of a seasonal species nature by using each product promptly, in its best condition, in order to insure that, for example, winter navaga would be followed by fish of the spring catch and then the summer catch etc.

It is not so important to have a full species assortment of fish as it is to insure that there is a sufficient quantity of good quality fish (not old) in some variety. This is the principle on which plans for delivery, production, storage, supply and marketing should be based.

Instructions for storage of goods in refrigerators should be reviewed with a view to definitely reducing the maximum permissible periods for storage.

When selecting the particular temperature regime for a product whose average salinity is known and, consequently, the average freezing point is known, it should be borne in mind

that normally each carload lot of lightly salted fish products does not have uniform salinity. In most warehousing operations they avoid breaking up carload lots into parts according to salinity and storing it in different cold chambers. In connection with this, when selecting the particular temperature regime for storage, the selection must be made with regard for the product with the lowest salinity.

I recommend that the workers engaged in refrigeration, cold storage, fish plants, bases, shops, those operating refrigerators and warehousemen at all enterprises and organizations that are engaged in storage of fish and fish products to improve their level of knowledge by using "Reference Book for Operation of Refrigerated Warehouses"¹. This is a valuable guide on all basic problems of warehouse storage of food products.

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The cryoscopic points (freezing points) for several delicatessen fish products were determined at the VNIRO Standards Laboratory in 1963. T.A. Dubrovskaya, working under

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Gostorgizdat. M., 1963, page 176.

the supervision of S.I. Gakichko, obtained the results shown in Table 41:

Table 41

a	b			g	h	i
	d	c				
		e	f			
Hot smoked pink salmon						
Cold smoked fat Atlantic herring .	58,6	10,4	15,1	-11,9	-13,8	0+2
Soft salmon caviar .	51,4	6,4	11,05	-6,9	-12,0	-5-0
Canned soft sturgeon caviar	41,3	4,9	10,6	-7,2	-10,8	-7-6
Preserves "Herring in mustard sauce" . . .	52,3	3,2	5,8	-3,8	-4,5	-4-3
	57,6	6,8	10,6	-7,2	-10,4	-8-0

a- fish product; b- % content;
 c- NaCl; d- moisture;
 e- per 100 gm of product;
 f- per 100 gm of moisture in product;
 g- freezing point of tissue juice, °C;
 h- cryoscopic point °C;
 i- specified storage temperature, °C.

Unfortunately, the moisture content in soft salmon roe used in the experiment was somewhat lower than the lowest limits observed during many years of observations by TINRO.

In addition, it should be taken into account that the sodium chloride content in such roe is lowered to 4% (and even lower). This shows that the lower temperature limit for storage of soft salmon roe has already been reached and storing soft salmon roe of low or undetermined salinity at a temperature below -7°C is not justified.

For canned soft sturgeon roe the temperature fixed in the instructions for storage (-4 to -3°C) is also a limit.

It would be advisable to check the result, under production conditions, that was obtained for cold-smoked fat Atlantic herring to determine whether very lightly salted herring (6.4% sodium chloride in the meat) will not freeze at a temperature down to -12°C . If this is verified, then it will be possible to store herring and other cold-smoked fat fish at temperatures guarantying its protection against mould and freezing. Evidently, the available technical possibilities for storage are not being fully used.

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During storage, fish products undergo changes in their physical state, chemical composition, taste and nutritional qualities, odour, colour, consistency and structure. The character and rate of these changes are influenced by product properties, the packaging and also the

storage conditions and, in particular, temperature, humidity, mobility exchange and purity of the atmosphere. Light has harmful effects on most fish products.

Direct contact of fish products with the atmosphere is harmful in most cases, since the fat contained in the fish oxidizes under the influence of oxygen in the air. Because of this, fish products are packed in the most impermeable containers, while salted goods are packed and poured over with brine, and frozen goods are glazed.

For products such as fish which is iced, frozen, lightly salted, hot-smoked or marinated, preserves, caviar or cooked products, the technological conditions for storage, and also the period for storage, shipment, marketing and packaging methods are at least as important as high quality of the raw fish used, the materials, promptness and sanitation in processing.

There are whole groups of fish products that are not ready for consumption when their preparation is completed; they must be kept under specified conditions for predetermined minimum periods to mature. Such products include: fish conserves (particularly in oil), canned hors d'oeuvres fish preserves made from salted, salted-spiced and salted-marinated fish, and also preserves in oil, spice-brined fish, salted,

spiced and marinated fish in any type of container.

VNIKhI workers (Piskarev, Kaminarskaya, Luk'yanitsa, Bornovalova, 1963) have established that:

1) the rate of changes taking place in tissue fat during storage of fish depends on the amount of fat contained in the fish, on its chemical characteristics and biochemical features of that fish;

2) in frozen fat fish the protein denaturizes less than in lean fish. In connection with this, measures successfully used against oxidation spoilage of fat in such fish as, for example, anchovy kilka, are useless against denaturization of its protein. In particular, block freezing and glazing does not protect kilka meat from changes in its consistency (toughness, dryness), taken place during storage.

The colour of synthetic films used for wrapping fish products has an important effect on the rate of oxidation spoilage of the contained fat.

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Experiments in storage of products in cellophane of various colours have shown the following conditional coefficients for storage period of product during which the fat was maintained in an excellent condition:

Colorless	1.0
Pink-red	1.4
Sky blue	1.6
Sea green	1.9
Blue	2.1
Lemon-yellow	2.3
Violet	2.4
Grass green	3.1
Orange	3.4

Thus, orange coloured cellophane is the best for storage of fish products.

Combined storage of fish products and other kinds of products is permissible only in extreme cases, and these must be first-class goods without signs of spoilage, mold, acrid, spoiled and foreign odours, and they must be packed in clean containers in good condition.

Retail trade outlets, similar to communal feeding enterprises, must exercise stricter adherence to the normal regimes for storage of fish products that have been officially established for them.

The rules for storage must be rigidly applied in fixing the maximum storage periods for products under such conditions. It would be advisable to universally stimulate interest in a system of state control and to hold persons responsible who violate storage rules.

Many years of experience has taught that the quality of fish products most frequently deteriorates as a result of their being kept in auxiliary storage and in the marketing rooms of stores, in stalls, booths, pantries, canteens and restaurants.

The directive of the CC CPSU and the Government "Measures for further development of the fish economy in the country, improvement of quality and assortment of fish products"¹ requires that stores selling fish and fish products must be equipped with refrigeration facilities; more refrigerated warehouses must be built for storing the frozen fish and lightly salted herring delivered to the trading network.

¹ "Pravda", 1966, No. 462.

RAW AND ICED FISH

Iced fish should be stored at a temperature a little higher than the freezing point (between 0 and -0.5°C), and for a certain fish it should be even lower, taking into account the cryoscopic point.

A decisive effect on storage results is caused by /289 bringing the temperature of raw fish and commercial iced fish as close as possible to its freezing point, or at least to zero temperature.

For example, it has been found that fresh cod spoils two times faster at 3°C than at 0°C .

Different species of fish do not have the same stability in storage when in the iced state. For example, of the freshwater fish the bass, pike, carp and catfish will keep somewhat longer than bream, while of the ocean fishes, practically all the cod species show better stability during storage than the ocean perch or whiting, whereas herring withstands storage in ice worse than other species.

Fish taken on the open sea carries less bacteria than fish taken from interior water bodies and coastal fishery. This accounts for the comparatively greater stability of ocean fish under similar conditions.

According to current instructions for Rosmyasorybtorg refrigerators, iced fish in containers with crushed ice, intended for use in the iced state, is placed in a specially equipped room. Such fish can be held for no more than 2 weeks at a temperature of -1°C , when this period has elapsed the iced fish must be removed from the refrigerator (base) or sent for freezing.

FROZEN FISH

The length of the possible storage period for frozen fish products depends mainly on the temperature. The lower the temperature, the longer the product can be stored without noticeable deterioration of quality. On the other hand, storage of frozen products at a temperature above -18°C is frequently accompanied by deterioration in quality, and this is aggravated as the temperature is raised.

The effect of fluctuations in storage temperature on the quality of frozen fish products is associated with the duration and limits of these fluctuations. Fluctuations whose mean temperature is above -18°C are particularly harmful to the products.

The rate of freezing has a smaller effect on preservation of quality of the product than does the subsequent storage temperature.

Frozen fish should be stored in refrigerators at a temperature between -18 and -30°C (depending on the technological capabilities of the refrigerator, the properties of the fish, its packaging and duration of intended storage) and at a relative humidity not below 95%. For certain species of fish as, for example, saury, a temperature of -30°C is not sufficiently low.

