FISHERIES RESEARCH BOARD OF CANADA

Translation Series No. 2394

Technological and chemical characteristics of commercial fish in the Pacific Basin

by I.V. Kizevetter

Original title: Tekhnologicheskaya i khimicheskaya kharakteristika promyslovykh ryb Tikhookeanskogo bassina

From: Izvestiya Tikhookeanskogo Nauchno-Issledovatel'skogo Instituta Rybnogo Khozyaistva i Okeanografii (TINRO) (Proceedings of the Pacific Scientific Research Institute of Marine Fisheries and Oceanography), : 189-225, 1971

Translated by the Translation Bureau(TTH)
Foreign Languages Division
Department of the Secretary of State of Canada

Department of the Environment
Fisheries Research Board of Canada
Halifax Laboratory, Halifax, N.S.
Vancouver Laboratory, Vancouver, B.C.

1973

75 pages typescript

DEPARTMENT OF THE SECRETARY OF STATE
TRANSLATION BUREAU

MULTILINGUAL SERVICES DIVISION

CANADA

SECRÉTARIAT D'ÉTAT
BUREAU DES TRADUCTIONS

DIVISION DES SERVICES MULTILINGUES

TRANSLATED FROM – TRADUCTION DE	INTO – EN
Russian	English

AUTHOR – AUTEUR

I.V. Kizevetter

TITLE IN ENGLISH – TITRE ANGLAIS

Technological and chemical characteristics of commercial fish from the Pacific Basin

TITLE IN FOREIGN LANGUAGE (TRANSLITERATE FOREIGN CHARACTERS)
TITRE EN LANGUE ÉTRANGÈRE (TRANSCRIRE EN CARACTÈRES ROMAINS)

Tekhnologicheskaya i khimicheskaya kharakteristika promyslovykh ryb Tikhookeanskogo bassina

REFERENCE IN FOREIGN LANGUAGE (NAME OF BOOK OR PUBLICATION) IN FULL. TRANSLITERATE FOREIGN CHARACTERS.
RÉFÉRENCE EN LANGUE ÉTRANGÈRE (NOM DU LIVRE OU PUBLICATION), AU COMPLET, TRANSCRIRE EN CARACTÈRES ROMAINS.

Izvestiya Tikhookeanskogo Nauchno-Issledovatel'skogo Instituta Rybnogo Khozyaistva i Okeanografii (TINRO)

REFERENCE IN ENGLISH – RÉFÉRENCE EN ANGLAIS

Proceedings of the Pacific Scientific Research Institute of Marine Fisheries and Oceanography

PUBLISHER – ÉDITEUR	DATE OF PUBLICATION / DATE DE PUBLICATION			PAGE NUMBERS IN ORIGINAL / NUMÉROS DES PAGES DANS L'ORIGINAL
TINRO, Dal'izdat Publishing House	YEAR / ANNÉE	VOLUME	ISSUE NO. / NUMÉRO	189-225
PLACE OF PUBLICATION / LIEU DE PUBLICATION				NUMBER OF TYPED PAGES / NOMBRE DE PAGES DACTYLOGRAPHIÉES
Vladivostok	1971			75

REQUESTING DEPARTMENT / MINISTÈRE-CLIENT: Environment

BRANCH OR DIVISION / DIRECTION OU DIVISION: Fisheries Research Board, Halifax Laboratory

PERSON REQUESTING / DEMANDÉ PAR: Mr. C.W. Shinners

YOUR NUMBER / VOTRE DOSSIER N°:

DATE OF REQUEST / DATE DE LA DEMANDE: October 12, 1972

TRANSLATION BUREAU NO. / NOTRE DOSSIER N°: 143544

TRANSLATOR (INITIALS) / TRADUCTEUR (INITIALES): TTH

SOS-200-10-6 (REV. 2/68)
7530-21-029-5333

DEPARTMENT OF THE SECRETARY OF STATE
TRANSLATION BUREAU

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CLIENT'S NO. / N° DU CLIENT	DEPARTMENT / MINISTÈRE	DIVISION/BRANCH / DIVISION/DIRECTION	CITY / VILLE
	Environment	Fisheries Research Board Halifax Laboratory	Halifax,N.S.
BUREAU NO. / N° DU BUREAU	**LANGUAGE / LANGUE**	**TRANSLATOR (INITIALS) / TRADUCTEUR (INITIALES)**	
143544	Russian	TTH	January 18, 1973

Tikhookeanskii nauchno-issledovatel'skii institut rybnogo khozyaistva i okeanografii /TINRO/ - Pacific Ocean Research Institute of Fisheries and Oceanography /TINRO/.

Tekhnologicheskaya i khimicheskaya kharakteristika promyslovykh ryb tikhookeanskogo basseina.

by: Prof. I.V. Kizevetter, Doctor of Technical Sciences.

Technological and chemical characteristics of commercial fish from the Pacific basin.

Dal'izdat, Vladivostok, 1971

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*Numbers in the right-hand margin indicate the corresponding pages in the original. (Translator).

Syngnathiformes

Cornetfish* Fistularia petimba that were caught in November in the East China Sea, were examined. This long (27 - 47 cm) fish is light in weight (18 - 71 g) and is found singly in the catches. When dressed, cornetfish yields little flesh (42 - 47%) because it has a large head (21 - 25.6%), a massive skeleton (18.3%) and bulky viscera (9.1%, including 3% liver). Cornetfish flesh has a low fat content. The content of fat recorded in the inedible portions of its body is also rather low (Table 271).

Cornetfish flesh canned in its natural juices has been given a favourable rating. Its boiled flesh is similar in flavour to shrimp. 190

Beryciformes

Red snapper (Trachichthodes gerrardi) of the family Berycidae predominates in trawl catches. Its body length ranges from 20-54 cm, but specimens measuring 36 - 40 cm prevail in the catches.

Red snapper has a pinkish-red body colouring and large, firmly attached scales. The fish has a large head and a low content of flesh. In a red snapper weighing 1150 - 2470 g, the head amounts to 32.6 - 44.6%, viscera to 3.4 - 5% (including 0.6% liver), fully dressed body** to 50.1 - 56.6%, bones to 8.9 - 11.8%, fins to 2.6 - 4%, scales to 2.7 -4.3%, flesh with the skin on to 31.1 - 42.4%.

* Also known as trumpetfish or flute-mouth. (Translator).

** Headless dressed fish with the tail removed. (Translator).

The relative mass of the viscera veries seasonally in the red snapper on account of the changes in the mass of its sexual glands. Prior to the spawning it amounts to 7.5-11.4% (including 4.3-8.5% sexual glands), but it drops to 4.2-7.3% (includign 2-5% gonades) after the spawning. It may therefore be assumed that the weight ratios of different body parts vary in the red snapper (whose spwning season is rather lengthy) from on region to another and are different on different months.

Table 271.

Химический состав частей тела свистульки

1 Части тела	6 Пределы содержания, % 7 влага	8 жир	9 белок	10 зола
2 Мясо	74,3 / 77,3	1,0 / 3,3	19,6 / 20,5	1,4 / 2,5
3 Голова, кости, плавники	68,0 / 69,0	0,8 / 4,7	15,7 / 19,0	8,3 / 14,3
4 Печень	70,8	9,2	18,6	1,4
5 Остальные внутренности	76,2	2,8	18,4	1,6

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Chemical composition of different body parts in cornetfish.
1. Body parts; 2. Flesh 3. Head, bones, fins 4. liver 5. Remaining vescera 6. Threshold contents, % 7. Moisture 8. Fat 9. Protein 10. Ash

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The flesh of red snapper contains 1.4% fat, 20.4% protein, 76.9% moisture and 1.2% ash. When boiled or fried, its flesh is delicate and has an excellent flavour. Red snapper should be classified as a goodquality food fish. The flesh of red snapper contains (according to Teplitskaya's data) 1.5γ% vitamin B_{12}, 200γ% vitamin B_2, 100γ% vitamin Bc and 4500γ% vitamin PP. Vitamins of the group B have been detected in red snapper eggs (B_{12} - 14γ%, B_2 - 1000γ%, PP - 300γ%).

The content of oil in the liver does not exceed in red

snapper 5.5-6%, that of vitamin A is 5500 I.U. (i.e. 93000-94000 I.U. per gram of liver oil). The liver is rich in water-soluble vitamins B_{12} (127γ %), B_2 (2500γ %), Bc (200γ %) and PP (9000γ%).

Zeiformes

John dory (Zeus japonicus) belonging to the family Zeidae, were examined. The fish were caught between January and May in the East China Sea.

This peculiarly shaped fish has a massive head, large bones and fins. For example, the weight ratios of different body parts in the John dory specimens weighing 570 to 1450 g, varied as follows (in % of the weight of the fish): head 25.3-28.3, viscera 14.2-15.3, fully dressed body 52.2-60.5 (including bones and fins amounting to 13.6-18, flesh with the skin on 38-47). Its flesh has an average flavour and is non-fatty, but its viscera have a fairly high fat content (Table 272).

Mugiliformes

The barracuda family (Splyraenidae) includes several 191
species: Sphyraena japonica, Sphyraena jello, Sphyraena pinguis and Sphyraena picuda. The first three species have a flavourous, delicious flesh; the last species is not used for food purposes.

Judging from the results of the research done by V. Bogacheva, I. Frolova and A. Lisachenko, the weight ratios of different body parts vary within a fairly large range in the barracudas caught during different seasons and in different regions. (Table 273).

Data from M. Sycheva's and A. Lisachenko's analyses on the chemical composition of barracuda flesh are presented in Table 274.

Table 272.

Химический состав частей тела хамсичков

1 Части тела	5 Пределы содержания, %			
	6 влага	7 жир	8 белок	9 зола
2 Мясо	76,9 79,2	0,4 1,7	18,8 20,1	1,3 1,6
3 Голова, кости	72,8 78,3	1,6 3,1	14,9 16,9	7,3 11,4
4 Внутренности	56,6	21,5	20,2	1,7

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Table 272.

Chemical composition of different body parts of Zeus japonicus.

1. Body parts 2. Flesh 3. Head, bones 4. Viscera 5. Threshold contents, % 6. Moisture 7. Fat 8. Protein 9. Ash

Table 273

Весовые соотношения частей тела барракуд

1 Показатели	14 Полосатая барракуда				21 Красная барракуда		25 Барракуда абтузата
	15 февраль			16 июль–август	22 март		
	Восточно-Китайское море 17	Западная Австралия 18	Новая Зеландия 19	Тонкинский залив 20	Юго-восточная зона Тихого океана 23	Восточно-Китайское море 24	Северо-западная часть Индийского океана 26
2 Длина тела, см	27 / 95,5	70 / 75	28 / 38	52 / 91	33 / 54	33 / 34	54 / 89
3 Вес рыбы, г	120 / 4500	2200 / 3800	140 / 340	820 / 3550	290 / 985	220 / 230	1000 / 5600
4 В % к весу рыбы:							
5 голова	10,5 / 22,1	16,2 / 17,9	22,1	15,3 / 18,2	18,9 / 20,3	14,4 / 16,2	16,0 / 19,0
6 внутренности,	2,9 / 16,5	6,2 / 8,6	6,4	4,7 / 16,5	5,3 / 6,2	6,2	5,5 / 11,0
7 в т. ч. печень	—	1,3	—	2,1	—	—	—
8 тушка	80,9	74,0	71,5	68,2 / 76,9	71,0 / 73,4	18,1	68,0 / 72,0
9 кости и плавники	5,7 / 11,5	6,5 / 11,5	7,8	—	12,5 / 13,6	12,4	—
10 чешуя	0,9 / 1,3	0,9 / 1,3	—	—	—	—	—
11 кожа	—	—	—	—	4,0—6,8	—	—
12 мясо с кожей	60,6 / 75,2	64,3 / 67,2	60,6	—	59,8 / 63,6	67,0	—
13 мясо без кожи	—	—	—	—	55,8 / 56,8	—	—

Table 273. Weight ratios of different body parts in barracudas. 1. Indices 2. Body length, cm 3. Weight of the fish, g 4. In % of the weight of the fish 5. head 6. viscera 7. including liver 8. fully dressed body* 9. bones and fins 10. scales 11. skin 12. flesh with the skin on 13. flesh with the skin removed (skinned) 14. Sphyraena jello 15. February 16. July-August 17. East China Sea 18. Western Australia 19. New Zealand 20. Guld of Tonkin 21. Sphyraena pinguis 22. March 23. Southeastern Pacific Ocean 24. East China Sea 25. Sphyraena abtusata 26. Northwestern Indian Ocean.

* Dressed, headless fish with the tail removed. (Translator).

Table 274

Химический состав мяса барракуд

1 Вид	6 Район лова	14 Период лова	20 Вес рыбы, г	21 Пределы содержания, % 22 влага	23 жир	24 белок	25 зола
2 Полосатая барракуда	7 Тонкинский залив	15 Июль-август	820 3500	75,5 78,9	0,5 1,1	19,0 21,4	1,4 1,7
	8 Восточно-Китайское море	16 Февраль	120 4500	75,1 78,9	0,5 3,0	19,0 22,0	1,1 1,7
	9 Западная Австралия	17 Февраль	2200 3800	72,4 73,8	2,0 2,3	22,0 22,0	1,4 1,6
	10 Новая Зеландия	—	140 340	78,2	0,4	20,1	1,7
	11 Юго-восточная часть Тихого океана	18 Март	290 985	70,9	5,5	21,8	1,4
3 Барракуда ланкон			3100 4500	73,5 75,1	1,6 3,5	20,9 22,3	1,4 1,6
4 Красная барракуда	12 Восточно-Китайское море	19 Февраль	220 230	64,0	16,1	18,5	1,4
5 Барракуда абтузата	13 Северо-западная часть Индийского океана	—	1000 5600	74,0 75,0	0,4 2,0	21,2 24,2	1,4 1,6

Table 274. Chemical composition of flesh in barracudas.

1. Species 2. Sphyraena jello 3. Sphyraena langson 4. Sphyraena pinguis 5. Sphyraena abtusata 6. Fishing region 7. Guld of Tonkin 8. East China Sea 9. Western Australia 10. New Zealand 11. Southeastern Pacific Ocean 12. East China Sea 13. Northwestern Indian Ocean 14. Fishing period 15. July-August 16. February 17. February 18. March 19. February 20. Weight of the fish, g 21. Threshold contents, % 22. Moisture 23. Fat 24. Protein 25. Ash

According to the data found in the literature, barracuda flesh has a 2-7.3% fat content, in view of which this fish should be classified as medium-fatty.

The flesh of Sphyraena jello is dark (cream-coloured), with a bluish-greenish iridescence. Boiled flesh is darker. The stock obtained is dark, unappetizing, with an unpleasant odour and flavour. Fried flesh of Sphyraena jello, particularly in the form of fish-cakes, has been given a satisfactory rating. The flesh of Sphyraena pinguis compares favourably with that of Sphyraena jello because of its lighter colour, delicate texture and pleasant flavour. Judging from the data available in the literature, the flesh of Sphyraena pinguis has been given the top rating for its flavour. 192

Barracudas can be classified as food fish, although their flesh has fairly low organoleptic indices. Frozen storage is the most expedient method for barracudas.

Inedible portions of the barracuda body (in both Sphyraena pignuis and S. jello) have a high content of fat (Table 275).

When processing the offal for fish meal, it is therefore possible to increase the fat content in the product obtained.

The liver of the Sphyraena jello caught in July in the Gulf of Tonkin (and weighing 800-1900 g) contained (according to the data of G. Dolbish) 5-6% lipids and 65-68% moisture, as well as 1070 to 4040 I.U. of vitamin A per gram, i.e. 20980 to 67200 I.U. vitamin A per gram of liver oil.

According to the results of A. Teplitskaya's analyses

and to the data found in the literature (Khigashi*, 1959), the threshold contents of the water-soluble vitamins of the group B, which have been found in the body of barracuda specimens examined, is as follows (Table 276).

Table 275

Химический состав частей тела барракуд

1 Части тела	6 Пределы содержания, %			
	7 влага	8 жир	9 белок	10 зола
2 Голова, кости и плавники	54,5 / 63,9	2,4 / 13,9	15,6 / 22,4	6,1 / 12,3
3 Внутренности	60,2 / 74,3	1,5 / 19,9	17,1 / 18,6	1,3 / 2,3
4 Молоки	79,6	1,4	18,0	1,7
5 Икра	62,6	10,3	22,0	3,5

Table 275. Chemical composition of different body parts in barracudas. 1. Body parts 2. head, bones and fins 3. viscera 4. milt 5. roe 6. threshold contents, % 7. moisture 8. fat 9. protein 10. ash

Table 276

1 Ткани	5 Пределы содержания (γ%) в сыром веществе				
	B_{12}	B_2	B_6	PP	Bc
2 Мясо	3,5—8	400—600	200	4000—6500	390—470
3 Внутренности	50—52	500—700	—	7000—10000	—
4 Печень	—	740	—	—	—

Table 276. 1. tissues 2. flesh 3. viscera 4. liver 5. threshold contents (γ%) in raw tissues.

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* All the Foreign names appearing in this paper, are transliterated from Russian. (Translator).

Mugilidae

Two of the species belonging to the family are commercially important in the Pacific Ocean and in the Sea of Japan. These are striped mullet (Mugil cephalus) and pilengas (Kugil so-iuy). Pilengas is quite common in our waters; striped mullet is found but rarely. Fishing for pilengas takes place in the southern Primor's* during the spring and in the autumn. The commercial value of this fish is negligable.

Striped mullet and pilengas attain a length of 60 cm (commonly measure 30-40 cm) and a weight of 3 kg (commonly weigh 1.2-2 kg).

Weight ratios of different body parts were determined in pilengas by E. Kleie, Z. Podoba, S. Gakichko, when the fish caught during July-September in Peter the Great Bay, in the Amur river estuary and in the Tyk Bay were examined. The weight ratios of different body parts varied within a very small range in the pilengas weighing 500-1700 g (in % of the weight of the fish): head 13.6-17.2, fully dressed body 66.9-71 (including 3.6-5.6 bones, 2.9-4 fins, 56.4-61 flesh with the skin on) and viscera 8.9-16.8. Pilengas have a flavoursome, delicate, fatty flesh. This fish is particularly oily in the autumn. Results of the analyses carried out by Z. Podoba, L. Vakulyuk and N. Firsova 194
show that the Pacific Mugilidae have a high fat content in the flesh, as well as in the inedible portions of their body (Table 277).

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* Maritime. (Translator).

Table 277

Химический состав частей тела пилengаса и лобана

1 Район лова	8 Период лова	Что исследовано 17	29 Пределы содержания, % 30 влага	31 жир	32 белок	33 зола
		А — Пилengас				
2 Амурский залив, южное Приморье	9 Апрель	18 Мясо	69,8 74,6	5,6 5,9	18,1 19,3	1,4 1,7
	10 Сентябрь	19 Мясо	67,2 70,1	9,8 12,6	19,2 20,1	1,2 1,4
	11 Октябрь	20 Мясо	68,9 69,4	8,1 9,0	20,4 21,6	1,2 1,3
	12 Сентябрь-октябрь	21 Головы, плавники	60,8 62,2	5,5 14,4	14,2 16,5	10,5 15,7
3 Лиман р. Амура	13 Сентябрь	22 Мясо	67,0 68,4	10,4 17,3	19,6 21,4	1,3 1,4
	14 Октябрь	23 Мясо	65,4 66,9	11,4 19,6	18,4 19,3	1,3 1,6
4 Японское море	—	24 Мясо	72,6 74,2	2,6 4,8	18,6 19,4	1,1 1,2
		В — Лобан				
5 Тихий океан	—	25 Мясо	68,3 70,2	1,2 7,8	18,0 21,0	1,1 1,7
6 Побережье Австралии	15 Июль-ноябрь	26 Мясо	59,8 74,6	2,6 16,2	15,8 20,4	1,2 1,6
		27 Головы и хвост	50,2 59,9	16,1 24,3	15,8 16,6	6,4 6,7
7 Восточно-Китайское море	16 Ноябрь	28 Мясо	72,0 75,0	4,3 4,5	18,9 21,9	1,1 1,3

Table 277. Chemical composition of different body parts in pilengas and striped mullet. 1. fishing region 2. Amur Bay, southern Primor'e* 3. Amur river esturary 4. Sea of Japan 5. Pacific Ocean 6. Australian coast 7. East China Sea 8. Fishing period A-Pilengas 9. April 10. September 11. October 12. September-October 13. September 14. October 15. July-November 16. November 17. Tissues examined 18. Flesh 19. Flesh 20. Flesh 21. Head, fins 22. Flesh 23. Flesh 24. Flesh; B-Striped mullet 25. Flesh 26. Flesh 27. Head and tail 28. Flesh 29. Threshold contents, % 30. moisture 31. Fat 32. Protein 33. Ash

* Maritime. (Translator).

The fat content in the flesh of pilengas from Peter the Great Bay depends upon the size of the fish: the content of fat in the flesh of small specimens (weighing 15-200 g) does not exceed 1.5-2.5%, but may be as high as 10-15% in the flesh of large fish (1500-2000 g).

The large pilengas caught during the autumn in the southern Primor'e and in the esturary of the river Amur, are a fairly vauable fish. Commercial fishing for pilengas should therefore be encouraged and developed on a larger scale.

According to the data found in the literature (Ionaze, Muroyama, 1956; Khiroze et al), the following vitamins have been detected in pilengas flesh: B_1 (100-130 γ%), B_2 (400-530 γ%), B_6 (400-430 γ%), pantothenic acid (160-830 γ%) and folic acid (120-p26 γ%).

The fat extracted from pilengas flesh is pale-yellow in colour and has pleasant organoleptic properties. Its physico-chemical constants are as follows: d_4^{15}-0.9204, n_D^{20}-1.4725-1.4748, saponification number 186.4-192.6, iodine number 115.6-124.3, unsaponifiable substances 0.2-0.7%. 195

Polynemiformis

The family Polynemidae inclused several species of fish, which may be valuable commercially. Catches from Australian waters include occasionally Eleutheronema tetradactylum specimens measuring 25-92 cm and weighing 240-10000 g. Small specimens of Polynemidae have a greater relative mass of flesh than do large specimens (Table 278).

The flesh of Polynemidae is non-fatty, has an excellent flavour when boiled or fried. A higher fat content has been

established in inedible parts of the body (Table 279).

Table 278

Весовые соотношения частей тела у пальцеперых

1 Показатели	13 Крупные	14 Мелкие
2 Вес рыбы, г	10000	240--370
3 Длина тела, см	92,5	25,5—28,0
4 В % к весу рыбы:		
5 Голова	19,6	21,5
6 Внутренности,	7,8	8,9
7 в т. ч. печень	0,9	—
8 Тушка,	64,8	67,3
9 в т. ч. кости	14,0	8,0
10 Плавники	4,1	2,3
11 Чешуя	3,5	—
12 Мясо с кожей	47,8	59,3

Table 278. Weight ratios of different body parts in Polynemidae. 1. Indices 2. weight of the fish, g. 3. Body length, cm. 4. In % of the weight of the fish 5. Head 6. Viscera 7. Including liver 8. Fully dressed body 9. Including bones 10. Fins 11. Scales 12. Flesh with the skin on 13. Large 14. Small

Table 279

Химический состав частей тела пальцеперa

Части тела	8 Пределы содержания, %			
	9 влага	10 жир	11 белок	12 зола
	74,0	0,1	19,4	1,2
	79,0	2,5	21,2	1,5
3 Внутренности	75,8	2,2	14,4	1,6
4 (без. печени)	81,2	3,8	17,7	2,3
5 Печень	67,3	2,2	14,4	1,4
	81,2	12,7	20,0	1,6
6 Позвоночник, кости, голова,	54,2	2,2	16,1	17,8
7 плавники	67,6	21,0	20,1	19,3

Table 279. Chemical composition of different body parts in Polynemidae. 1. Body parts 2. Flesh 3. Viscera (without the liver) 4. Liver 5. Vertebral column, bones, head, fins 6. Threshold contents, % 7. Moisture 8. Fat 9. Protein 10. Ash

Table 280

1 Части тела	6 Пределы содержания (γ%) в сыром веществе		
	B_{12}	B_2	PP
2 Мясо	6—10	200—400	2000—3500
3 Голова	2,5—3	200	2000
4 Внутренности	4—9	300—500	2800—3000
5 Печень	30	2000	5000

Table 280. 1. Body parts 2. Flesh 3. Head 4. Viscera 5. Liver 6. Threshold contents (γ%) in raw tissues.

Bony parts of the body (the head, the bones and the fins) yield an excellent broth, which congeals readily. The flesh of Polynemidae has a high content of vitamin B_{12} (Teplitskaya); the liver is particularly rich in this vitamin (Table 280).

Polynemidae are valuable food fish. Frozen storage is recommended.

Perciformes 196

Centropomidae family. The Ambassis copsi specimens caught in the East China Sea, were examined. The fish measures 15-19 cm in length and weighs 90-120 g. It has a fairly massive head (19.5-23.2% by weight). When dressed, it yields 69.8-74.3% fully dressed bodies and 3.5-6.3% viscera. The flesh contains 79.8% moisture, 0.6% fat, 17.6% protein, 1.8% ash. It is non-fatty and unpalatable.

Serranidae family. Epinephelus fasciatus* and Polyprion oxygeneios* (the latter is also known as the grouper), sea bass Lateolabrax japonicus and Niphon spinosus, as well as Malakichtis griseus were examined.

Characteristics of the fish investigated and weight ratios of their different body parts are presented in Table 281

* The two are referred to in Russian as grey perch. (Translator).

according to A. Lisachenko's, E. Kleie's et al. data.

Serranidae have a large head and massive bones. Small Malakichtis have the lowest mass of flesh. It has been established that the relative content of flesh increases in Epinephelus fasciatus and Polyprion oxygeneios as the overall size of the fish decreases on account of the marked decrease in the ralative mass of its head.

Chemical composition of Serranidae flesh is presented in Table 282 according to the results of the analyses by

Table 281

Весовые соотношения частей тела серрановых

1 Показатели	10 Серый окунь: Восточно-Китайское море, 11 февраль	Серый окунь: Тонкинский залив, июль—12 сентябрь	Серый окунь: Новая Зеландия, 13 февраль	14 Морской японо-морской судак: зал. Петра Великого, 15 октябрь	Морской судак 16 нифон: Восточно-Китайское море, февраль 17	18 Малакихтис: Восточно-Китайское море, ноябрь—19 январь
2 Длина тела, см	60 / 31	29 / 30	56 / 94	67 / 86	—	28 / 46,3	11 / 14
3 Вес рыбы, г	4520 / 14000	390 / 510	2800 / 16100	4970 / 10200	150	240 / 1420	25 / 50
4 В % к весу рыбы:							
5 голова	28,5 / 33,3	16,2 / 19,2	20,0 / 27,5	27,5 / 32,8	33,0	28,6	23,7 / 30,7
6 внутренности,	3,5 / 6,8	5,1 / 6,3	4,5 / 8,7	4,4 / 11,5	—	8,9	3,6
7 в т. ч. печень	1,1 / 1,2	—	0,5 / 1,2	0,7 / 2,0	—	1,3	—
8 плавники, позвоночник, кости	12,6 / 14,9	8,0 / 12,0	—	12,1 / 15,1	11,2	9,8	21,9
9 мясо с кожей	45,0 / 50,0	62,2 / 66,2	—	47,8 / 49,1	48,8	52,7	43,8

Table 281. Weight ratios of different bony parts in Serranidae. 1. Indices 2. Body length, cm 3. weight of the fish 4. In % of the weight of the fish 5. Head 6. Viscera 7. Including liver 8. Fins, vertebral column, bones 9. Flesh with the skin on

10. Epinephelus fasciatus and Polyprion oxygeneios 11. East China Seas, February 12. Gulf of Tonkin, July-September 13. New Zealand, February 14. Lateolabrax japonicus 15. Peter the Great Bay, October 16. Niphon spinosus 17. East China Sea, February 18. Malakichtis 19. East China Sea, November-January.