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For long term storage of all species of frozen fish, the quality will be best preserved if the product is kept at a storage temperature between -25 and -40°C .

Temperature fluctuations greater than $\pm 1^{\circ}\text{C}$ should not be permitted because abrupt temperature changes during long-term storage will greatly lower the quality of the fish.

Under Soviet Rule, the refrigerator capacity in this country has increased by approximately 40 times. The refrigerator capacity built during the last 20 years makes up about 85% of the total refrigerator capacity, and all this capacity is intended to store frozen products at a temperature below -18°C .

In relation to storage of frozen fish, the technological position is perfectly clear. It is clearly reflected in the literature, in the design of new refrigerators and rebuilding of old ones. The tendency towards low temperature storage has been firmly established.

One of the chief advantages of low temperature storage of frozen fish is the capability to maintain the relative humidity of the atmosphere very close to the saturation point. This moisture regime prevents qualitative and quantitative losses in the product due to drying and at the same time there is no threat of mould spoilage.

Drying will have the least effect during the coldest season of the year, in localities with the coldest climate, in the largest refrigerators and with the best insulation and maximum loading of the storage chambers. The greatest amount of drying will take place in chambers on the upper storeys of the refrigerator and in chambers with outside walls.

The lower the air temperature, the less will be the moisture deficit (in grams of moisture per cubic metre of air) at the same relative humidity, for example, at a temperature of -12°C and relative humidity of 95% the moisture deficit equals 0.12 gm/m^3 , while at a temperature of -18°C and the same relative humidity the moisture deficit is equal to 0.06 gm/m^3 (two times less).

It is necessary to take into account not only the establishment of a low temperature regime for storing frozen fish, but also the absence of temperature fluctuations. During long-term storage under unstable temperature conditions, all the high indices of quality of the fish achieved by quick freezing can be lost because elevated temperature in the storage chamber will cause the smallest ice crystals in the fish to disappear and, when the temperature is again lowered, the remaining crystals will grow into even larger ones.

Frozen fish must not be allowed to dry out during storage, since such drying is associated with both loss in weight and deterioration in quality. To prevent /291 drying of the fish it is necessary to take care that the relative humidity of the atmosphere in the storage chamber will be between 95 and 100% and that the chamber will be kept filled. If it should be necessary to raise the humidity over 95% by means of modern devices in the refrigerator, it is advisable to bring into the chamber an amount of ice equal to at least 3-5% of the chamber volume. The loss of mass will then be at the expense of the ice and not of the fish.

Another vital factor is the storage temperature. It has already been stated that at a temperature of -12°C and relative humidity of 95% the moisture deficit in the atmosphere of the refrigerator chamber will be twice as great as it would be at the same relative humidity but at a temperature of -18°C . If it is also noted that at a temperature of -18°C it is possible, without risk of mould formation on the fish, to raise the relative humidity of the fish to 100%, the progressive importance of universal and total changeover to storage of frozen fish at low temperature regimes, will then become evident, when the qualitative and quantitative losses are reduced to practically nil.

The more fully the storage chamber is packed with frozen fish, the more complete and higher its stacking, the less unused space there is in the chamber, then the lower will be the qualitative losses (drying, rime formation) and the better preserved will be the quality of the products.

For very long-term storage of frozen fish, and also for storage of the most unstable or very valuable fish, it is advisable to select the best chambers (in which very strict control must be maintained to insure sufficiently low and stable temperature, and also the required atmospheric humidity) and to provide special servicing, observation and care for the products.

The best method of long-term storage for frozen sturgeon species fish, besides using low temperature regimes, is delivering it to the consumer without thawing (not to use isothermic freight cars with ice-salt cooling during the warm period of the year, but to load such fish during these periods only into refrigerated freight cars or holds of ships), glazing the individual bales during stacking and plentiful glazing of the stacks (with ~~h~~ water).

If it is impossible to maintain a sufficiently low temperature of the medium during storage, then every effort must be made to retain the reserve of cold available in the fish,

and thereby slowing down the thawing process. To do this, the fish (in boxes or loose) is stacked in the largest possible pile, disregarding the rules for walk-throughs and other spaces, and quickly cover it with a thick layer of dry insulation. Naturally, the pile must not only be assembled and covered as quickly as possible, but it must also be protected from the effect of the sun's rays and precipitation.

Iced and frozen fish which must be stored / 292 at elevated temperatures is stacked in as large a pile as possible, the shape of the pile must approximate a cube, and there must not be spaces between individual packages either horizontally or vertically.

Table 42 gives permissible storage periods for frozen fish, depending on the temperature regime in the chambers, and beginning from the time the fish is frozen and packed in containers (VNIKhI data).

The storage period for fish that was frozen by the contact brine and ice-salt methods must not exceed one month.

Repeated freezing shortens the storage period in comparison with that shown above. However, if necessary the storage period can be extended beyond that shown in Table 42 if the quality of the fish at the expiry of the maximum normal

Table 42

a	b			a	b								
	<table><tr><td>-12</td><td>-18</td><td>-25</td></tr></table>			-12	-18	-25		<table><tr><td>-12</td><td>-18</td><td>-25</td></tr></table>			-12	-18	-25
-12	-18	-25											
-12	-18	-25											
Glazed sturgeon				Cod									
Great sturgeon . .				Rockfishes and									
Sevriuga	4	7	10	flounders (ocean	3	6	9						
	3	6	9	perch, flounder,									
Glazed salmon . . .	3	6	9	halibut)	2	4	6						
					4	8	12						
Glazed herring . .	4	8	12	Small fry . . .	3	6	8						
Caspian	1	2	4		1	2	3						
Atlantic	1	2	4	Scad									
	0,5	1	2,5	glazed	3	5	8						
Baltic herring in				unglazed	2	3	5						
blocks													
glazed	1	2	4	Filletts									
unglazed				cod									
Glazed Caspian				ocean perch and									
kilka in blocks .				halibut									

a - fish product;

b - storage period (in months) at temperature °C.

period permits an extension of storage time for the same or another period (such permission is given by signed agreement).

When fish shows unsuitability for further storage (without loss of quality) before the maximum normal storage period has expired, it must be utilized.

According to rules established by Rosmyasorybtorg, frozen fish and fish fillets must be stored at a temperature of -18° or lower. When fish is stored without containers, drying is reduced by covering the fish with a heavy layer of canvass, sacking, matting or other material. The mantle is sprayed with water from the hydrant to form a coating of ice on its surface.

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In Norway, the Government has established mandatory temperature regimes for storing frozen fish (including fillet) depending on the duration of storage:

<u>Duration of storage, months</u>	<u>Temperature $^{\circ}\text{C}$</u>
4	-20
6	-24
9	-28

Also, there is a special provision that the temperature must never be higher than the stated levels during the storage period, and fluctuations are permissible only in the direction of lower temperature.

SALTED FISH

When determining the stability and optimum temperatures of storage regimes for salted fish products it is advisable to

proceed from the concentration of table salt in the moisture contained in the product and not from the percent content of the salt in the product.

VNIKhI recommends the conditions and permissible storage periods given in Table 43 for salted fish.

Salted fish and herring in barrels is stacked, depending on the type, size, strength of barrel, and the space requirement, from 2 to 2.8 m high. Barrels and drums with balyk semi-products, semga and salmon, and generally very large barrels filled with brine are stored in the vertical position in a single layer. Boxes of salted fish should be stacked in firm and high stacks.

When selecting the temperature regime for storing salted fish products in containers with brine, it should be kept in mind that practically all fish have the ability to swell, during which time the salt content increases. This applies equally well to anchovies, herring and Pacific Ocean salmon, also to semga, and to sturgeon balyk semi-products. TINRO (Nasedkina) has established that the closer the storage temperature of the salted product in brine is to the freezing point, the lower will be the amount of swelling and increase in salinity. This law is very well known to merchants.

Table 43

a	b	c	d	e
Herring: light and medium salted in tight barrels . . .		90 and over	moderate	
in boxes	$-6 \div -4$ $-10^* \div -5$	"	"	6 3
hard salted in tight barrels .	$-2 \div 0$	"	"	10
spiced and marinated in tight barrels	$-6 \div -2$	"	"	4
Salmonid fish: light salted, in tight barrels	$-8 \div -4$ $-10^* \div -5$	"	"	4 3
in boxes	$-8 \div -4$	"	"	8
medium and hard salted, in tight barrels	$-5 \div -2$ $-4 \div 0$	"	"	6 8
Cod and others: light and medium salted	$-6 \div 0$	"	"	4
hard salted				
Spiced fish (small herring) in tight barrels				

- a - fish products;
 b - storage temperature °C;
 c - relative humidity of the atmosphere, %;
 d - air circulation;
 e - storage period, months.