Table 282

Химический состав мяса серрановых

1 Название	7 Район лова	14 Период лова	Вес рыб., 23 г	24 Пределы содержания, % 25 влага	26 жир	27 белок	28 зола
2 Окунь серый	8 Восточно-Китайское море	—	470	70,9	5,7	—	—
		15 Январь	510				
		16 Февраль	390	72,6	0,5	16,9	1,3
			14000	78,5	6,7	21,3	2,9
		17 Май—	2800	76,9	0,2	19,0	1,2
		июль—	16100	79,0	2,7	20,2	1,4
		18 сентябрь					
		19 Декабрь	4000	73,4	2,6	22,2	1,8
3 Окунь серый	9 Новая Зеландия	20 Февраль	4970	74,1	2,0	19,5	1,2
			10200	77,7	5,0	19,5	1,3
4 Морской японский судак	10 Зал. Петра Великого	21 Октябрь	150	75,6	1,3	17,8	1,1
				79,3	2,0	19,0	1,4
	11 Восточно-Корейский залив		—	76,1	1,2	18,6	1,1
				77,6	2,6	19,4	1,6
5 Морской судак нифон	12 Восточно-Китайское море	—	—	78,5	0,4	19,1	1,8
6 Малакихтис	13 То же	22 Ноябрь	38	76,4	1,0	17,2	1,4
			50	78,6	2,3	21,0	1,6

Table 282. Chemical composition of Serranidae flesh.

1. Name 2-3. Epinephelus fasciatus and Polypron oxygeneios 4. Lateolabrax japonicus 5. Niphon spinosus 6. Malakichtis 7. Fishing regions 8. East China Sea 9. New Zealand 10. Peter the Great Bay 11. East Korea Bay 12-13. East China Sea 14. Fishing period 15. January 16. February 17. May-July 18. September 19. December 20. February 21. October 22. November 23. Weight of the fish, g 24. Threshold contents, % 25. Moisture 26. Fat 27. Protein 28. Ash

Table 283

Химический состав частей тела серрановых

1	2	4 Части тела	10 Пределы содержания, % 11 Влага	12 Жир	13 Белок	14 Зола
3 Малакихтис		5 Голова, плавники, позвоночник, кости	61,4 — 69,3	2,8 — 8,0	14,9 — 18,8	7,9 — 15,9
		6 Внутренности	45,0 — 80,4	11,5 — 44,5	5,1 — 9,5	1,0 — 1,5
		7 Печень	65,0 — 71,2	15,4 — 19,7	7,4 — 15,0	1,3 — 1,7
		8 Голова, плавники, позвоночник, кости	73,1 — 79,6	0,5 — 1,5	11,9 — 17,9	7,0 — 8,5
		9 Внутренности	75,1 — 89,0	0,7 — 6,3	9,3 — 7,1	1,3 — 1,6

Table 283. Chemical composition of different body parts in Serranidae.

1. Species of Serranidae 2. Epinephelus fasciatus and Polyprion oxygeneios 3. Malakichtis 4. Body parts 5. Head, fins, vertebral column, bones 6. Viscera 7. Liver 8. Head, fins, vertebral column bones 9. Viscera 10. Threshold contents, % 11. Moisture 12. Fat 13. Protein 14. Ash

Table 284

1 Части тела	5 Содержание (γ %) в сыром веществе B_{12}	B_2	PP
2 Голова	2—2,5	100—200	2500—3500
3 Внутренности	21—32	300—800	3000—18000
4 Печень	75—182	1000—1500	2500—6500

Table 284. 1. Body parts 2. Head 3. Viscera 4. Liver 5. Content (γ%) in raw tissues

M. Nikolaeva, M. Sycheva, A. Lisachenko et al., and to the data available in the literature.

With regard to the fat content, Serranidae should be

classified as low- or medium-fatty fish. The Serranidae species examined have (with the exception of Malakichtis) a firm, light-coloured flesh with excellent organoleptic properties both in a boiled and in a fried state. The flesh of the sea bass and Niphon representatives is particularly flavoursome, whereas Malakichtis is bony and its flesh is unpalatable. 198

A. Teplitskaya found the following water-soluble vitamins in the flesh of Serranidae (γ%): B_2 (100-200), Bc (200), B_{12} (2-3.0) and PP (3000-7000).

Serranidae are valuable food fish. Fat accumulates in considerably greater quantities in the inedible portions of their body than in their flesh (Table 283).

The stock made with the bony parts of the body is flavourous, nutritional, rich in fat, and it congeals readily.

We wish to note that a 28.6-44.5% fat content has been recorded in the viscera of the Epinephelus fasciatus and Polyprion oxygeneios specimens caught in the East China Sea in February and December. In view of their high fat content, viscera of these fish represent during certain seasons a valuable raw material which may serve as a source of oil.

Of the internal organs of grey perch, liver may offer a certain interest because it contains (according to the data from G. Dolbish's analyses) 62.2-70.3% moisture, 3.8-11.5% fat and 1300-20530 I.U. vitamin B per gram of liver (34210-301910 I.U. vitamin A per gram liver oil). Viscera (particularly the liver) of Serranidae are rich in vitamins B_{12} and PP (M. Sromyatnikova's and A. Teplitskays's data, Table 284).

Percidae family. Common perch (Perca fluviatilis Linne) lives in the Amur river basin. This fish has no commercial significance, but is found in catches. As a rule, the perch weighs 0.5-1.5 kg, rarely attains 3-4 kg in weight.

Weight ratios of different body parts characterize the perch as a fish with a small relative mass of flesh. For example, having dressed the perch weighing 0.5-0.9 kg, which were caught in July-August in the river Amur, E. Koshubo obtained the following (in % of the body weight): scales 5.1-6.2, heads 26.7-29.4, fully dressed bodies 58.3-61.3 (including 10-11.6 bones, 2.6-3.2 fins, 5.9-6.8 skin, 38.9-41 flesh) and viscera.

According to the data from Z. Podoba's analyses, the 199
flesh of the Amur perch caught in July-August (and weighing 500-900 g) has a low fat content (0.6-0.8%), but a high content of moisture(78.9-81%). Its content of proteins does not, however, deviate from the norm (16.4-18.6). Viscera of this fish are also poor in fat and have the following composition (in %): moisture 82.8, fat 0.7, protein 14.9, ash 1.2.

Amur perch flesh has the same chemical composition of the flesh varies as follows (in %): moisture 79.5-80.7, fat 0.5-0.7, protein 17.2-18, ash 1.2-1.3.

Cheilodoctelidae family. Nemodactylus valeniennesi and Nemodactylus macropterus, representatives of the family Cheilodoctelidae, are found in trawl catches from the New Zealand shelf.

Sexually mature specimens of Nemodactylus macropterus attain a length of 24-40 cm and a weight of 500-1600 g; those of Nemodactylus valeniennesi 80-82 cm in length and a weight of 800-850 g.

These fish have the massive head. Large specimens also have very bulky verterbae. Weight ratios of different body parts vary in nemodactylus (having a weight of 485-840 g) as follows (in % of the overall weight of the fish): head 27-31, viscera 3.1-4.9 (including 1.3 liver), fully dressed body 64.1-69.9 (including verteral column and bones 6.2-11.9) fins 2-2.1, flesh with the skin on 49.4-59.8. The body of Nemodactylus is covered with large, firmly attached scales that are removable with difficulty. The flesh of Nemodactylus valeniennesi is virtually identical to that of Nemodactylus macropterus. In both species the flesh contains 74.6-75.8% moisute, 2.9-5.9 fat, 19-20 protein, 1.2-1.8% ash.

A. Teplitskaya recorded 4-7.5 γ% vitamin B_{12}, 300 γ% vitamin B_2, 5000-8000 γ% vitamin PP and 100-200 γ% vitamin Bc in the flesh of Nemodactylus mercropterus.

Nemodactylus are medium-fatty fish. Their flesh is firm and has good flavour, when cooked. These are food fish. Frozen storage is recommended.

Latridae family. Latris forsteri (or trumpeter) is a large fish with a body length of 40-51 cm and a weight of 2000-4000 g.

The flesh of the Latris caught near the shores of New Zealand, contains 72.1% moisture, 6% fat, 20.3% protein and 1.4% ash. It has an excellent flavour when either boiled, or fried.

Latris is a high-grade food fish. Frozen storage is recommended.

G. Dolbish has found that even in the liver oil of large specimens (weight 3000-4000 g) the fat content does not exceed

1.5-2%, that of vitamin A 2000 or 2100 I.U. (110000-113000 I.U per gram of liver oil).

Arripadae Family. Arripis trutta (Australian salmon) were caught in New Zealand waters, where this species is a widespread commercial form. The specimens found in the catches measured 51-52 cm in length and had a weight of 2500-2600 g. Arripis commonly has a length of 40-50 cm and weighs 1200-2200 g.

Dressed Arripis yields 19.1% heads, 5.5% viscera (including 1-1.9% liver), 75.4% fully dressed bodies, 5.3% bones, 2.6% fins (in % of the weight of the undressed fish) and 51.1% flesh with the skin on.

The flesh is fairly fatty and contains 70% moisture, 7.1% fat, 21.8% protein, 1.1% ash. According to A. Teplitskaya's data, the flesh (particularly the liver) has a high content of vitamins of the group B (Table 285).

The liver contains (according to G. Dolbish) 3.2-13.2% oil and 4000-4100 I.U. vitamin A (4000-41400 I.U. vitamin A per gram of liver oil).

Judging from the data of V. Dzhovett and V. Davis (1938), 200
the flesh of Arripis specimens weighing 1350-2161 g, has a virtually stable chemical composition during the period of January to September: moisture 67.3-69.4%, fat 5.4-8%, protein 21-21.5%, ash 3.6-4%.

It flesh has a firm texture and a peculiar flavour. Arripis has been classified with regard to its technological properties as a food fish that can be either boiled or fried. The principal storage method is frozen storage.

Theraponidae Family. The Therapon theraps caught in the Gulf of Tonkin, are small (10-17 cm in length) fish weighing 30-92 g. When dressed, they yield (in % of the overall weight of the fish) 19.8-29.1 heads, 6.7-9.8 viscera (including 1.2 liver), 52.9-73.5 fully dressed bodies (including bones and fins which amount to 13.6-15.9), and 43-56.8% flesh with the skin on.

The flesh of Therapon is non-fatty, bony and unpalatable. It contains 71.5-78.2% moisture, 0.8-4% fat, 19.9-22.3% protein, 1.9-2.3% ash. Therapon has no value as a food fish.

Priacanthidae family. The following three species of the family Priacanthidae from the East China Sea were examined: Priacanthus macracanthus, Priacenthus boops and Priacanthus tayenus.

Weight ratios of different body parts in these species of Priacanthidae were (according to the data of E. Kleie and I. Frolov) similar in the specimens weighing 100-400 g and varied as follows (in % of the overall weight of the fish): head 21-29.9, viscera 8.6-16.6 (including 2.8 liver), fully dressed body 56.5-62 (including 10-15.5% fins, vertebral column), flesh with the skin on 45.4-50%.

According to the data of E. Kleie, M. Sycheva and O. Legon'ko, the flesh of Priacanthus macracanthus is non-fatty, bony, inferior in flavour. Similarly to the other Percoidei, Priacanthus macracanthus accumulates considerably greater quantities of fat in the bone tissues and viscera than in the flesh (Table 286).

Table 285.

1 Части тела	5 Содержание (γ %) в сыром веществе			
	B_{12}	B_2	PP	Bc
2 Мясо	6—8	400	5000	100
3 Икра	20—30	1000	2500	—
4 Печень	120—130	2000	16000—17000	500

Table 285. 1. body parts 2. flesh 3. roe 4. liver 5. content (γ%) in raw tissues.

Table 286.

1 ей	6 Части тела	14 Пределы содержания, % 15 влага	16 жир	17 белок	18 зола
2 us boops	7 Мясо	74,3	3,2	21,0	2,0
3 canthus macracanthus	8 Мясо	75,5	0,7	17,8	1,3
		79,3	1,7	21,6	1,6
4 Priacanthus tayenus	9 Мясо	76,5	0,2	19,0	1,5
		78,9	0,4	20,4	1,7
5 Все виды окуней	10 Голова	70,4	3,4	12,2	8,5
		75,6	5,3	16,7	9,2
	11 Позвоночник	58,6	16,0	10,2	15,3
	12 Внутренности	73,5	1,1	13,9	1,4
		78,5	6,1	21,6	2,2
	13 Печень	53,5	17,5	27,1	2,0

Химический состав частей тела приакантусов

Table 286. Chemical composition of different parts in Priacanthus. 1. Species of Percoidei 2. Priacanthus boops 3. Priacanthus macracanthus 4. Priacanthus tayenus 5. All the species of Percoidei 6. Body parts 7. flesh 8. flesh 9. flesh 10. head 11. vertebral column 12. viscera 13. liver 14. threshold contents, % 15. moisture 16. fat 17. protein 18. ash

Table 287.