* These temperature limits can only be applied when the freezing point is sufficiently low, in order to prevent freezing.

The damage due to swelling is not limited only to increase in salinity of the product. Swelling is accompanied by deterioration in appearance, consistency, aroma and taste of the product, losses of a considerable part of the extractive substances, and a reduction in nutritional value and assimilability.

Herring that is packed in boxes (or cans) after / 294 salting and without brine and which matures at a sufficiently cool temperature (without fat spoilage) is oilier, tastier and has a keener and more appetizing herring bouquet than does herring which matured in brine and lost much of its extractive substances and in which the meat has absorbed brine (swelled) during the maturing process.

Excessive swelling of salted fish during storage in brine can be counteracted by using substances other than brine for protecting the tissue fat of the fish from oxidation spoilage, and also by maximum packing of the fish in the container, as a result of which a minimum amount of brine (8-10% of the weight of fish) is required, and also by using the very lowest possible storage temperatures (without freezing the product). There is reason to believe that the addition of sugar during brining fish (sweet, special, spiced brines) significantly lowers the amount of swelling.

An important and still unsolved problem is the organization of proper maturation of salted herring during storage at consumer points. The fastest, high quality maturation of herring and other salted fish takes place at a temperature of 8°C , and the slowest permissible rate is at a temperature of -8°C . When selecting the temperature regime, within these limits, it is necessary to consider the method by which the herring was packed (with or without brine, hermetically sealed in tin cans or not hermetically sealed in containers) and, consequently, the extent to which the fat was protected from spoilage, and also the risk that decay had begun in lightly salted herring before it had matured. /295

Lightly salted Pacific Ocean herring that was processed by the interrupted brining method and packed in containers shows distinct signs of immaturity after 20 or 30 days of cold storage. However, the time interval between packing Pacific Ocean herring and its delivery to consumer points is adequate for its maturation (regardless of the salinity and fattiness of the herring). It is an entirely different matter with Atlantic herring which, as a rule, is delivered to consumer points without maturation or not sufficiently matured.

Lightly salted herring from unsaturated brining matures and spoils faster than that prepared by the interrupted brining method.

As a rule, industry does not have conditions for organizing maturation of herring. However, if we should suddenly acquire the means to build a sufficient number of maturation warehouses at the points where herring is transferred from ship to rail, then the marketing network would find itself in an extremely difficult position. There would continually be the threat of overmaturation of herring acquired in the mature state long before its sale, therefore the market should not attempt to obtain fully-matured salt herring ready for consumption.

Proper care of salted ocean herring until it is ready for consumption (organizing proper maturation during storage at consumer centers) should really take place in warehouses belonging to the marketing organization. In the strictest sense, the problem could be solved by financing large-scale construction of cooled herring warehouses in the marketing system.

To a considerable extent this also applies to the marketing of other matured fish products.

If salted fish packed in barrels and poured over with brine is not kept out of the direct rays of the sun

during the warm season of the year it will quickly "cook" and the tissues will become so flabby that the meat will drop off the spinal column.

When such barrels are rolled, handled or shaken the product will become partially or completely converted to a structureless mass and will lose all market value. Hard-salted fish, when packed without brine and kept in the sun suffers from oxidation spoilage of the fat, but "cooking" of the meat does not take place.

Whenever open storage of salted fish is unavoidable, awnings must be erected. Awnings with blank rear and end walls are erected in such a fashion that they will not face the sun or the prevailing wind. If it is impossible to erect temporary (or permanent) awnings, the products must be covered over with a material that can protect them from heat, light and moisture. However, not all covering materials give good results. For example, covering barrels of salted fish from all sides and the top with a canvass during the warm season of the year will result in further heating of the product, because the wind cannot circulate under the canvass, and the dead warm air around the barrels encourages spoilage in the fish. As another example, covering barrels of fish with straw which is soaked by rain creates a heating chamber

instead of insulation.

The best protection in these cases is provided by tents or even empty wooden containers heaped up on top of the stack.

Salt fish stored in the open during the winter loses quality and weight. It is also negatively affected by the air, wind and light. Therefore, if it is impossible to store salt fish in heated warehouses during the winter, it is advisable to store it under snow. To meet this requirement, in the fall a suitable area is selected on the most elevated piece of land, drainage is dug, the area is lined with moss, sawdust, dry pine needles or a thick layer of pine branches is laid, then a wooden flooring is made of planks, smooth rails, slabs, boards, sheets or small logs. Fish in barrels, boxes (in extreme cases loose) is then piled in regular stacks. The stack is reinforced with some type of lumber (as a frame or barrier), covered on top and from the sides with canvass, lined with matting and then covered with a sufficient amount of sawdust, moss or pine branches.

When zero weather sets in the stack is uniformly covered with snow from all sides (1.5-2 m deep), and this must be done as soon as possible, before the temperature within the stack goes down too low. The snow cover on the pile grows through the winter. Dry insulation is required underneath the

snow as protection against freezing of the salted fish. It also plays a positive role in the spring when the snow is removed.

If the fish is packed in good tight barrels or covered with moisture-impermeable canvass, there is no need for haste in digging it out from under the snow long before it is to be shipped or used. If there is danger of moisture reaching the fish, the snow must be removed from the stack before it thaws.

Careful observation of these simple requirements / 297 will prevent freezing of salted fish during the winter and, therefore, large losses of product; protection will also be provided against the harmful effects of wind, light and air.

CURED AND DRIED FISH

Cured fish should be stored in dry, well ventilated and darkened accommodation at a temperature not over 10° C. The recommended relative humidity of the atmosphere is 70-80%.

However, in the majority of cases short-term storage of cured fish is provided by boards or other primitive light-weight storage in which the possibility of maintaining the

relative humidity of the atmosphere at the desired level is remote and almost completely dependent on the humidity of the outside air.

In relation to this, the fluctuations in relative humidity of the outside air cause the cured product to alternately dampen and dry out, depending on the degree of its moisture content, hygroscopicity, packaging and stacking.

Because of the properties of cured fish, in order to preserve its qualities and reduce weight losses we regulate the storage regime, pile the fish in stacks, and change the duration, force and frequency of air circulation in relation to the temperature and relative humidity of the outside air.

Beliefs about the high stability of cured fish in storage are not fully justified. Firstly, some cured goods are characterized by extreme instability and, secondly, even the most stable of them (vobla, taran), under ordinary storage conditions, do not last for more than 3 or 4 months without significant loss of quality. Cured fish is a seasonal product. Having been prepared in the spring and early summer, it must be mainly utilized before the beginning of autumn.

Highly perishable cured fish (herring, mackerel, ocean perch, halibut, whitefish, vimba, shemaia), and also

the usual assortment of cured fish (vobla, taran, bream) intended for long-term storage, should be kept at a temperature close to the freezing point but certainly not above -5 or -8°C . Under such conditions vobla, taran and bream will keep for up to 1 year.

Salted and dried fish (for example stint) requires almost the same storage conditions as cured fish, but if it has been sufficiently dehydrated it will keep in the refrigerator for up to 8 or 10 months.

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SMOKED FISH AND BALYK PRODUCTS

VNIKhI recommends the regimes and maximum periods of storage shown in Table 44:

Table 44

a	b	c	d	e
Balyk products				
Cold smoked herring	$-2 \div 0$	75-80	intense	60
Fish: cold smoked	$-5 \div 0$	75-80	"	66
hot smoked	$0 - 2$	75-80	"	60
	$-1 \div 1$	75-80	"	2

a - fish product; b - storage temperature $^{\circ}\text{C}$;
 c - relative humidity of the atmosphere %;
 d - air circulation;
 e - storage period, days.

Rosmyasorybtorg has established regimes and storage periods as shown in Table 45:

Table 45

a	b	c	d
Cold smoked fish (except herring and balyk)			
Herring balyk	$-5 \div 0$	75—80	60
	$-5 \div -2$	75—80	15
Hot smoked fish	$-2 \div -1$	75—80	2

a - fish product; b - temperature °C;
 c - relative humidity, %;
 d - duration of storage, days.

The regimes established by Rosmyasorybtorg for this group of products is more progressive and economically justifiable.

VNIKhI has carried out some interesting work on freezing and storage of hot-smoked fish. It was found that the colour, consistency, taste and aroma of the meat and also the external appearance and all other commercial and nutritional properties of hot-smoked Black Sea mackerel and ocean perch could be preserved for 4 or 5 months.