1 Части тела	5 Пределы содержания, % 6 влага	7 жир	8 белок	9 зола
2 Мясо	75,5	0,1	18,9	1,4
	79,4	0,4	22,1	1,9
3 Внутренности	79,8	1,0	17,0	1,9
4 Голова, кости,	64,3	1,0	14,2	5,6
позвоночник, плавники	76,0	2,1	18,1	16,0

Химический состав частей тела черного окуня

Table 287. Chemical composition of different body part in Rachycentron canadum. 1. body parts 2. flesh 3. viscera 4. head, bones, vertebral column, fins 5. threshold contents, % 6. moisture 7. fat 8. protein 9. ash

Table 288.

Состав мяса ставрид декаптерусов

1 Район лова	6 Период лова	11 Вес рыбы, г	12 Пределы содержания, % 13 влага	14 жир	15 белок	16 зола
Восточно-китайское	7 Ноябрь	35				
		125	70,8	4,3	23,3	1,6
	8 Сентябрь	—	71,4	2,9	22,7	2,4
[illegible]	9 Май	40	74,8	0,4	—	—
залив		85	78,4	1,1		
	10 Июль-август	65	71,8	0,4	19,9	1,6
		380	75,5	3,5	22,3	2,2
4 Калифорнийский залив		1500				
		1800	71,3	4,6	22,5	1,3
5 Индийский океан		340				
		415	77,5	0,8	20,0	1,7

201

Table 288. Composition of flesh in Decapterus.
1. fishing region 2. East China Sea 3. Gulf of Tonkin 4. Gulf of California 5. Indian Ocean 6. fishing periods 7. November 8. September 9. May 10. July-August 11. Weight of fish, g 12. threshold contents, % 13. moisture 14. fat 15. protein 16. Ash

Rachycentridae family. Among the fish belonging to the family Rachycentridae, we examined Rachycentron canadum, which are also known as "sargeant fish". The Rachycentron canadum specimens caught in the Gulf of Tonkin and near the Australian coast, weighed 730-7100 g. When the fish were dressed, the following weight ratios of their different body parts were established (in %): heads 25.5-26.2, viscera 7.8-11.6 (including 1.1-1.7 liver), fully dressed bodies 58.8-66.4 (including 3.8-4.4 fins, 1-1.2 scales, 8.4-3.4 shin, 45.6-51.1 skinned flesh). 201

The flesh of Rachycentrum canadum is non-fatty, but flavoursome, when fried. It is somewhat less flavourous when boiled.

A. Teplitskaya's analyses show that the flesh contains water-soluble vitamins B_{12} (6 γ%) B_2 (200 γ%), Bc (500 γ%) and PP (3500 γ%).

Rachycentron canadum is a valuable food fish. It should be stored in a frozen state. In contrast to other Percoidei, it contains little fat in the inedible portions of its body (Table 287).

G. Dolbish found in the liver of Rachycentron canadum 5.6-12.2% oil and 510-790 I.U. vitamin A (9500-14000 I.U. vitamin A per gram of liver oil).

Carangidae family. This family analgamates a large number of different fish species, many of which are valuable commercially.

The following four species of Carangidae have been examined: Decapterus muroadsi, D. Maruadsi, D. polyaspis (a Californian species), D. russeli.

When dressed, representatives of these species yield small quantities of flesh: 18.1-26.3% heads, 5.2-12.2% viscera (including 1.1-4.4% sexual glands, 0.8-1.8% liver), 60-66.1% fully dressed bodies (including 6-7% bones, 5.7% fins, 50.6-56.4% flesh with the skin on). The first two species are small 202
(15-25 cm in length, 40-205 g in weight). The Californian Decapterus is the largest species in this group (it attains 44-55 cm in length, 1500-1800 g in weight).

Data from M. Sycheva's and A. Lisachenko's analyses show that the fat content in the flesh of Decapterus does not exceed 4.5%, whereas the content of proteins is high (Table 288).

The flesh of Decapterus is flavourous and is fully adequate for food purposes. Decapterus canned in its natural juices has been given a good rating.

The bony body parts of the Decapterus specimens caught in the East China Sea in November, i.e. the heads, fins and tails, had the following composition (in %): moisture 61.3-70 g, fat 5.1-6.1, nitrogenous substances 15-20; a high content of fat (25.1%) was recorded in the viscera.

Carangidae of the genus Caranx. The following two species of this genus have been examined: Caranx delicatissimus and Caranx chrysohrys. Both species have a large head, massive bones and fins. Therefore, they yield little flesh, when dressed.

According to the data of E. Kleie and M. Sycheva, weight ratios of different body parts in the representatives of the Caranx species investigated (weighing 70-80 g), which were caught during different seasons (in February, July, August) and in differnt regions (Gulf of Tonkin, Great Australian Bight, New Zealand shelf), varied within the following range (in % of the total weight of the fish): head 19.4-27.3, viscera 7.9-10.8 (including 1.2 liver), fully dressed body 60-72.7 (including 7.9 -14.5 bones and fins, 52.7-58.5 flesh and skin).

According to the data from M. Vakhrusheva's and Z. Repins's analyses, the flesh of the Caranx specimens caught in different regions, proved to have a very low fat content: it attained 7% in the flesh of one single, exceptionally large specimen (Table 289).

Table 289.

Химический состав мяса ставрид каранкс

1 Район лова	6 Период лова	12 Вес рыбы, г	13 Пределы содержания, %			
			14 влага	15 жир	16 белок	17 зола
2 Восточно-Китайское море	7 Январь-август	70 1900	72,6 78,0	0,8 2,5	19,2 21,3	1,6 2,4
3 Новозеландский шельф	8 Февраль	65 480	76,6 78,1	1,4 1,5	19,8 21,6	1,5 1,6
4 Большой Австралийский залив	9 Февраль	650 22450	70,5 76,5	1,5 1,2	19,5 22,8	1,5 2,4
5 Тонкинский залив	10 Май	45 1125	72,0 78,7	0,4 4,1	—	—
	11 Июль-август	50 770	74,1 78,0	0,6 2,1	—	—

Table 289. Chemical composition of flesh in Caranx.
1. fishing region 2. East China Sea 3. New Zealand shelf 4. Great Australian Bight 5. Gulf of Tonkin 6. Fishing period 7. January-August 8. February 9. February 10. May 11. July-August 12. Weight of the fish, g 13. Threshold contents, % 14. moisture 15. Fat 16. Protein 17. Ash

Table 290.

Содержание мяса ставрид селар

1 Район лова	8 Период лова	12 Вес рыбы, г	13 Пределы содержания, %			
			влага 14	жир 15	белок 16	зола 17
2 Ставрида Selar boops						
3 Восточно-Китайское море	9 Май	130 230	72,6	5,3	19,3	1,6
4 Новая Зеландия	10 Февраль	35 105	76,1	0,9	21,9	1,5
5 Тонкинский залив	11 Апрель-август	140 340	71,0 78,2	0,3 1,2	19,8 21,4	1,8 2,0
6 Ставрида большеглазая						
7 Восточный район Индийского океана	—	190 310	76,0	1,6	21,0	1,9

Table 290. Composition of flesh in Selar.
1. Fishing region 2. Selar boops 3. East China Sea 4. New Zealand 5. Gulf of Tonkin 6. Selar crumenophthalmus 7. Eastern Indian Ocean 8. Fishing period 9. May 10. February 11. April-August 12. Weight of the fish, g 13. Threshold contents, % 14. Moisture 15. Fat 16. Protein 17. Ash

It has been established that the moisture and protein contents are inversely proportionate in Caranx. This shows that the percentage of the protein hydration in the flesh varies between 3.4 and 4.

Boiled flesh of Caranx is grey in colour and has a satisfactory flavour. The stock made with bony portions of its body has an excellent flavour and congeals readily. Fried flesh of Caranx is equally flavoursome.

Inedible portions of Caranx bodies have a highly unstable fat content. For example, bony parts of the body, (the head, fins, vertebral column) contain 7-10.5% fat, liver contains 4.7-26.7% oil, stomach and intestinal tissues 4.1-41.1% fat. Caranx liver contains (according to G. Dolbish) 330-1100 I.U. vitamin A (7020-25100 I.U. per gram liver oil), intestinal and stomach tissues contain 720-9120 I.U. vitamin A (i.e. 2200-19520 I.U. per gram liver oil). 203

Selar species of Carangidae. Two Selar species have been examined: Selar boops and Selar crumenophthalmus. Selars bear rows of very large scutes on the lateral portions of their caudal region.

These fish have large heads and a massive skeleton. The relative mass of their flesh is therefore 50-55% or less.

According to the data of Vakhrusheva, Kleie and Repin, weight ratios of different body parts in the two Selar species investigated, vary but slightly, regardless of the fishing period (February-August), fishing region (Gulf of Tonkin, East China Sea, New Zealand shelf etc.), or weight of the fish (35-340 g): head 25-28%, viscera 4.9-9.4%, fully dressed body 60.3-69.7%

(including bones and fins 15.1-16.6%, flesh with the skin on 50-54.4%) (in% of the total weight of the fish).

The two Selar species are non-fatty fish, even though the total fat content in the Selar boops caught in May amounted to 5.3% (Table 290).

The flesh has excellent organoleptic properties when boiled or fried. Smoked products have an excellent flavour.

In the liver of the Selar specimens caught in the Gulf of Tonkin in April, G. Dolbish found 5% oil and 160 I.U. vitamin A per gram (3200 I.U. vitamin A per gram liver oil).

Scomberoiden lysan. This large Carangidae species was examined by M. Vakhrusheva. In this fish the relative mass of flesh does not exceed 56% because of the massive skeleton and large head. Weight ratios of different body parts in the Scomberoiden lysan weighing 490-7230 g, varied within the following range (in % of the total weight of the fish): head 14.3-21.1, viscera 4.2-11.7 (including 3.6 liver), fully dressed body 65-70, vertebral column 8.6-18.3, fins 2, scales 2.7-3, flesh with the skin on 51-56.5.

Scomberoiden lysan flesh has the following chemical composition: moisture 70-74, fat 1.5-4.4, protein 22.4-23.7, ash 1.3-1.5. The flesh has a high protein content, as a result of which the protein hydration index persists at the 2.9-3.1 level. This may account for the fact that the flesh of Scomberoiden lysan is somewhat dry, when it is boiled or fried. It has, however, an excellent flavour. The stock made with the bony parts of the fish body is flavoursome and congeals readily.

Liver of large (7.2 kg) Scomberoiden lysan specimens (liver 3.6% of the total body weight of the fish) contains 2-3.7% oil and 4000-4500 I.U. vitamin A per gram of the tissue (223500-241000 I.U. per gram tissue fat). Its stomach and intestines contain 4-4.5% fat and 2000-2600 I.U. vitamin per gram (60000-65000 I.U. vitamin A per gram tissue fat).

Table 291.

Химический состав частей тела ставрид трахинотусов

1 Район и период лова	7 Вес рыбы, г	8 Части тела	14 Пределы содержания %			
			15 влага	16 жир	17 белок	18 зола
2 Ставрида — Trachinotus blochii						
3 Восточно-Китайское море (январь-февраль)	155	9 Мясо	67,5	11,7		
	330		70,2	13,8	—	—
		10 Голова	68,5	13,7		
			70,5	15,6	—	—
		11 Внутренности	75.7	6,5		
			76,6	7,0	—	—
4 Тонкинский залив	35	12 Мясо	76,4	0,6	19,8	1,2
	17		77,1	1,5	21,0	1,8
5 Ставрида — Trachinotus russeli						
6 Тонкинский залив	250	13 Мясо	77,3	1,3	—	—
	270					

Table 291. Chemical composition of different body parts in Trachinotus. 1. Fishing region and period 2. Trachinotus blochii 3. East China Sea (January-February) 4. Gulf of Tonkin 5. Trachinotus russeli 6. Gulf of Tonkin 7. Weight of the fish, g 8. body parts 9. flesh 10. head 11. viscera 12. flesh 13. flesh 14. threshold contents, % 15. moisture 16. fat 17. protein 18. ash

Table 292.

Химический состав мяса япономорской ставриды Восточно-Китайского моря

1 Период лова	7 Длина тела, см	8 Вес рыбы, г	9 Пределы содержания, %			
			10 влага	11 жир	12 белок	13 зола
2 Январь	12,9	3,0	71,6	1,0	19,1	1,2
	24,0	10,5	78,1	5,2	20,0	1,3
	26,9	280	70,2	1,6	19,6	1,1
	35,0	550	77,5	7,5	21,1	1,3
3 Февраль	20,3	110	73,6	2,4	19,9	1,3
	33,5	470	76,4	4,3	22,0	1,3
4 Март-май	19	110	68,0	5,0	18,6	1,3
	33	430	75,1	10,0	19,5	1,7
5 Ноябрь	17	70	71,0	0,6	19,4	1,6
	28	240	75,5	6,4	24,2	2,2
6 Декабрь	16	40	74,0	2,1	20,7	1,3
	18	68	75,5	2,8	21,9	1,8
	21	135	69,4	5,4	19,6	1,3
	27	240	71,5	9,1	21,2	1,8

Table 292. Chemical composition of flesh in Trachurus japonicus from the East China Sea.