To do this it is necessary that the fish come out of the smoking chamber not over-dried, promptly and be sufficiently quickly frozen, and the temperature deep in the meat lowered below -15°C .

Ocean perch was kept in an excellent condition at storage temperatures of -10 , -18 and -30°C for respectively $\frac{1}{2}$ month, 2 and 4 months; mackerel was kept for 1, 3 and 5 months (the lower the temperature, the longer the period of permissible storage).

When storing frozen, salted, cured, dried and smoked fish (including balyk products), the product is more or less seriously threatened by mould damage.

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In addition to the earlier known methods of preventing mould on fish products and removing that which had already formed¹, continually greater use is being made of sorbic acid.

AzcherNIRO tested an aqueous sorbic acid solution, 0.1% concentration, for prophylactic treatment of cold-smoked herring.

The best results were obtained by spraying this solution

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Nikitin B.P. Prevention and removal of spoilage in fish products. Izd-vo "Pishchevaya promyshlennost'", 1964.

on freshly smoked herring, the wrapping paper and containers with subsequent drying of the fish paper and container in a stream of air (under a fan).

Visible spots of mould appeared on the herring processed by this method, after the third month of storage, whereas herring in control boxes (not processed with sorbic acid) showed signs of moulding at the end of the first month of storage.

CONSERVES

The current instruction permits storage of fish conserves at a temperature between $+15$ and -1°C .

However, long-term storage of such products in a warm place has a very unfavourable effect on their quality.

Sterilized fish and fish and vegetable conserves should be stored at a temperature between $+5$ and -1°C , at a relative humidity of not over 75% and specified air circulation.

The freezing points of most fish conserves lie between -2.2 and -3.1°C . The first freezing does not deteriorate the quality of fish conserves in oil, especially if, during the

process, the hermetic seal has been maintained on the can, the appearance of the product has not been damaged, and it is smoothly and gradually defrosted. Freezing many types of fish conserves in oil could, evidently, be a means of quickly maturing the product (if the technique is properly developed).

PRESERVES

Preserves are kept at a temperature between -8 and $+2^{\circ}\text{C}$, depending on the degree of maturation and the requirement to hasten, delay or stop the maturing process. Permissible storage periods (from 1 to 6 months) depend on the assortment, maturity, general quality of the product and the storage temperature.

The relative humidity of the atmosphere should not exceed 75%.

Close control is required to prevent extensive bulging and overmaturation of the preserves.

/300

CAVIAR

VNIKHi recommends the following regimes and storage periods for sturgeon and salmon caviar (Table 46):

Table 46

a	b	c	d	e
Sturgeon, soft: canned				
pasteurized	-4 ÷ -3	75-80	moderate	10*
barrelled	-4 ÷ -2	75-80	»	12
paste, barrelled	-6 ÷ -4	85-90	»	8
ovaries	-12 ÷ -10	75-80	»	12**
	-6 ÷ -4	75-80	»	6
	-7 ÷ -6	85-90	»	10
Salmon, soft				

a - caviar; b - storage temperature °C;
c - relative humidity of the atmosphere, %;
d - air circulation;
e - storage period, months.

★

Far from all the soft canned sturgeon caviar, even that prepared with antiseptics, can be kept for up to 10 months; six month storage is frequently the maximum. Soft canned caviar made with pure salt is a very short-term product (maximum 2-3 months).

★★

Barrelled paste caviar actually can be kept for one year without loss of quality, but it must be kept frozen, i.e., at a temperature between -18 and -20°C.

Canned soft sturgeon caviar should be stored in a cold chamber in cans that are freed of ice and sacking, piled on special racks or shelves two cans high (in any case not over 3 cans). When stacked higher there is a noticeable loss of weight in the caviar and the strength of the egg casings decreases.

Although it has been proven that the optimum storage temperature for pressed caviar is -18 to -20°C , VNIKhI recommends storage of caviar at -10 to -12°C , and the current instruction in the fish industry still specifies storage of pressed caviar at a temperature of -2 to -4°C .

Long-term and multilateral experience in storage and quality evaluation of pressed caviar at Moscow and Leningrad, similar to the experiments carried out on low temperature storage of this product, strongly indicate that pressed caviar be stored frozen at a temperature of -18 to -20°C , particularly when long-term storage is anticipated (over 3-4 months).

Barrels containing soft and pressed caviar should be 301 arranged in the horizontal position with spacers between layers.

Pasteurized soft sturgeon caviar, in contrast to non-pasteurized, is fully suitable for storage at very low (but constant)

temperatures in the frozen state. This is advisable when, for example, the cold storage chamber containing frozen fish or frozen pressed caviar is partly empty, or when the caviar is removed from the refrigerator in small lots during the winter.

Furthermore, freezing pasteurized soft sturgeon caviar, as was demonstrated on specially conducted experiments and practical work, definitely improves the quality by eliminating, to some extent, the undesirable effect of heat treatment (pasteurization) on the egg casing, making the consistency less rubbery. Freezing frequently returns the initial tenderness, succulence, external appearance and even to some extent the aroma of the caviar.

There is sufficient basis to recommend low temperature freezing of pasteurized soft caviar with subsequent storage at constant temperature in the frozen state and gradual defrosting directly before use or storage according to instructions.

Prior to 1966, the one-time refrigerator capacity in the USSR was a little over 3 million tons, refrigeration capacity has been provided at an accelerated rate and, in 1965, 330 thousand tons of capacity was commissioned,

including: fish industry - 19 thousand tons, the trade as a whole - over 158 thousand tons. For the current five year period, the planned increase in refrigerator capacity (in %) is: fish industry - 26, distribution refrigerators - 47, and Tsentrosoyuz refrigerators - 96.

These data are proof that the assortment and quality of fish and fish products, on the basis of further equipping the industry and trade with refrigeration, should definitely improve.

Refrigerated railroad cars and trucks will also be improved and provided in greater numbers.

TECHNOLOGICAL SERVICING AND PROCESSING

Servicing of fish and fish products during their storage, and, in individual cases, their preparation is one of the most important conditions for preservation of quality, prevention of spoilage, quantitative losses and emergency utilization. Such care is not only necessary in relation to goods received with spoilage on them, shortcomings which are developed during storage, but also in a number of cases they apply to first-class products.

Servicing fish products during storage consists of observing storage conditions, the condition of the product and its packaging, the prompt and fastest possible removal of items found to be deficient.

Thus, for example, insufficient ice on iced fish, damage to the glazing on frozen fish, the absence or deficiency of brine in barrels containing salted fish, considerable thawing of frozen fish, much settling of salted fish in barrels, partial or complete freezing of goods which are damaged by freezing, and also any other damage or deviations from the norms must be detected before the product is accepted for storage and removal measures implemented immediately.

When freight is received, it is necessary to insure that optimum storage conditions are provided for each type of product; containers should be promptly repaired or replaced, carry out addition, selection and washing of fish, replace or add brine, keep fish in cold brine, remove all types of bloom from cured, dried and smoked goods by wiping or washing them with subsequent drying, thoroughly remove and destroy the larvae and eggs of insect pests, regularly add ice, carry out secondary glazing of fish, freezing (drying) or smooth defrosting of accidentally frozen lightly salted delicatessen products

(which should not be frozen) etc.

Servicing of delivered goods and processing must be carried out promptly and thoroughly, without regard for who may have been careless or irresponsible (receiver, manufacturer, shipper) in permitting the spoilage to occur. For subsequent compensation, by the responsible party, when processing losses the responsible party should be informed before the start of work and documentary proof of receipt of defective goods should be sent to them. If a representative of the manufacturer or shipper is present, it is best to draw-up a bilateral document.

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Fish or fish products undergoing decay decomposition of the surface slime, viscera or heads, having various kinds of bloom on the surfaces of the body, dirt, mechanical damage or pest infestation create such an unfavourable impression that they appear to be unsuitable as food. This is not always proved by health and food requirements. Competent inspection frequently shows that the product can be brought back to edible condition by special methods of processing.

There are many technological methods for further processing of such product. Such processing will not only pass sanitary inspection, but its application should frequently be demanded. Further processing under sanitation inspection

should precede the final decision by experts concerning the procedure for using the product for food purposes. Permissible and frequently beneficial methods of mechanically cleaning the product of various dirt, bloom, surface odours, washing in fresh or ocean water or in brine of various densities, scrubbing with brushes and water, brine or with dry salt, and, for frozen fish contaminated by mould, even dry snow.

When cleaning mould colonies from the product, it must be kept in mind that, when wiping it and making the product appear free of mould from the outside, a considerable part of the mould is only rubbed into the surface of the fish. Therefore, after such cleaning the fish should be either immediately used or placed in such storage conditions where it would be impossible for mould to develop. For frozen goods this means a temperature below -12°C , while for cured, dried and cold smoked fish it means very dry air properly circulated around the fish, and also dry product.

Other frequently-used methods are cutting up the fish to remove spoiled parts of the body or individual specimens, replacing spoiled brine, salting iced or thawed frozen fish, adding salt to light and medium salted product, as well as additional salting of hard salted product by various methods depending on the condition of the product, local conditions

and the purpose of this additional salting. It is also advisable to use cold or, on the other hand, heat processing. It is permissible to use vinegar in certain instances (but not to conceal signs of decay decomposition).

All fish that has had spoilage and was processed to remove it must be inspected for quality by the sanitation inspection services before it is used.

Permission to use such products as food can only be given after approval has been obtained from sanitary experts.

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Damp boxes containing conserves and preserves are placed in checkerboard order for drying, with 2 cm spaces between boxes, layers are separated by means of spacers. It is better to transfer the cans from soaked boxes into dry ones, and the damp cans should be thoroughly wiped with a dry clean rag.

Conserves that have been chilled to 0°C or lower should not be immediately placed in warm accommodation. The temperature in the warehouse should either be lowered or the conserves should gradually be warmed up, taking care that the temperature difference between the conserves and the surrounding atmosphere does not exceed 4 or 5°C , otherwise the cans will

sweat, which can cause corrosion of the tinplate and spoil the labels.

Warehouses must be ventilated in such a way that the containers will not be caused to sweat. When unlabelled and unlacquered cans are used for long-term storage of conserves, their surfaces are covered with neutral industrial vaseline or other anticorrosive materials.

Before shipment, the cans of conserves are cleaned of these materials by one of the following methods. At temperatures of 15-20^oC the cans can be wiped dry with clean cotton rags provided that smear is not very sticky, it has not formed a film, is fairly easily removed, the amount of work not great and there are enough hands to do the job. If it is important to clean the cans quickly and economy of effort is required, they can be washed in a one half percent solution of calcined soda and water at a temperature of between 30 and 40^oC for no more than 5 minutes, and then wiped with rags or medium brushes. After the smear has all been removed the cans are vigorously rinsed in a bath of clean water at the same temperature as the alkaline solution. The cans are then wiped dry with rags and placed in boxes. This method of cleaning the cans increases productivity of labour by several times.

It is important to promptly change the solution, maintain the required temperature in the baths and to insure that the operation proceeds according to plan.

Cans that show signs of corrosion on the outer surfaces must be immediately separated. Surface rust can be cleaned off with rags, then the cans smeared with neutral vaseline or labels can be applied and the product dispatched for prompt consumption.

It is categorically forbidden to remove rust by means of crushed brick, sand or chalk, and also to scrape it off with knives or other means which would damage the plating on the tin. Cans that have been cleaned of rust, like bent cans, are sorted into separate lots and used according to special instructions.

Cans with blisters or honeycomb resulting from deep corrosion must be separated from the lot as being non standard. The question of utilizing such unsuitable conserves is decided by a special procedure.

The following are the three most important conditions for successfully reprocessing product to remove or prevent spoilage:

- 1) Prompt reprocessing;

2) well qualified work of reprocessing under the guidance of an experienced master, technologist or market specialist;

3) prompt use or storage in appropriate conditions with strict observance of the degree of stability of the product for further storage.

When prompt use or guarantee of appropriate storage conditions for raw fish, iced or thawed frozen fish are impossible, there should not be haste to salt it, since this operation is usually unprofitable. It is advisable to find out whether or not it is possible to ice-salt (or snow-salt) and freeze the fish in order to insure its temporary preservation until it can be used.

When ice (snow) and salt are available and the freezing is carried out intelligently, even during the warm period of the year, with no cooled warehouses whatsoever, it is possible to preserve such fish in an ice-salt (or snow-salt) mixture in covered stacks for 25-40 days without signs of spoilage developing and even without noticeable saltiness. However, it must be realized that this method requires a great deal of labour and special knowledge and experience.

Organizations and enterprises which do not have, among their staff, an experienced specialist for carrying out fully competent reprocessing of fish by one or another method, are

strongly advised to use all possible means to interest an experienced specialist in this type of work.

Spoilage of fish products and measures for treating as a maintenance measure and reprocessing are well known. Appropriate recommendations and directives can be found in our work "Preventing and removing spoilage on fish products"¹.

Emergency reprocessing of defective fish products in order to restore them to edible condition is often carried out by means of the services of other organizations, in their accommodation, using their equipment and tools. Therefore, advise should not be limited simply to reprocessing. It is necessary to also exercise active and prompt sanitation and nutritional control of the organization, period, sanitary and technological methods used in the reprocessing.

¹
Izd-vo "Pishchevaya promyshlennost'". M., 1964.

STANDARDS AND STANDARDIZATION

Our national economy has been given the task of providing, within the near future, high quality products from all branches of the economy.

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Raising the quality of products, improving the assortment and expanding the volume of production are the chief current problems of science and technology.

The most effective means for strengthening the economy of the country is to raise the quality of the products. This is the main condition for progress. Quality must be controlled. To this end, there is a state system for regulating quality by means of standards.

The State standard (GOST) can be used to actively and smoothly influence the level and uniformity of the quality of all types of products.

The basic idea of standardization can be briefly stated as follows: select the best, make it a law, insure mass production and widespread distribution.

Standardization is the establishment and introduction of samples and norms with which production must conform, it is the reduction of a multitude of types to the smallest number of

samples of definite quality, size, shape, weight and other indices (physical and technical, chemical, biochemical, and, in food industries, mainly organoleptic), and without superfluous detail.

The application of current regulations insures orderly activity in a specified area to the betterment of all interested parties and with their participation.

By insuring a single approach to the evaluation of quality and variety of product, standardization brings about simplification and reduction in calculations, price lists, warehousing and transport operations.

Thus, common interest and greater production experience and consumption bring about reductions in losses and waste, hastened the introduction of complicated mechanization and automation, which is a very important element in planning the national economy, expansion of industrial output, guarantees high quality and unification of product, and lower prices.

Standardization is based on the combined results of science, technology and practical experience. It determines the basis for both current and future development.

Standardization is a very great importance as the source of organization in the national economy in accordance with the

interests of the socialist state and friendship of socialist countries. It promotes systematic renewal of output with account for the scientific and technical achievements and increased requirements of the Soviet society.

Standardization is a necessary condition and a most important means for accelerating technical progress and the establishment of the material and technical base for communism. It has been universally recognized as one of the factors encouraging scientific and technical progress, development of international trade and strengthening economic and cultural bonds between countries.

In all economically developed countries it is felt that standardization plays a strategic role in the economics of industry and in raising production quality. This means that at all levels and stages of production (from raw material and auxiliary branches of industry through to the finished product) standardization promotes efficiency of research and improvement of technology by increasing productivity and providing consumers with cheap high-quality goods.

The main purpose of standardization in this sense is to regulate the relationship between consumer and supplier.

Standardization is not the mechanical selection of average characteristics, but it is based on scientific analysis,

choice and optimum selection, the most vital, and that which will permit work to be organized on the widest scale and with the most foresight. This feature of standardization has very great significance in the comprehension of its essence since, at the present time, many specialists in various areas of science and technology still contrast the meaning of standardization with continual technical progress.

The object of standardization can be the process, rule, sequence, product, method or means of production, i.e., all that comprises the economic organism and can be qualitatively or quantitatively characterized by means of conditional units, signs or concepts.

The standard is something which has been reviewed and approved by a competent organization and is the result of precise work carried out on the basis of the achievements of science, technology and practical experience.

A Soviet standard is a collectively created document. The standard is a measure of the quality of production.

Quality is the sum total of properties of the specimen which characterize its physical essence and the consumer suitability. Quality is one of the most important concepts in the theory and

practice of standardization, since, in the majority of cases, quality of production is the main object and content of all the standardization effort. The level of standardization work can practically be evaluated by the level of production quality.

The quality of goods can be estimated by means of various characteristics, and the correct determination of these characteristics is one of the most complex tasks in standardization work.