1. Fishing period 2. January 3. February 4. March-May 5. November 6. December 7. Body length, cm 8. Weight of the fish 9. threshold contents, % 10. Moisture 11. fat 12. Protein 13. Ash

Trachinotus species of Carangidae. Two species of Trachinotus caught in the East China Sea and Gulf of Tonkin, have been examined: Trachinotus blochii and Trachinotus russeli. According to the data of M. Sycheva, dressed Trachinotus yields (in % of the total weight of the fish): 27.3-32 head, 4.7-6.7 viscera (including 1.4-2.4 sexual glands and 0.8-1.4% liver), 56.6-62.3 fully dressed body, 12.7 13.4 fins and bones, 46.6-52 unskinned flesh. Trachinotus has the same relative mass of flesh as the other species of Carangidae.

The flesh of the Trachinotus specimens caught in the East China Sea, is fatty to medium-fatty, delicate and flavoursome, whereas that of the Trachinotus caught in the Gulf of Tonkin is non-fatty (Table 291).

Because of its high fat content and delicate flesh, Trachinotus is superior to all the Carangidae examined by us.

At 23°C, the fat of Trachinotus yields an abundant residue solid glycerides, has an iodine number of 107.8 and a saponification number of 192.2.

Trachurus species of Carangidae. Trachurus argentus caught in the New Zealand shelf area, and Trachurus symmetricus (jack mackerel) caught near the Mexican coast have been examined.

The Trachurus argentus weighed 240-290 g, T. symmetricus were 1550 to 1820 g in weight. According to M. Sycheva's data,

the two species have virtually identical weight ratios of their different body parts, in spite of the considerable differences in their weight (in % of the total weight of the fish): head 18.2-20.2, viscera 8.1-9.1, fully dressed body 67.4-73, bones and fins 9.7-12.8, flesh with the skin on 56.4-61.9.

The flesh of the Trachurus species examined is maximum-fatty with satisfactory organoleptic indices. Its chemical composition varies within the following range (in %): moisture 71.3-74.6, fat 3.7-4.6, protein 20.3-22.5, ash 1.3-1.5%. Bony portions of the body (the head, vertebral column, fins) contain: 66-68% moisture, 7-9.8% fat, 16-17,4% protein and 6.1-14.4% ash. 205

Trachurus japonicus is the most wide-spread Pacific species and constitutes the major bulk of the catches obtained in the central zone of the East China Sea.

T. japonicus specimens having a length of 10-40 cm (commonly measuring 22-30 cm) and a weight of 22-830 g (commonly weighing 250-400 g), are found in the catches.

Weight ratios of different body parts in the Trachurus japonicus measuring 17-36 cm and weighing 63-650 g, vary as follows (in % of the total weight of the fish): head 17.4-23.5%, viscera 5.4-8% (including 1% liver and 1.3-5% sexual glands), fully dressed bodies 69.6-75.9%, bones and fins 9.4-11.7%, unskinned flesh 53.8-60.5%.

In small specimens* the flesh content is lower because of the higher relative weight of their head, bones and fins. Relative weight of the flesh in small Trachurus specimens therefore does not exceed 56.6%, whereas it is 60.6% (of the total weight

* i.e. specimens measuring less than 20 cm in length.

of the undressed fish) in large specimens. A row of hard scutes bearing spines extends along the Trachurus body. The scutes do not turn soft even when the fish is cooked for a long time, and must therefore be removed.

According to the data of E. Kleie, M. Sycheva, T. Ivanyushina, N. Rublevskaya et al., the fat content in the flesh of Trachurus japonicus does not exceed 9-10% (Table 292).

The fat content in the flesh of the Trachurus japonicus caught during the same season, increases with the size or weight of the fish. For example, the flesh of the T. japonicus specimens caught in January in the East China Sea, and weighing 30-70 g, contained only 1-1.5% fat; in the fish weighing 280-460 g. the fat content was 1.6-6.2%; in large Trachurus japonicus (weighing 460-550 g) it was 6.2-7.5%. As a rule, the flesh of the Trachurus specimens weighing less than 100 g, contains 1.5-2% or less fat, whereas the flesh of large specimans (400-500 g) has a 5-7% fat content.

The fat content of Trachurus flesh is inversely proportionate to its moisture content. For example, at the 7.5, 6.2, 5.2, 1.5 and 1% content of fat in the flesh, the moisture contenst were 70.2, 41.4, 71.6, 77.7 and 78.1%, respectively, and the protein content varied between 19.1 and 21.1%. 206

No significant seasonal variations in the fat content of the flesh have been observed. However, the flesh of equisize Carangidae has a somewhat higher fat content at the end of the year (in November and December) than during the rest of the year. In order to determine the seasonal variations in the fat content

of Carangidae, further research on a more rigidly controlled biological material is needed.

M. Sakaguchi (1964) has demonstrated that the flesh of Trachurus japonicus contains up to 300 mg% non-albuminous nitrogen; among the free essential amino acids, histamine predominates (9.7 mg%), whereas the contents of lysine and tryptophan are very low. Essential amino acids reveal increased contents of aspartic (aminosuccinic) acid and glutamic acid, as well as of taurine (amino-ethylsulfonic acid).

In contrast to other marine fishes, Trachurus japonicus has a large quantity (up to 390 mg%) of creatine among its non-albuminous extractable substances, and an increased amount of creatinine. The peculiarities of the composition of extractable substances are reflected in the flavour of this fish.

Indeed, boiled flesh of the Trachurus has a specific, slightly acid flavour characteristic of the flesh of all the high-quality fish. The flesh is greyish in colour. Small Trachurus specimens have a watery, unpalatable flesh, when cooked.

Large Trachurus japonicus specimens canned in their natural juices have been rated as average; canned products of the type "freshened fish in butter sauce" have been given a satisfactory rating. Since scales of the armour do not soften during the sterilization, they should be removed when the fish is dressed for canning. According to V. Myasoedova's data, the fat extracted from the body tissues of Trachurus japonicus, is light-yellow in colour and, at a room temperature, yields an abundant residue; its iodine number fluctuates between 121.2 and 134.8. The fat becomes readily hydrolized and exidized; therefore, frozen fish of this

species should be glazed before storage.

Inedible parts of the Trachurus japonicus body have a highly unstable chemical composition. For example, chemical composition of the bony parts of its body (the head, the fins, the vertebral column) vary in the Carangidae species examined within the following range: moisture 65.7-76.8%, fat 1.5-12.6%, protein 14.2-20.9%, ash 5.9-13.1%; fat content in the viscera fluctuates in these fish between 1.8 and 40.1%. Fat content of the inedible parts of the Trachurus japonicus body is at it maximum in December (up to 40% fat), whereupon it begins to decrease (by March the fat content drops to 6-8%.) 207

Research by Sh. Muroyama (1956), M. Ionaze and T. Mori (1957), Kh. Khigashi (1959), as well as the results from M. Syromyatnikova's and A. Teplitskaya's analyses show that body tissues of Trachurus contain a full range of water-soluble vitamins (table 293).

Other species of Carangidae are found in the Sea of Japan and in the East China Sea, in the eastern zone of the Indian Ocean and in the Gulf of Tonkin (Table 294). The species Carangoides and Uraspis have a white, juicy flesh with an excellent flavour when boiled or fried. Frozen storage is recommended for this fish.

All the species of Carangidae examined by us bear rows of large, hard scutes with sharp hooks. The scutes are arranged along the sides of the fish body. They are highly resistant to heat and do not turn soft even during the sterilization. Removal of the scutes is therefore imperative and should be regarded as a permanent feature of the technological processing.

The flesh of different Carangidae species varies markedly in organoleptic properties. Trachinotus and Caranx have the most flavoursome flesh. Fish of all these species markedly deteriorate in flavour with a decrease in size.

Carangidae should be stored frozen for further use in cooking or hot smoking.

Table 293

1 Витамин	4 Пределы содержания (γ%) в сыром веществе				
	5 мясо	6 печень	7 пилорические придатки	8 костистые части тела	9 кишечник, желудок
B_6	270—360	—	—	—	—
B_c	100—400	180—1000	—	250—300	1000—1700
2 Пантотеновая кислота	200—500	870—1400	—	—	—
B_2	100—700	1000—1900	200—740	200—600	600—700
3 Холин	57	—	—	—	—
B_1	—	810	170—360	—	—
B_{12}	3,5—12	27—133	—	3—8	12—116
PP	7000—11000	3000—10000	—	2500—9500	3000—3500

Table 293. 1. Vitamins 2. Pantothenic acid 3. Choline (bilineurine) 4. threshold content (γ%) in raw tissues 5. flesh 6. liver 7. Pyloric admixtures 8. Bony body parts 9. Intestines, stomach

Table 294

1 Показатели	16 Вид, место лова			
	Carangoides Chrysophrus	Carangoides fulvoguttatus	Megalsap-Corbyla	Uraspis sp.
	Восточная часть Индийского океана 17	Восточная часть Индийского океана 18	Тонкинский залив 19	Восточно-Китайское море 20
2 Длина тела, см	34	23—30	23—31	11—21
3 Вес, г	885	295—520	165—375	135—330
4 В % к весу рыбы:				
5 Голова	28,2	28,3	26,4—28,8	9,0—11,8
6 Внутренности	11,8	5,2	7,2—9,4	7,9—8,1
7 Тушка,	58,9	—	58,3—60,2	68,7—70,0
8 в т. ч. кости	10,0	14,9		
9 плавники	2,2	2,2	14,4—16,4	8,7—11,0
10 мясо с кожей	47,4	47,1	45,4—48,5	57,3—61,2
11 Состав мяса, %				
12 Влага	70,3	74,1	76,2	67,5—70,2
13 Жир	7,8	4,9	0,3	11,7—13,8
14 Белок	20,0	20,1		
15 Зола	2.0	1,0	23,5	18,6

Table 294.
1. Indices 2. Body length, cm 3. Weight, g 4. In % of the weight of the fish 5. Head 6. Viscera 7. Fully dressed body 8. including bones 9. fins 10. flesh with the skin on 11. Composition of the flesh, % 12. Moisture 13. Fat 14. Protein 15. Ash 16. Species and fishing area 17. Eastern Indian Ocean 18. Eastern Indian Ocean 19. Gulf of Tonkin 20. East China Sea

Seriola species (yellowtail, amberjack, rudderfish) are members of the family Carangidae. They measure 90-100 cm in length and have a weight of 5-8 kg. N. Nikonova, M. Vakhrusheva, V. Adistanova studies Seriola quinqueradiata (referred to as yellowtail) and Seriolella brama, which were caught in the New Zealand shelf region.

Yellowtail specimens weighing 3000-5250 g and caught in different regions (Peter the Great Bay, East China Sea, Great Australian Bight) were dressed, and the weight ratios of their different body parts were recorded (in % of the total body weight): head 22.1-27, viscera 5.4-9.4, fully dressed body 65-66.5, fins and bones 8.4-11.1, scales 0.3, unskinned flesh 50-55.2%.

Fat content in the flesh of the different Seriola species examined varied markedly (Table 294).

Data found in the literature (Miyama, 1939-1940; Tzuiki, Okuno, 1956, et al.) show that the fat content in the flesh of yellowtail fluctuates between 5.6 and 24.1%. Fat content in the flesh of Seriola aureovitata and Seriola purpuroscens does not exceed 0.8-1.4%. In yellowtail the highest fat content (16-20% fat) was recorded in the abdominal flesh.

The flesh of Seriola consists of white and red muscles (8-12% of the total flesh content). Judging from the works by Zh. Okuda (1916), T. Mori and S. Konozu (1957), M. Sakaguchi,

M. Khuzhita (1964) et al., red muscles contain less fat than the white muscular tissues (14.4-6.4 and 5.6-24.1%, respectively) and have a lower content of both creatine and creatinine than do the latter (240 and 360%, respectively). They have, however, a markedly higher content of non-albuminous nitrogen (960 and 470 mg%, respectively) and choline (136 and 59 mg%, respectively). Red muscular tissues also contain considerably greater quantities of water-soluble vitamins, such as B_1 (470 and 140 γ%, respectively), B_2 (730 and 40 γ%), PP (7700 and 6800 γ%), B_{12} (6.8 and 1.3 γ%), Bc (2000-2500 and 100-300 γ%), B_6 (1370 and 190 γ%), pantothenic acid (700-800 and 100-150 γ%).

Fat from the red muscles has a higher content of unsaponifiaole substances then the fat found in the white muscles (on an average 4 and 2.5%, respectively). All this means that red muscles play a specific biochemical role in metabolism.

M. Sakaguchi, M. Khuzhita and V. Simidu (1964) recorded high content of non-albuminous nitrogen (570 mg%) in the muscles of yellowtail Seriola; extractable nitrogenous substances include large quantitites of creatine (320 mg%) and creatinine (34 mg%).

Free intramuscular amino acids (the total content of which amounts to 800-860 mg%) include a particularly large amount of histidine (780 mg%). This biochemical peculiarity accounts for the fact that during the storage histamine forms and accummulates in Seriola as a result fo the decarboxylizing of histidine, whereupon the content of histidine decreases. V. Simidu and his assistants note that after five days of storage at 15°C, the amount of histidine drops in the flesh of Seriola from 1000 mg% to 20-30 mg%, while its histamine content increases from 5 mg% to 700-750

mg%. Seriola flesh may cause food poisoning, if not fresh.

Seriola should be stored frozen for subsequent use in cooking. 209

It has been observed that during the storage (after 1.5 -2 months of storage) the fat of Seriola soon becomes oxidized and turns rancid. This is due to the high content of heavily unsaturated fatty acids (iodine number 178.8-181.3) in the glycerides of the fat. Frozen Seriola must therefore be glazed before it is stored.

The flesh of the Seriola species examined is white, firm even slightly dry, with a delicious, slightly acid flavour. Food products made with boiled or fried Seriola flesh have satisfactory organoleptic indices.

"Freshened fish in butter sauce" is the only valuable item among the large variety of canned products made of Seriola flesh.