A system of quality control requires a program. Such a program is state planning of level of quality in production on the basis of a system of state standards. Standards are established on the basis of thorough analysis of production capabilities and requirements in meeting consumer demand. Standards regularly determine the level of production quality, establish units for technical requirements for raw material, materials, semi-products and the finished goods. They fix the actual characteristics for production with consideration for quality and the properties of the initial raw material and the materials, technology and techniques of production. Standards determine systems and means for control and testing, they insure regulation in production, supply and consumption, both inside and outside the trade.

The standard is the most powerful means of protecting consumer interests. Our government's policy for technology is woven into the state standards. The judicial force of standards and practical application of standards is established by the laws of the Soviet Union. They fix the requirements of standards, the regulation of delivery and production and responsibility for quality.

The legal force of standardization is directed against those who, without regard for mutual satisfaction, unilaterally violate established laws.

The indices given in the GOST's must reflect contemporary achievements of science and technology, take into account the experience of the leading enterprises, be guided by the result of scientific research and experimental work and the data provided by experience in production. In connection with this, the preparation of GOST's in the USSR is a joint project involving the participation of scientific and research institutes, designers, planning organizations, the collectives of leading enterprises, a wide circle of specialists and scientific-technical societies.

The state standards for fish industry products are approved by the Committee for Standards, Measures and Measuring Instruments of the Council of Ministers USSR, who also

has the exclusive right to publish and republish all standards in the Soviet Union.

The work on State standards carried out in the /309 USSR is inseparably bound to the main tasks confronting the national economy of the Soviet Union as a whole.

Therefore, in this country, we attach very great importance to the greatest possible range of state standards for domestic production, high quality of the standards themselves and uncompromising adherence to their requirements.

The order of development and approval of technical requirements for industrial production (production and technical scheduling and national consumption) is regulated by Special Instruction number 2-65, approved 7 May 1965 by the State Committee for Standards, Measures and Measuring Instruments USSR. Besides the general requirements, it contains the types of technical requirements (MRTU, RTU, STU, TU), sequence of their development, agreement and approval.

Ministries and Directorates in the USSR develop standards and technical requirements, insure production output in full accordance with the specifications in standards and technical requirements, and they also establish systematic control on the application of current standards and technical requirements at all stages of processing and production output, including design, preparation of products, application of

technology and the process of manufacture of the finished product.

Each main group of products within a branch has, selected within it, base organizations for standardization (from among the scientific and research institutes, design organizations and enterprises). They are charged with both the task of developing standards and methodical leadership in standardization work for the appropriate group of products.

The organization and technical leadership in work on standardization within the confines of the branch industry as a whole is provided by selected leading organizations.

Control over introduction and application of state standards and technical requirements at enterprises, in organizations and branches is directed towards the development of standardization and measuring instruments in the country, further improvement of product quality, reliability and serviceability of goods, accelerating specialization in production, strengthening state discipline in the introduction and application of standards, insuring development of precise instrument technology, and the application of a single system of technical documentation.

Control of the introduction and application of standards and technical requirements anticipates a deep study

of the state of production, identification of causes for delay in introduction and the non-application of standards, development and provision of organizational measures for eliminating and preventing discovered shortcomings, and raising production quality.

Proposals made by the branches of the Committee for Standards, Measures and Measuring Instruments of the Council of Ministers USSR on the results of control are mandatory for all inspection enterprises and organizations.

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When inspection reveals non-adherence of products to the requirements of State standards and technical requirements the branches of the Committee for Standards, Measures and Measuring Instruments of the Council of Ministers USSR forbids shipment of the deficient products.

In many industrially developed countries, special governmental decrees define the state significance of standardization and its important role as a means of achieving national policy in problems of production quality and insuring their ability to compete on world markets.

Standardization of fish and fish products in our country includes very important work associated with a definite improvement in the requirements for quality, assortment, packaging, and the technological conditions of storage and shipment.

It is economically necessary to develop and introduce, wherever convenient, differentiated indices for quality, but this should not permit superfluously small assortments of goods and prices.

In order to obtain, by the organoleptic method, quantitative, objectively significant and fully justifiable indices of quality, many countries have long used the so-called point system of evaluation. The point system of evaluation consists of assigning numerical values to characteristics of the properties of the product.

Such a method of numerical measurement of organoleptic indices (by points) and using standardized scales for point evaluation (5, 10, 12, 25, 50, 100 and 125 point system evaluations) is called organometry.

The advantages of organometry, particularly when applied to products having grade divisions, is that in place of sometimes obscure and disputable formulations about degrees of

odour, taste and consistency or other indices, each qualitative position is assigned a numerical value. Thus organoleptics, with the help of organometry, acquires much greater force, certainty and indisputability of conclusions. This definitely improves the qualifications of organoleptic experts during the course of their work and at special seminars. Organometry helps maintain taste habits at the required professional level.

Organometry insures clarity, orderliness and /311
uniformity of judgment and presentation of data, it largely removes weaknesses from the organoleptic method which are associated with its subjectivity.

Organometry is able to numerically reflect the significance of the elements making up the qualitative evaluation of a product.

One of the hereto undeveloped sides of the GOST's and MRTU for fish and food products are the incomplete and inaccurately described specifications of peculiarities of taste and odour for products of a certain assortment (nature, technology, grade).

This problem is particularly delicate in relation to sturgeon and salmon caviar, semga-balyk products, some types of

smoked products, conserves, preserves, cooked products and all types of fish delicacies.

There are continually more technical and technological possibilities for state standardization to exert a stronger influence on the fish industry, on all the links in the trade and communal feeding network, to lower the upper limit of permissible salt content in fish products.

By keeping to sufficiently rigid, strictly principled and progressive positions it is possible to more properly resolve questions of quality in each individual case (to apply at specified times and to specific cases and situations all the exceptions from the requirements stated in the GOST's, the necessity or advisability of which will be clearly demonstrated).

Besides technical, fodder, medicinal and veterinary products, food products in the fish industry could now be evaluated by objective (instrumentation) methods more frequently than is actually practiced.

It is necessary to introduce objective methods of quality control of production in scientific and research institutes, and then directly in industry.

Popularization and improvement of the methodology and practice in organoleptic research, by means of which such essential indices of quality as odour, taste, external appearance and even the consistency of the product, is also of great importance. These indices always were and always shall be either singularly possible (taste, odour), or decisive (determining consistency).

The new standards more and more openly state certain technological requirements applicable to decisions in preparation, to periods and conditions for product storage, as well as other useful specifications. As an example, we shall discuss GOST 11829-66 "Cold-smoked black-backed shad small balyk", approved in 1966 and effective since 1967.

This delicacy is only processed from raw frozen or lightly salted black-backed shad at the present time. The upper temperature limit is restricted to 26°C during preliminary drying and smoking of the backs (to prevent fat dripping and steaming of the balyk). Insofar as storage of this very perishable product is concerned, the standard states that the product "will not undergo long term storage".

The foremost requirement for balyk products is that first-class balyk products will contain at least 16% fat.

A particularly interesting requirement, which is clearly intended to prevent error in resorting, is mandatory special trimming of the caudal fins during dressing of the finished product (second grade product must have the fins trimmed shorter than first grade product). This is convincing proof that such simple means can be used, when grade divisions are required, to prevent the possibility of error in resorting.

TASKS OF INDUSTRY AND MARKETING IN SATISFYING
AND EDUCATING CONSUMER TASTE AND DEMAND

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Educating consumer taste is a historically complex and long process.

Today, fish products are mainly produced in large, high capacity enterprises that are equipped with complex machinery, equipment and whole assembly lines. Control of the technological process is organized from chemical and bacteriological laboratories at such enterprises. This applies both to shore enterprises and to ships processing product on the open seas.

The history of the development of the fishing industry very convincingly shows that "economic epochs are distinguished, not by what is produced, but by how it is produced; by the method of labour"¹. If the means for production are being improved, then the quality of the products of that production should also be improved. It is useful to remember this and keep it in mind when investigating,

¹
Karl Marx. Capital. T.I.M-L., Sotsekgiz, 1931, page 131.

discussing and solving problems associated with indices of product quality and, in particular, with standardization.

Our fishery has never before undergone such great, decisive and multilateral changes in relation to geography, objects, seasons and volume of fishery, and also the technical and technological possibilities, fundamental changes in assortment and quality of products, as it has undergone in the recent past.

As a result of this the industry workers, in cooperation with those in trade and communal feeding, must now, as never before, intensively search for, develop and propose to the consumer, having responded to his evaluation and desires, new and frequently fairly unique fish products which have heretofore been unknown.

First-class scientifically organized population feeding should not accept simplified positions and lowered requirements arising from the fact that the fish product must not be repulsive to the consumer, it must not be toxic, or merely concentrating on meeting demand and limiting concern for the assortment and quality of fish products to such elementary properties.

The forces of the fish industry and its management must strive to immediately increase production of such fish

products as are in greatest demand by the population and the volume of production of those which do not meet this demand. Nevertheless, serious consideration must also be given to the maximum esthetic and physiological value of the product at the lowest possible cost.

If, by way of an example, a comparison is made of some commercial positions in 1940 with the positions in 1967, then it will be found that now the demand, in this country, for salt herring and even cold-smoked herring is fully or almost fully met for practically all the assortment of fish conserves, whereas, in 1940, there was a serious shortage of all these products throughout the country.

The industry has direct orders to send edible raw fish first for production of frozen, smoked and cured fish, balyk products, lightly salted herring (mainly fat), and also conserves (with special emphasis on further increase in the production of sprats, sardines, saury in oil).

Brining of fish is recognized in this country as an expedient method of conservation and is carried out only on those fish which, when salted, yield an excellent product of the delicatessen-type that is in great demand.

Such fish include herring and small herring fishes (except the sardine species), anchovies (Black Sea-Azov anchovy and, currently, the small amount of Pacific Ocean anchovy), salmonid fishes with red and pink meat (semga, salmon and Pacific salmon), and also whitefishes (muksun, peled, broad whitefish, pyzh'yan, omul, cisco and tugun). Semi-products are also salted for subsequent curing or cold smoking, this includes balyk products.

Brining such fish as cod, ocean perch, cyprinids, percids, most marine fishes, is patently unnecessary and therefore is kept to a minimum. Such brining is permitted only as an exception on the older vessels carrying on fishery far from shore and in the absence of facilities for freezing, conserving or processing fish flour.

Salting such fish as sturgeon (except for balyk products), flounder, goby, zander or, for example, navaga, is completely forbidden as a conserving process, because it very greatly lowers the natural properties of the raw material.

Simultaneously, enormous efforts are directed towards 315 having herring, anchovy, salmon, and other fish from among those used for semi-products for subsequent curing or cold-smoking, processed by moderate and light salting to produce light salted, tasty and

aromatic delicacies or tender oily consistency.

Close inspection of the raw material and technological tendencies at many shore fish-processing enterprises, and particularly enterprises that are presently in the trade system, would reveal that they frequently process the kind of fish the consumer would prefer to buy in the fresh state.

For example, iced or frozen zander, which is practically unheard of in the stores, is a desirable item two or three days after being fried in vegetable oil as a cold snack without any garnishing. This does not mean that zander is excellent jellied, prepared in the Polish fashion, or fried in butter and served with hash brown potatoes, lettuce and cucumber. This rare and remarkable fish should be used only according to its nutritional properties.

For example, it is undesirable to smoke lightly salted keta by the cold method, or frozen Pacific salmon by the hot method. It would be better to produce less smoked cod and haddock, and to cook more of them (in cooking shops, communal feeding enterprises and in the home).

Great importance is attached to raising the quality of fish products and consumer demand by improving the external appearance, taste, aroma, consistency and generally the food

In this country at the present time, home cookery uses only canned crab meat and, less frequently, salmon au naturel for salads with potatoes, fresh cucumber, other vegetables, greens and mayonnaise. Sometimes natural and also purely delicatessen fish conserves are used in the preparation of first (liquid) courses.

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The limited demand for some natural fish conserves (for example, fat ocean herring in jelly) can be accounted for partly by poor advertising of this first-class food product. We are talking about a product that is perfectly suitable for cold plates (salads, Russian salads with sauces or seasoning), and also in hot dishes (first and second courses) with an abundance of vegetable garnishing and various sauces.

Conserves in jelly au naturel are very good when served cold with lemon, horseradish, olives, greens or tomatoes.

Incidentally, fish conserves au naturel could be prepared from many species of fish in a far greater assortment and quantity.

The conserves "cod liver" are so oily and nutritional that it is best to have them with, for example, hot boiled potatoes, fresh or pickled cucumbers, tomatoes, mushrooms,

sauerkraut or in salads made from fresh white or red cabbage.

The large quantity of fish oil left over is of excellent aroma, rare assimilability and other remarkable hygienic properties and can be used on vegetable and fish salads and in many other cold plates made from vegetables and fish. Cooked cold lean meat of cod, hake and other gadid fish, and also natural salmon conserves in combination with cod oil can be used to produce excellent foods.

When evaluating the commercial demand or consumer value of any fish or its product, a whole complex of indices must be taken into account. These are obtained by the most complex and delicate instrumentation methods of research, and also by simple observations from life. This requires judgment based on first hand experience.

For example, a consumer in a large commercial center who is familiar with a very large variety of new food products, including fish products, is able to more quickly, correctly and objectively appreciate new product than the consumer who has only known Volga-Caspian Sea region fish in his life. It will be much easier to convince the former that the majority of fish now taken on the open seas are fully acceptable and frequently excellent food products which possess

essential advantages in comparison with many fish from the internal reservoirs.

Marketing of new products can be accompanied / 317 by considerable difficulties at the start. For example, in Leningrad, it was initially very difficult to sell even the excellent and high quality mature ivasi herring (a very fat Pacific Ocean sardine), in which both the salesmen and consumers found unusual and strong new odours. After a short time the ivasi became one of the most popular fish products in the country (as lightly salted herring, canned products "sardines in oil", in marinades and smoked).

We now find it difficult to market other sub-species of sardine which are very similar to ivasi (however, ivasi is fatter).

The first attempts at marketing select quality cod in Moscow ended in failure for a long time simply because of the unaccustomed odour of that fish. At the present time, the majority of Moscovites prefer cod to many other fish because of its tender white meat with a delicate ocean aroma and the complete absence of tiny prickly bones. In the seaboard countries of Western Europe, cod, haddock and pollock have been in great demand for many centuries.

The reader will find it hard to believe that, during the first few years of this century, a well known, progressive

Peterburg wholesale fish firm with considerable resources persisted in marketing Amur River salmon soft caviar. It started by giving away this new product free to many third-rate taverns on the outskirts of Peterburg. By the following year the firm was snowed-under by orders for keta caviar, which is a product that is still in great demand.

Up to 1853, the unique Caspian black-backed shad from the lower waters of the Volga was not eaten, it was considered to be mad because of its circular movements in the water during spawning. However, it was caught in enormous quantities for rendering very cheap technical oil.

The Caspian eel was also not used as food for a long time simply because of its snake-like form. In the Baltic area, at that time, fried eel was already considered a delicacy.

In the Soviet Union, most consumers still refused to buy canned crab meat at the end of the 1930's. A bonus was even established to salesmen for every can of crab meat sold.

These examples show that, if the product is really excellent, no initiative, resources or energy should be spared for intelligent and up-to-date systematic advertising.

The Soviet Union is one of the few countries with large fishery in which, in spite of the enormous possibilities for shark fishery without additional expenditures, these fish are nevertheless not used for food.

This is accounted for by insufficient education of consumer taste and the absence of work to dispel firmly implanted prejudices and false ideas concerning sharks, the meat of which has reasonably good food qualities (see the Chapter "Species Composition and its Characteristics").

In our country, shark fishery is in the embryonic stage at the present time, the sale of shark meat is practically unrestricted on the external market. Thus, there is no direct requirement to force the meat of edible sharks on the Soviet consumer. However, the fully acceptable nutritional properties of the meat of certain species of shark and the forthcoming definite development of their fishery raise the question of skillfully acquainting our consumer with this first-class product.

In practically all countries, shark meat is marketed under a different name and enjoys excellent demand under such a disguise. In Germany, shark meat was even marketed earlier under the name of "Russian great sturgeon".

Nowadays, both industry and trade are experiencing, and shall continue to experience for some time, difficulties in marketing such ocean products as squid, shrimp, ocean scallops, sea mussels, and also certain species of fish which the consumer has still not taken a fancy to, and which are characterized by certain peculiarities as, for example, odour of the meat, shape of the head or of the whole body.

The consumer still knows very little about the true nutritional, medicinal, prophylactic, protective, hygienic, and dietetic properties of fish products as a whole. He knows that the best tasting herring comes in boxes. Soviet advertising could easily, with interest, profitably and promptly explain these differences to millions of consumers.

We too, undoubtedly, are obliged to broadly inform the consumer about features of raw material and technological processes, about methods of cooking which have a definite effect on quality and consumer properties of fish products.

If the industry provides a certain amount of fish and fish-vegetable conserves that are prepared without preliminary frying of the raw material, then it would appear that such a feature should be communicated to the consumer on the label of the can, a brief explanation provided with the first lots of such conserves, and the consumer asked to communicate his

reaction to such a novelty.