The internal organ of Seriola offering interest, is its liver, where G. Dolbish established 10-11% oil and a high concentration of vitamin A (8000-8200 I.U. per gram liver, or 70000-78000 I.U. per gram liver oil). Stomach and intestinal tissues are poor in both oil (3.5-8%) and vitamin A (610 I.U. per gram of tissue, or 19020 I.U. per gram of tissue fat). According to the data found in the literature (Ionaze, 1956; Enomoto, 1958; Khigazhi, 1959; et al.), the liver also contains the following vitamins (in γ%): B_2 (400-500), Bc (17000-20000), B_{12} (30-150), PP (7000), pantothenic acid (2400-3000).

Formionidae family. Single specimens of Formioniger are found in the catches from the Gulf of Tonkin and East China Sea.

This peculiarly shaped fish has a fairly small head (16.6% of the body weight), but a rather massive vertebral column (14.4%), large fins (4.2%) and bulky viscera (6.9%). Therefore, when dressed Formioniger amounts to 32-93% of its undressed weight: its fully dressed body is 75-76%, unskinned flesh 66-68% of the total weight of the undressed fish.

According to the data from M. Sycheva's analyses, the flesh of the Formioniger (weighing 415-670 g), which were caught in October in the Gulf of Tonkin, had the following composition (in %): moisture 73.6, fat 2.3, protein 21.2, ash 2.2.

TABLE 295

1 Вид	4 Район и период лова	8 Вес рыбы, г	9 Содержание, % 10 влага	11 жир	12 белок	13 зола
2 Лакедра желтохвостая	5 Зал. Петра Великого	5200	75,6	1,5	21,7	1,1
	6 Большой Австралийский залив	2860	76,2	0,7	21,5	1,6
3 Лакедра Seriolella brama	7 Новозеландский шельф	3000	70,8	7,9	19,4	1,5

Table 295. Chemical composition of flesh in Seriola. 1. Species 2. Yellowtail 3. Seriolella brama 4. Fishing region and period 5. Peter the Great Bay 6. Great Australian Bight 7. New Zealand Shelf 8. Weight of the fish, g 9. Content, % 10. Moisture 11. Fat 12. Protein 13. Ash

TABLE 296

1 Наименование	5 Пределы содержания, % 6 влага	7 жир	8 белок	9 зола
2 Мясо	68,9—79,1	0,3—6,4	17,0—20,1	1,1—1,6
3 Голова, позвоночник, плавники	71,9—74,4	0,4—1,2	16,1—17,3	7,9—10,4
4 Внутренности	71,6—79,5	0,9—2,1	16,8—21,3	1,5—1,5

Table 296. Chemical composition of different body parts in Coryphaenidae. 1. Body parts 2. Flesh 3. Head, vertebral column, fins 4. Viscera 5. Threshold contents, % 6. Moisture 7. Fat 8. Protein 8. Ash

As is well known from the literature, the Formioniger caught in November in the East China Sea is more oily (6.2% fat), but has a lower protein content (16.6%) and a higher content of moisture (74.5%). Its flesh is very delicate and has an excellent flavour. This is a valuable food fish, and it should be stored frozen.

According to the data from G. Dolbish's analyses, the liver of Formioniger contains 8-12.2% oil with 9500-10000 I.U. vitamin A per gram of oil.

Coryphaenidae family. Coryphaena hippurus is a large fish measuring 50-180 cm in length and weighing 1.2-6.5 kg.

Having dressed some Coryphaenidae, V. Bogachev obtained 13-22% heads, 9-14% viscera, 67-76 fully dressed bodies with the fins on, and 52-53% fillets (in % of the body weight of the fish). The flesh of Coryphaenidae is firm, with a peculiar flavour. According to M. Sycheva's analyses and to the data from the literature, the flesh and tissues of different body parts in Coryphaenidae have a low fat content; the fat content in the flesh of large Coryphaenidae specimens may, however, be as high as 5-6% (Table 296).

A. Teplitskaya recorded in the flesh of Coryphaenidae vitamin B_{12} (γ%), B_2 (400γ%), Bc (200γ%) and PP (17500γ%); a very high content of B_{12} (165γ%) and B_2 (2500γ%) was found in the liver.

According to the data of G. Dolbish, the liver contains 2.1-5% oil and 50-4480 I.U. vitamin A, which corresponds to 1070-127400 I.U. vitamin A per gram of liver oil. Coryphaenidae should

be classified as food fish. 210

Emmelichthyidae family. Plaglogenion macrolepis, a representative of this family, is a fairly small fish measuring 19.5-26 cm in length and having a weight of 195-400 g. When dressed, it yields a large quantity of flesh. Weight ratios of its different body parts are as follows (in % of the total weight of the fish): head 11.2, viscera 8.3, fully dressed body 80.5, bones 12.8, scales 1.3, flesh with the skin on 62.3.

The flesh of this fish is non-fatty (1.4% fat content), contains 77.2% moisture, 19.1% protein and 1% ash. It has a good flavour in a fried state; hot smoked products made of this fish are equally delicious.

According to M. Syromyatnikova's and A. Teplitskaya's analyses, the flesh contains vitamins B_{12} (2-2.5 γ%) B_2 (200 γ%), Bc (200 γ%), PP (2500 γ%); the liver has high contents of vitamins B_{12} and PP (75-132 γ% and 12000 γ%).

Plaglogenion macrolepis should be classified as a valuable food fish.

Viscera of this fish contain 7.9% fat and 1710 I.U. vitamin A (21620 I.U. per gram of tissue fat). Its liver is lean (4% oil) and contains 5610 I.U. vitamin A per gram of the liver tissue (i.e. 141000 I.U. per gram of liver oil).

Lutianidae family. This family includes over fifteen species.

The following species of Lutianidae have been examined: Lutianus sanguineus, Lutianus vitta, Lutianus fulviflamma and Pristipomoides microdon. The fish were caught in the East China

Sea, Gulf of Siam and in Australian waters.

P. Kantemirov's, E. Kleie's and I. Frolov's analyses show that these species differ little with regard to their content of flesh (Table 297).

Data from M. Sycheva's and E. Kleie's analyses show that in spite of their considerable size and weight, Lutianidae have a lean flesh. Furthermore, it has been established that sexually mature specimens of Lutianus sanguineus are more oily at the beginning of the year than in the summer or during the autumn (Table 298). 211

A Teplitskaya recorded the following water-soluble vitamins in the flesh of Lutianidae: B_{12} (1.0-2.0 γ%), B_2 (100-200 γ%, Bc (100-200 γ%) and PP (up to 12000 γ%).

The flesh of Lutianidae is firm and has a delicious flavour, particularly when it is browned in fat before it is cooked. The stock made with this fish is rich, but does not congeal.

According to American sources, the flesh of the Lutianidae from the Gulf of Alaska is more oily and has the following composition (in %): moisture 74.3-80.1, fat 2.5-2.9, protein 18.4-22.1, ash 1-1.2. The fat content of the inedible body parts in Lutianidae is considerably higher than the content of fat in its flesh (Table 299).

Among the internal organs of Lutianidae, liver offers a certain amount of interest (1-1.3% of the total weight of the fish). According to the data presented by G. Dolbish, it contains (depending upon the fishing season) 3.9 to 27.8% oil and 1040-16770 I.U. vitamin A per gram (44670-155280 I.U. vitamin A per gram liver oil).

The liver of Lutianidae has the highest content of oil in

July and August (10-27% oil) and during this season its liver oil is particularly rich in vitamin A (up to 155280 I.U. per gram).

Intestinal and stomach tissues of Lutianidae contain 4.2-18.2% fat with traces of vitamin A.

G. Dolbish found 6.1% oil (containing 95410 I.U. gram per vitamin A) in the liver of Pristipomoides microdon.

According to A. Teplitskaya's data, the liver and viscera of Lutianidae contain 10-70 γ% vitamin B_{12}, 400-800 γ% vitamin B_2 and 3100-12000 γ% vitamin PP.

TABLE 297

1	11 Пределы содержания, в % к весу тела			
	12 рифовый красный окунь	рифовый золотистый 13 окунь	окунь рифовый желтохвостый 14	синий окунь 15
2 г	600—3500	350—570	285—510	470—2300
3 Голова	22,6—25,9	29,7—33,0	24,7—37,6	16,2—26,1
4 Внутренности,	4,2—8,3	3,1—3,3	1,7—5,0	9,9—10,7
5 в т. ч. печень	0,9—1,8	—	—	0,8—1,2
6 Тушка,	65,8—72,6	57,7—61,5	52,0—64,4	62,7—63,4
7 в т. ч. чешуя	—	1,8—2,6	1,7—3,9	—
8 плавники	2,7—3,6	2,3—2,7	4,1—4,3	—
9 позвоночник и кости	16,6—19,6	9,2—12,1	10,8—11,7	12,0
10 мясо с кожей	43,3—52,3	49,4—49,6	41,1—52,0	48,7—53,5

Table 297. Weight ratios of different body parts in Lutianidae. 1. Body parts 2. Weight of the fish, g 3. Head 4. Viscera 5. Including liver 6. Fully dressed body 7. Including scales 8. Fins 9. Vertebral column and bones 10. Flesh with the skin on 11. Threshold contents in % of the body weight 12. Lutianus sanguineus 13. Lutianus fulviflamma 14. Lutianus vitta 15. Pristipomoides microdon

TABLE 298

1 Вид окуня	4a Период лова	8 Вес рыбы, г	9 Пределы содержания, %			
			10 Жир	11 Вода	12 Белок	13 Зола
2 Красный рифовый окунь	Февраль—5 апрель	1900	76,0	1,0	20,0	1,3
		3200	76,8	2,7	21,3	1,3
	6 Июль—август	600	78,0	0,1	19,0	1,3
		4100	78,6	2,1	19,5	1,6
	7 Сентябрь—октябрь	1400	78,9	0,4	18,0	1,4
		3400	79,2	0,7	19,0	1,7
3 Золотистый окунь	—	350	76,3	0,1	20,1	1,2
		570	78,0	0,6	21,5	1,6
4 Желтохвостый окунь	—	285	77,6	1,0	21,5	1,5
		510				

Table 298. Chemical composition of flesh in Lutianidae. 1. Species 2. Lutianus sangineus 3. L. fulviflamma 4. L. vitta 5. Fishing period 6. February-April 7. July-August 8. September-October 9. Weight of the fish, g 10. Threshold contents, % 11. Fat 12. Protein 13. Ash

Nemipteridae family. Three species of this family have been studies. According to the data of V. Bogachev and A. Lisachenko, these fish yield small quantities of flesh, when dressed (Table 300). 212

Liognathidae family. Liognathus rivulata caught during the period of May-July in the northern zone of the Gulf of Tonkin, have been examined. These are small fish (16-19 cm in length, 7-170 g in weight). They have a very large head (32.7% of the total body weight) and massive bones (16.1-18.2%). Relative weight of their flesh does not exceed 38-42% of their body weight. The flesh is lean and has fairly average organoleptic properties.

According to M. Sycheva's data, the flesh contains 77.4-79.2% moisture, 0.1-0.5% fat, 19-21.2% protein and 1-1.2 ash.

Pomadasyidae family. This family includes over ten species of large, fleshy fish.

The flesh and various body parts of seven Pomadasyidae species caught at different times of the year in the Korea strait, Great Australian Bight, eastern Indian Ocean and East China Sea, have been examined. 213

According to the data of P. Kantemirov, A. Lisachenko et al., the content of flesh in the Pomadasyidae species listed above (with the exception of Parapristipoma triliniata) does not exceed 45-46% (Table 303).

TABLE 299

1 тела	4 Пределы содержания, %			
	5 влага	6 жир	7 белок	8 зола
ости и печень	73,3—70,8	8,7—5,2	13,2—23,6	2,5—1,4
плавники	56,8—70,4	2,8—6,9	19,2—24,9	4,5—17,3

Table 299. Chemical composition of different body parts in Lutianidae. 1. Body parts 2. Viscera 3. Bones and fins 4. Threshold contens, % 5. Moisture 6. Fat 7. Protein 8. Ash

TABLE 300

1 Показатели	Нитенер японский (N. Japonicus)	Нитенер обыкновенный (N. virgatus)	Нитенер (Scolopsis temiarali)
2 Период и район лова	14 Ноябрь, Восточно-Китайское море	15 Февраль, приавстралийские воды	
3 Длина тела, *см*	14—25	15—23	19—27
4 Вес 1 экз, *г*	40—320	60—180	150—625
5 Весовые соотношения частей тела, %			
6 Голова	15,4—37,4	28,5—35,6	24,2—34,9
7 Внутренности,	6,8—9,6	4,3—6,8	3,6—8,0
8 в т. ч. печень	—	0,8	
9 Тушки,	59,0—61,6	47,3—53,7	54,2—69,6
10 в т. ч. чешуя	—	0,8—1,0	1,5—3,5
11 плавники	2,0—3,6	2,0—2,1	2,2
12 кости	9,8—11,3	11,4—16,3	10,7—11,1
13 мясо с кожей	41,3—46,2	32,0—40,8	41,9—55,5

Table 300. 1. Indices 2. Fishing period and region 3. Body length, cm 4. Weight of individual specimens, g 5. Weight ratios of different body parts, % 6. Head 7. Viscera 8. including liver 9. Fully dressed body 10. including scales 11. fins 12. bones 13. flesh with the skin on 14. November, East China Sea 15. February, Australia coastal waters.

TABLE 301

1 Части тела	5 Пределы содержания, %			
	6 влага	7 жир	8 белок	9 зола
2 Мясо	76,8 80,5	0,3 1,5	15,4 20,0	1,6 1,8
3 Голова, плавники и позвоночник	67,6 73,2	2,2 4,3	14,2 17,9	10,3 19,5
4 Внутренности	78.5	4,6	15,1	1,8

Table 301. Chemical composition of different body parts in Nemipteridae. 1. Body parts 2. Flesh 3. Head, fins, vertebral column 4. Viscera 5. Threshold contents, % 6. Moisture 7. Fat 8. Protein 9. Ash

TABLE 302

1 Части тела	5 Содержание (γ%) в сыром веществе		
	B_{12}	B_2	PP
2 Мясо	5—8	200—5000	700—3000
3 Голова	3—5	300—500	1800—2000
4 Внутренности	25—43	400—700	3200—4000

Table 302. 1. Body parts 2. Flesh 3. Head 4. Viscera 5. Contents (γ%) in raw tissues

TABLE 303

1 Вид	2 Место и период лова	11 Характеристика рыб		14 Пределы содержания, в % к весу тела						
		длина, см 12	вес, г 13	голова 15	внутренности 16	тушка 17	кости 18	плавники 19	чешуя 20	мясо с кожей 21
(Hapalogenus nigripinnis)	3 Восточно-Китайское море			28,9	8,0	55,0	10,0	4,9	3,3	45,0
(Parapristipoma trilineata)	4 Воды Корейского пролива	—	250 435	18,3	6,6	75,1	21,0			54,1
Pristiopomoides microdon	5 Воды юго-востока Тихого океана	33 47	750 2200	27,2 33,0	1,9 2,6	59,8 66,0	17,7 25,5	3,6 4,6	--	41,1 44,8
(Plectoroponus maculatus)	6 Воды северо-западной Австралии	42 61	910 2900	28,5 33,7	4,1 12,0	54,9 59,4	6,2 10,4	3,3 4,4	4,4 4,8	40,1 48,4
Pomadasys hasta)	7 Восточный район Индийского океана	23 70	225 6000	28,3 39,0	4,5 6,9	51,0 59,8	10,0 15,5	2,0 2,7	2,0 5,6	41,0 44,3
(Plectorhynchus cinctus)	8 То же	50 67,5	2400 6000	20,6 33,6	8,0 16,4	52,0 66,9	6,5 15,3	0,8 34	0,3 0,4	41,0 45,9
(Pomadasys opercularе)	9 Персидский залив	40 44	1140 1460	33,8 40,4	4,4 7,5	49,6 53,8	—	—	7,5 8,6	41,7 45,1
Pomadasys argureus	10 Красное море	30 42	600 1450	32,0 40,6	3,3 5,2	48,1 52,5	—	1,6 2,6	3,8 5,1	

Table 303. Weight ratios of different body parts in Pomadasyidae. 1. Speices 2. Fishing area and period 3. East China Sea 4. Korean Strait 5. Southeastern Pacific Ocean 6. Northwestern Australian waters 7. Eastern Indian Ocean 8. Same as above 9. Persian Guld 10. Red Sea 11. Characterization of the fish 12. Length, cm 13. Weight, g 14. Threshold contents in % of the body weight 15. Head 16. Viscera 17. Fully dressed body 18. Bones 19. Fins 20. Scales 21. Flesh with skin on

The flesh of Pomadasyidae is juicy, white, has an excellent flavour when boiled or fried. It can be used for a large variety of food products. The stock made with this fish is clear, rich and flavoursome.

According to the data from M. Sycheva's, A. Lisachenko's and E. Kleie's analyses, the flesh of these fish is non-fatty (Table 304). Plectoropomus maculatus, Plectorhynchus cinctus and Pomadasys operculare are generally lean fish with a low fat content.

Similarly to the other representatives of Percoidei, Pomadasyidae have a particularly high fat content in their bone tissues and viscera (Table 305).

No vitamin A has been found in the fat from the intestinal and stomach tissues of these fish; 550-5820 I.U. vitamin A have been recorded per gram of liver (the liver has a 4-5.2% oil content), i.e. there are 10000-95410 I.U. vitamin A per gram liver oil. 215

A. Teplitskaya determined the content of the group B vitamins in the body tissues of Pomadasyidae (Table 306).

Sciaenidae family (drums). Six species of drums caught in the Sea of Japan, in the East China Sea and in the Great Australian Bight, have been examined. These species include the white (or silver) seatrout (drum), the yellow "kosteperyi"* drum, and Sciaena Schlegeli.

When representatives of different Sciaenidae species (weighing 75-1500 g) are dressed, they yield (in % of the total weight of the fish) 17-25.4 heads, 4.5-9.1 viscera (including 0.5-2 liver and 1.8-2 sexual glands), 65.1-78.5 fully dressed bodies

* Transliteration of the Russian term. (Translator).

9.7-13 bones and fins, 46.2-62.8 unskinned flesh. "Kosteperyi" drum proved to be the fleshiest species.

TABLE 304

1 Вид рыбы	9 Период лова	Вес рыбы, 12 г	13 Пределы содержания, %			
			14 влага	15 жир	16 белок	17 зола
2 Серебристый ворчун	10 Февраль	250	75,1	1,5	20,3	1,4
		2330	76,8	2,7	21,1	2,0
3 Трехлинейный ворчун	11 Ноябрь	340	73,6	3,3	20,4	2,7
4 Ворчун аргуреус	—	—	77,8	1,3	19,0	1,3
5 Сладкогуб	—	470	75,3	0,3	20,5	1,2
		4600	77,4	0,7	20,7	1,5
6 Сладкогуб красный	—	910				
		2900	77,5	0,5	19,8	2,3
7 Ворчун пятнистый	—	—	77,6	0,6	20,2	1,4
8 Ворчун Pristi-opomoides	—	750				
		2200	78,6	0,3	20,6	1,3

Table 304. Composition of flesh in Pomadasyidae.

1. Fish species 2. Pomadasys hasta 3. Parapristipoma triliniata 4. Pomadasys argureus 5. Plectorhynchus cinctus 6. Plectoropomus 7. Pomadasya operculare 8. Pristiopomoides microdon 9. Fishing period 10. February 11. November 12. Weight of the fish, g 13. Threshold contents, % 14. Moisture 15. Fat 16. Protein 17. Ash

TABLE 305

	1 Части тела	4 Пределы содержания, %			
		5 влага	6 жир	7 белок	8 зола
2	Голова и плавники	58,6	7,6	14,7	8,6
		64 3	10 8	19,5	13,4
3	Внутренности	71,8	6,5	15,9	1,5
		72,0	10,7	19,5	2,1

Table 305. Chemical composition of different body parts in Pomadasyidae.

1. Body parts 2. Head and fins 3. Viscera 4. Threshold contents 5. Moisture 6. Fat 7. Protein 8. Ash

TABLE 306

1 Ткани	7 Содержание (%) в сыром веществе			
	B_{12}	B_2	Bc	PP
2 Мясо	3—9,5	200—300	100	700—1300
3 Голова	3	300	—	1000—1200
4 Кишечник	7,5—19	300—700	—	4000—4500
5 Икра	18,5	800	—	1500
6 Печень	70—100	2000	400	9500

Table 306

1. Tissues 2. Flesh 3. Head 4. Intestines 5. Roe 6. Liver 7. Content (%) in raw tissues

TABLE 307

1 Название	4 Район лова	11 Период лова	Вес рыбы, г 19	20 Пределы содержания, %			
				21 влага	22 жир	23 белок	24 зола
Серебристый 2 горбыль	5 Восточно-Китайское море,	12 Январь	270 295	73,1	5,1	20,5	1,3
Костеперый 3 горбыль	6 Восточно-Китайское море, воды Австралии	13 Январь	1500	78,0	1,8	18,9	1,3
		14 Февраль	210	75,4	2,3	21,6	1,6
		15 Март—май		80,3	1,8	14,9	0,9
(Pseudosciaena polyactis)	»		260	81,0	2,4	17,2	1,6
		16 Ноябрь	—	76,4	3,5	19,8	1,3
	7 Бохайское море	17 Апрель	—	80,6	2,0	16,3	1,0
(Pseudosciaena crocea)	8 Восточно-Китайское море	18 Май	—	81,2 83,3	0,4 0,7	15,8 16,2	1,0 1,4
(Sciaena Schlegeli)	9 Японское море	—	—	83,1	2,8	13,2	0,9
Sciaena Saturna	10 Китайское море	—	—	76,0	1,0	19,1	1,6

Table 307. Composition of flesh in Sciaenidae.

1. Species 2. Silver seatrout 3. "Kostoperyi"* drum 4. Fishing region 5. East China Sea 6. East China Sea, Australian waters 7. Po hai Sea 8. East China Sea 9. Sea of Japan 10. China Sea 11. Fishing period 12. January 13. January 14. February 15. March-May 16. November 17. April 18. May 19 Weight of the fish, g 20 Threshold contents, % 21. Moisture 22. Fat 23. Protein 24. Ash

* Transliteration of the Russian term. Translated literally it means "with bony fins". (Translator).

Results of the analyses carried out by E. Kleie, T. Ivanyushina, O. Legen'ko, show that the Sciaenidae species examined have a low fat content and are occasionally lean fish (Table 307).

The flesh of Sciaenidae is delicate and has excellent organoleptic properties: it is similar in flavour to fresh-water carp. These fish are best suited for frying.

A. Teplitskaya established the following vitamins in the flesh of Sciaenidae: B_{12} (3.5 γ%), B_2 (100 γ%), PP (3000 γ%). 216

Similarly to the other saltwater Percoidei, Sciaenidae accummulate considerably larger amounts of fat in the tissues of their bony parts of the body and in their viscera than in the flesh (Table 308).

G. Dolbish found 3000-3800 I.U. vitamin A in the liver oil. No vitamin A has been found in the fat extracted from the viscera.

Lithrinidae family. The emperors (Lethrinus miniatus) caught in September in the northern zone of the Gulf of Tonkin, have been studied. The specimens examined measure 18-56 cm in length and have a weight of 145-2900 g. The Lethrinus found in the catches from the southern Australian and New Zealand waters, were approximately of the same length and weight as those above (body length 28.5-58.5 cm, weight 460-4860 g).

Emperors have a massive head amounting in large specimens to 31% of their total weight. The weight ratios of different body parts in the emperors weighing 145-4260 g, are as follows:

head 25.2-36.6, viscera 10.3-11 (including 0.7 liver), fully dressed body 53.6-61.3, bones 9.4-13.3, fins 1.6-3.9, scales 1-2, flesh with the skin on 40.9-52.6 (in % of the total weight of the fish).

According to the data from M. Sycheva's and E. Kleie's analyses, the flesh of the Lethrinus specimens examined contains 73.8-78.4% moisture, 0.1-4.7% fat, 19-21.8 protein, 1.4-2 ash.

Boiled flesh of this fish is similar in flavour to chicken. The stock made with it congeals readily. Emperors are a valuable food fish.

A. Teplitskaya established in the Lethrinus flesh vitamins B_{12} (3-5 γ%), B_2 (100 γ%), PP (3000-7500 γ%). Viscera of these fish are considerably richer in vitamins (B_{12} 29-31, B_2 1000-1600 and PP 4000-5500 γ%).

Sparidae family. Over ten species of fish varying in the degree of commercial importance, belong to this family.

The most valuable species are Pagrasomus major and Taius tumifrons.

Weight ratios of different body parts have been determined for the representatives of these two species caught during different seasons in the East China Sea, eastern Indian Ocean and Great Australian Bight (Table 309).

The relative mass of flesh varies in the Sparidae species examined between 36 and 59%. Moreover, the content of flesh increases as the overall weight of the fish decreases. 217

Sparidae have large, firmly attached scales, which must be carefully removed. According to the Japanese data, the amount

of flesh obtained from dressed specimens of Pagrasomus major, fluctuates between 52 and 55% of the total weight of the fish.

Results from the analyses carried out by N. Khalina, N. Bochkareva and L. Konysheva, as well as data from the literature (Zhovett, 1938; Davies, 1937, et al.) show that the flesh of Sparidae is non-fatty (0.2-3.1%), but has a high protein content (Table 310).

TABLE 308

1 Части тела	5 Пределы содержания, %			
	6 влага	7 жир	8 белок	9 зола
2 Голова, плавники и позвоночник	63,2 72,8	5,9 10,1	14,3 17,3	5,3 9,3
3 Внутренности (без печени)	67,3 70,6	12,3 13,4	16,1 18,0	0,9 1,2
4 Печень	62,4 74,3	15,0 20,4	9,7 15,0	1,3 1,5

Table 308. Chemical composition of different body parts in silver seatrout and "bony"* drum.

1. Body parts 2. Head, fins and vertebral column 3. Viscera (without the liver) 4. Liver 5. Threshold contents, % 6. Moisture 7. Fat 8. Protein 9. Ash

* Literal translation of the Russian term used ("kostistyi"). (Translator).

TABLE 309

1 Показатели	14 Красный морской карась			Карась 18 акантопагус
	Восточно-Китайское 15 море	Большой Австралийский 16 залив	Восточная часть Индийского 17 океана	Восточная часть Индийского океана 19
2 Период лова	20 Январь	—	21 Февраль	22 Февраль
3 Вес, г	115—1700	670—1260	260—1460	1250
4 Длина тела, см	16—41	29—34	29—38	34,5
5 В % к весу тела:				
6 Голова	24,3—34,2	25,9	30,2—32,5	21,6
7 Внутренности,	6,5—7,5	4,6	5,7—12,2	12,8
8 в т. ч. печень	1,4	0,6—1,6	—	1,6
9 Тушка	—	50,6—64,7	69,5	62,4
10 Кости		6,6—14,4	8,7	6,4
11 Плавники	11,2—14,7	1,5—4,2	2,9	2,4
12 Чешуя	—	1,5—4,8	—	1,6
13 Мясо с кожей	47,6—58,7	36,2—52,5	52,6	56,0

Table 309.