This practice is as important to the consumer
as it is to industry and trade.

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It is common knowledge that, in Western countries, flounder is one of the most expensive fish and is used in French, Canadian, Scandinavian and English cuisine in the production of first-class, frequently refined dishes, even in the most fashionable restaurants. Soviet fishermen take a great quantity of flounder from the Pacific Ocean. However, the majority of the consumers buy this fish reluctantly, in spite of the fact that the price on flounder is low.

Naturally, a very important fact is that in France, England, Norway and Denmark, dishes are prepared from live flounder, which contributes to the very high gastronomic properties. In our country, flounder is delivered to large consumer centers (Moscow, Sverdlovsk, Leningrad, Minsk or Donbass) frozen, whole, having undergone considerable ocean and railroad shipment (8-12 thousand km), long-term cold storage, and frequently premature thawing and subsequent refreezing or further freezing, and the fish is in soft, gas-permeable containers from the time it is processed until the consumer gets it, it suffers from pressure and harmful contact with the atmosphere.

All this makes it even more important to thoroughly inform the consumer about better methods of cooking frozen flounder (together with adequate measures to improve the quality of frozen flounder).

Also, individual packaging and sale of Pacific flounder according to zoological species would, evidently, increase the demand for most of the flounders that have excellent nutritional properties (yellowfin and certain other species of Pacific flounder).

It is necessary to inform the consumer that cooked flounder is excellent, that it is best to cook it over steam, and, when cooking in water, not to permit the water to boil. A direct responsibility of the trade and the industry is to demonstrate a sufficiently wide assortment of the best and most easily prepared delicious sauces for flounder.

Public tasting, at communal feeding enterprises, of specially prepared dishes from flounder, Baltic herring and kilka are the best advertising and means of familiarizing the consumer with new types of products.

For example, the consumer should know that to fry sturgeon or boil navaga is not advisable from the point of view of cooking, since this nullifies all the basic special properties

of these fish.

The consumer is still not insufficiently /320
informed how commonly available fish can be used to make
excellent special jellied dishes or for fish stuffing.

Naturally, methods and recipes for preparing
fish dishes can be learned from cookbooks, but it would
be better if experienced, artistic cooks sufficiently frequently
consulted consumers in large specialized stores, demonstrating
with actual raw materials the method of preparing fish under
domestic conditions and, at the same time, the consumer would
be able to taste the dishes that interested him.

A constructive example can be taken from the
retail tea and coffee trade. There, they systematically
organize wide-scale consumer tasting of tea and coffee of
various brands. A certain number of the consumers eagerly
take part in these tasting sessions, and then they communicate
their impressions to the bystanders and thus disseminate
useful information among the consumers.

Fish product advertising must definitely be developed
by making use of all the available means and forms (radio,
television, consumer tasting, demonstration cooking in the
presence of interested consumers, marketing propaganda

specially prepared by salesmen and consultant cooks at large specialized stores).

Very useful devices in propagandizing fish products of new types are placards about new goods, leaflets and small free brochures, text on the wrappers, articles in journals and newspapers, short advertising films and well prepared, short, conveniently presented public lectures.

All these propaganda forms and advertising must be based on reliable material and harmoniously composed, without over simplification and, at the same time, be readily understandable and entertaining in form.

Well thought-out trade names for new products are also of real importance in propaganda.

French confectioners, when marketing new cakes, pastries and pies in specified assortments, give them interesting advertising names as, for example, "pell-mell", while the Italians have given this type of mixture, for example, the remarkable advertising name of "tutti-frutti". Such names impress, intrigue, spread rapidly and live long.

A leading cook named a hot, keen dish created by him, and made of chopped meat, herring and potatoes: "forshmak" (this translates as "appetizer" in Russian). This name spread everywhere and is well established.

Such creatively conceived trade names for a product are an excellent advertisement in themselves. Because of the essential psychological effect of trade names on the consumer, the Soviet industry and trade must not cultivate and accept incidental, unjustified, difficult to pronounce and odd-sounding trade names for fish. Such names of fish as, for example, Atlantic eelpout, could well be disregarded and the much more suitable "loketta" (from loquette, the French name for this fish).

This certainly is the avenue to be followed in changing the names of some of the new fishes which were hastily given ill-conceived, unsuitable and unjustifiable names.

Displaying goods in salesrooms and windows, particularly new products in need of advertising, and which are artistically decorated with taste and in harmony in the trade sense, is one of the strongest means of propaganda for moving new goods toward the consumer. For this purpose, we should use special devices, lighting, and even automated movement in combination with sketches and appropriate texts.

A positive role could be played by grouping the bulk of new and delicatessen fish products in a comparatively small part of food stores in sufficiently large consumer centers or in specialized fish stores. This would make it possible

to provide a higher standard of maintenance on the products, their preparation and sale, display, presentation to the consumer, careful and skillful packaging of the purchases, and also the propaganda for new products requiring promotion. It would be possible to carry out systematic and highly efficient training of sales personnel in such stores.

All types of advertising and propaganda for fish products require multilateral knowledge, sufficient culture and special tact, manners and abilities.

Therefore, the thematic, textual, and artistic aspects of this complicated matter should preferably be centralized thereby universally propagandizing products by means of prompt and adequate types of advertising, instructions and having control over proper utilization of advertising materials, as well as providing practical help in this delicate art.

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- 2 Барбулевые, см. султанковые
- 3 Барбуля, см. султанка
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- 9 Aral whiteyed bream (A.s. bergi)
- 10 Caspian inconnu
- 11 Great sturgeon (Huso huso)
- 12 Eelpout
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- 2 Gymnosarda elegans
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- 4 Char
- 5 Pink salmon
- 6 Croakers (or Drums)
- 7 Atlantic croaker
- 8 Yellowfin croaker
- 9 Californian croaker
- 10 Red drum
- 11 Kingfish
- 12 Spotted seatrout
- 13 Maigre
- 14 White croaker
- 15 Gray weakfish
- 16 Ombre
- 17 Sciaenidae
- 18 White/Silver Bream
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- 20 Grey Jackassfish (see Ocean Carp)
- 21 Dollarfish (see Butterfish)
- 22 Dolphinfishes (see coryphaenids)
- 23 Speckled Drepane (seems to be a Spadefish)
- 24 Long-armed (rayed) Drepana
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- 3 Asp ("Zherekh")
- 4 Aral asp
- 5 North Caspian asp
- 6 South Aspian asp (A. aspius taeniatus)
- 7 Cisco
- 8 Snakehead
- 9 Snakehead (order Ophicephaliformes)
- 10 Large eyed Dentex
- 11 Sea Bream - large Kanarsky
- 12 Sea Bream - small Kanarsky
- 13 Sea Bream - Large-forehead (perhaps Taius tumifrons)
- 14 Wolffish
- 15 Atlantic wolffish
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- 17 Northern wolffish
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- 19 Cabellero (see Lutjanus spp.)
- 20 Brill (see Rh. rhombus)
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 2 Starry flounder
 3 Slime flounder (Jap); Lemon sole (Eur).
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 6 Common flounder
 7 Sohachi flounder
 8 Flathead flounder
 9 Arctic flounder
 10 Fluke;
 11 Japan Sea flounder
 12 Flounders
 13 Flatfishes
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 15 Captain (see otolithus)
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 18 Sea Bass - Blue
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- 8 Kilka
- 9 Anchovy - like kilka
- 10 Sprat
- 11 Bigeye kilka
- 12 Southern sprat
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- 15 Coho Salmon (O. kisutch)
- 16 Stickleback
- 17 "Dondevka" - the name for cisco in Yakutia
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- 19 Smelt
- 20 White Sea smelt
- 21 Arctic smelt
- 22 Ladoga smelt
- 23 Silver smelt
- 24 Neva smelt
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- 30 Redeyed Fishes
- 31 Redfin
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- 12 Garrick
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- 15 Salmonids
- 16 Salmon
- 17 Australian Salmon
- 18 Atlantic Salmon
- 19 Indian Salmon
- 20 Caspian Salmon
- 21 Kura Salmon
- 22 Pacific Salmon
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- 24 Bluefishes
- 25 Bluefish
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- 27 Yellowtail snapper (Rabirrubia)
- 28 Yellow (Vermilion?) snapper
- 29 "Cottoro" ("Kottoro") snapper
- 30 Redtailed snapper
- 31 Red snapper
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- 13 Blue Marlin
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- 28 Volga Lamprey
- 29 Caspian Lamprey
- 30 Kura river lamprey
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