1. Indices 2. Fishing period 3. Weight,g 4. Body length, cm 5. In % of the body weight 6. Head 7. Viscera 8. including liver 9. Fully dressed body 10. Bones 11. Fins 12. Scales 13. Flesh with the skin on 14. Pagrasomus major 15. East China Sea 16. Great Australian Bight 17. Eastern Indian Ocean 18. Acanthopogus 19. Eastern Indian Ocean 20. January 21. February 22. February

TABLE 310

1 Вид	4 Район лова	14 Период лова	Длина тела, см 21	Вес рыбы, г 22	23 Элементы содержания, % влага 24	жир 25	белок 26	зола 27
(Pagrosomus major)	5 Воды Австралии	15 Февраль	33,0	900	78,4	0,5	15,1	1,2
			38,0	1410	81,0	0,6	19,6	1,3
			25	500	75,6	0,2	21,0	1,4
			30	750	77,3	1,9	21,2	2,0
			19	260	74,7	0,4	20,8	1,8
			20	335	76,5	2,7	21,3	1,8
	6 Восточно-Китайское море	16 Январь	39	1385	72,7	3,1	22,9	1,3
			26	390	75,9	1,9	20,9	1,3
			19	115	78,8	0,2	18,8	
			26	430				
			30	870	73,3	2,8	23,9	
			41	1700				
	7 Восточно-Корейский залив	17 Сентябрь—ноябрь			76,0	2,1	19,6	1,6
			—	—	76,3	2,7	20,0	1,7
	8 Японское море			300	77,6	0,7	17,6	1,3
			—	580	77,9	3,1	20,3	1,4
	9 Австралийский залив	18 Сентябрь—ноябрь			75,5	0,2	20,7	1,2
			—	—	78,1	1,5	23,3	2,1
(Pagrosomus auratus)	10 Новозеландский шельф	19 Февраль	40	1160	74,7	0,7	22,7	0,9
			75	8660	75,1	0,8	23,3	1,1
	11 Воды Австралии	20 Февраль	21	260	76,5	0,2	18,1	1,3
			35	1060	81,0	0,6	21,2	1,8
(Parargyrops edita)								
2 Красный морской карась	12 Большой Австралийский залив	—	29	460	73,8	3,7	20,6	1,0
			34	670				
3 Карась серый	13 Восточно-Китайское море	—	67	6000	72,8	6,7	19,4	1,0

Table 310. Chemical composition of flesh in Sparidae.

1. Speicies 2. Pagrasomus major 3. Grey gilthead snapper* 4. Fishing region 5. Australian waters 6. East China Sea 7. Eastern Korea Bay 8. Sea of Japan 9. Australian Bay 10. New Zealand Shelf 11. Australian waters 12. Great Australian Bight 13. China Sea 14. Fishing period 15. February 16. January 17. September-November 18. September-November 19. February 20. February 21. Length of the body, cm 22. Weight of the fish, g 23. Threshold contents, % 24. Moisture 25. Fat 26. Protein 27. Ash

* Literal translation of the Russian term used ("karas' seryi"). (Translator).

Boiled or fried flesh of Sparidae is white and has an excellent flavour. The stock made with the bony parts of their body is equally delicious.

These species of Sparidae are valuable food fish. The flesh of Sparidae is similar to that of fresh-water fish with respect to its content of creatine (0.45-0.47% of dry weight), creatinine (0.06-0.065%) and carnosine (2.0%), but has a fairly low content of extractable non-albuminous nitrogen (10-13%).

According to the Japanese data, dry and defatted flesh of Sparidae contains the following amino acids (in % of dry protein); alanine 1, aspartic acid 1.7, arginine 5.1, valine 0.6, valine with leucine 2.2, glutamic acid 1.6, histidine 2.1, leucine 8.8, lysine 6.3, prolinel.2, tyrosine 2.6, phenylalanine 4.7, as 218
well as serine and tryptophan. Calcium (190-210 mg%), phosphorus (90-380 mg%), iron (1.0-3.0 mg%) have also been recorded in the flesh of Sparidae.

Inedible parts of the body of Sparidae have a markedly higher fat content than does the flesh (Table 311).

K. Takada, Zh. Nishimoto (1958) and Kh. Khigachi (1956) found choline (2.5 to 73.0 mg%), pantothenic acid (180-230 mg%) and folic acid (0.4-0.5 γ%) in Sparidae flesh. B. Zhovett (1928) recorded 2.5-3% oil in the liver, 2.8% in the viscera of Sparidae.

A. Teplitskaya has demonstrated that body tissues of Sparidae contain a full range of vitamins of the group B (Table 312).

According to the data provided by Japanese authors (Takado, 1958; Khigachi, 1956), the liver of Sparidae contains

choline (17-70 mg%), pantothenic (1600 γ%) and folic acid (40-220 γ%).

TABLE 311

1 Части тела	6 Пределы содержания, % 7 влага	8 жир	9 белок	10 зола
2 Голова	63,6 / 69,4	3,8 / 9,1	15,8 / 18,7	8,6 / 18,0
3 Плавники и позвоночник	55,5 / 53,3	2,1 / 9,6	18,1 / 20,7	8,3 / 17,7
4 Внутренности	70,7 / 78,0	1,8 / 7,7	14,4 / 20,1	1,5 / 2,2
5 Печень	70,0 / 70,9	7,1 / 7,3	20,0 / 20,9	1,5 / 2,0

Table 311. Chemical composition of different body parts in Sparidae.

1. Body parts 2. Head 3. Fins and verebral column 4. Viscera 5. Liver 6. Threshold contents, % 7. Moisture 8. Fat 9. Protein 10. Ash

TABLE 312

1 Ткани	7 Содержание (γ%) в сыром веществе B_{12}	B_2	PP	Bc
2 Мясо	1,9—3,6	100—300	1000—6500	100—300
3 Голова	2,5—3,2	200—300	1000—3000	250—800
4 Кишечник и желудок	12—32	600—1700	3000—5000	1150
5 Печень	100	2500	10500	—
6 Икра	47,5	500	3000	—

Table 312

1. Tissues 2. Flesh 3. Head 4. Intestines and stomach 5. Liver 6. Roe 7. Contents (γ%) in raw tissues

TABLE 313

1	Части тела	Содержание (γ%) в сыром веществе			
		B_{12}	B_2	PP	Bc
1	Мясо	2,5	200	4500	100
2	Голова	3	400	3000	—
3	Внутренности	10	400	3000	—

Table 313.

1. Body parts 2. Flesh 3. Head 4. Viscera 5. Contents (γ%) in raw tissues

Mullidae family. Of the six species forming part of this family, we investigated the common surmullet (Upeneus tragula).

Surmullet has weight ratios of its different body parts similar to those of the other Percoidei. The following data have been obtained for the specimens caught in the Great Australian Bight (and weighing 440-595 g): head 20.4-26.7, viscera 4.5-6.5, fully dressed body 59.9-68.1, bones 9.9-11.3, fins 3.5-4.5, scales 2-3.5, flesh with the skin on 50.1-56.8%.

Data from M. Vakhrusheva's analyses show that the flesh of surmullet is lean, but has a high protein content. Chemical composition of flesh in the surmullet specimens caught in the Gulf of Tonkin, Great Australian Bight and southeastern Pacific (specimens weighing 410-590 g) was as follows: moisture 74.3-67.1%, fat 0.4-1.1, protein 20-22.6%, ash 1.8-2.3%.

The fat content in viscera is also fairly low (4.5-5.3%). Moreover, no vitamin A has been found in the tissue fat. A. Teplitskaya has shown that raw flesh of Mullidae contains the following vitamins: B_{12} (5.5 γ%), B_2 (100 γ%), Bc (600 γ%), PP (2500-3000 γ%).

Boiled or fried flesh of these fish has excellent organoleptic properties. Mullidae should be classified as food fish.

Ephippidae family. Two species of saltwater Platax have been examined: Platax pinnatus (54 cm in length, 6430 g in weight) from the Gulf of Tonkin, and Platax orbicularis (measuring 45-47 cm in length and weighing 2900-3100 g) caught in northwestern Australian waters.

Weight ratios of different body parts are as follows: in these peculiarly shaped fish (in % of the total weight of the fish): head 22.7-23.4, viscera 8.7-10.2 (including 1.2-1.7 liver), fully dressed body 61.9-62.7, bones 9.7-16, fins 3.5-3.9, flesh with the skin on, 53.1-40, skin 5.8.

According to the data from N. Vakhrusheva's analyses, these fish have a fairly oily flesh (67.3% moisture, 8% fat, 21.7% protein, 2.1% ash). The flesh has, however, a sordid colouring, an unpleasant odour and flavour.

According to the data of A. Teplitskaya, the content of group B vitamins is fairly low in the body tissues of Platax (Table 313).

Platax should be processed for fish meal.

Drepanidae family. Small specimens of Drepane punctata caught in the eastern zone of the Indian Ocean, measure 10-23 cm in length and weigh 110-540 g; large representatives of this species attain 25-30 cm in length and a weight of 900-1500 g.

These fish have a peculiar body structure. Weight ratios of their different body parts are as follows (in % of the total weight of the fish): head 20.3-23, viscera 5.7-6.3 (including

1.3% liver), fully dressed body 70.0-70.7, bones 11.2, fins 2.7, scales 1.3, flesh with the skin on 58.8.

According to the data from M. Vakhurusheva's analyses, the flesh and viscera of Drepane have a low fat content; the content of fat in its bone tissues may be as high as 12% (Table 314).

A. Teplitskaya found the following vitamins in the flesh of these fish: B_{12} (3-5 γ%), B_2 (100-300), Bc (100-500) and PP (5000-6000 γ%). The content of these vitamins is considerably gihger in the tissues of internal organs (B_{12} (15-30 γ%) B_2 (400-800), PP (2000-5500 γ%)).

The stock obtained by boiling the flesh of Drepane, has an unpleasant odour and colour. This fish is therefore unsuitable for food purposes.

TABLE 314

1 Части тела	5 Пределы содержания, %			
	6 влага	7 жир	8 белок	9 зола
2 Мясо	70,4	2,2	22,5	1,3
3 Внутренности	82,6	2,0	—	—
4 Голова и кости	59,3	12,6	17,8	7,7
	61,0	12,0	20,1	8,3

Table 314. Composition of different body parts in Drepane

1. Body parts 2. Flesh 3. Viscera 4. Head and bones 5. Threshold contents, % 6. Moisture 7. Fat 8. Protein 9. Ash

TABLE 315

1 Период лова	6 Вес рыбы, г	7 Что исследовалось	16 Пределы содержания, %			
			17 влага	18 жир	19 белок	20 зола
2 Февраль	386 391	8 Мясо	57,4—67,5	16,3—27,0	13,3—14,5	1,2—1,3
3 Март — апрель	237 408	9 Мясо	63,0—73,6	9,4—18,6	10,6—16,0	1,0—1,8
4 Сентябрь	350	10 Мясо	66,0	18,0	14,5	1,5
5 Февраль	390	11 Костистые части тела	52,6—59,6	11,3—22.9	13,4	4,6—6,4
	»	12 Голова	60,9—64,0	19,5—20,4	12,0—12,3	5,5—6,4
	»	13 Печень	59,3	27,5	11,2	0,9
	»	14 Внутренности	39,5	54.0	—	—
	»	15 Жирки	10,0	73,7	—	—

Table 315.

1. Fishing period 2. February 3. March-April 4. September 5. February 6. Weight of the fish, g 7. Tissues examined 8. Flesh 9. Flesh 10. Flesh 11. Bony body parts 12. Head 13. Liver 14. Viscera 15. Fatty fins 16. Threshold contents, % 17. Moisture 18. Fat 19. Protein 20. Ash

Chaetodontidae family. Some ten species of brightly 220
coloured tropical fish, known as butterfly fish, form part of this family.

The following four species of butterfly fish have been studied: Chaetodon auriga, C. miliaris, C. collare and the "dlinnoperyi"* species. The specimens examined measure 14-23 cm in length and have a weight of 100-405 g. The fish have a large head (18.5-29.7%), massive bones (15.0-33.7%), fins (8.1-13.7%), scales (2.4-3.4%) and viscera (4.3-10.3%). The relative mass of their fully dressed bodies and of the unskinned flesh is therefore quite low (48-55 and 29-43%, respectively).

The flesh contains 74.8-79.8% moisture, 0.1-0.8% fat, 18.5-20.1% protein and 1.3-3.7% ash. It is unpalatable. This fish has no commercial or nutritive value.

Histiopteridae family. Representatives of this family

* Transliteration from Russian. The term used means "with long fins". (Translator).

are the principal object of fishing on the banks of the Imperial Range.

The specimens examined were caught in that fishing region between February and September. The body length of the fish is 22-31 cm, their weight ranges from 210-455 g. Histiopteridae have massive heads (25-32.5% of their body weight), large bones (8.4-15%), a thick skin (5.3-10.8%), bony fins (2.9-5.3%). Relative weight of their fully dressed body therefore fluctuates between 51 and 61%, that of the fillets between 32 and 42%. Viscera amount in these fish to 7-11% (including 1-1.4% liver).

Histiopteridae have a juicy, white extremely flavoursome flesh. The flesh, as well as all the other body tissues of these fish has a high fat content (Table 315).

Histiopteridae are valuable food fish. Their tissue fat has a high resistance to oxidation and a low iodine number (120-130). The composition of unsaturated fatty acids reveals increased contents of diene and triene acids and a reduced amount of polyene acids.

Pomacentridae family. Three species of fish have been examined.

Abudefduf anabatoides (body length 8.5-10.5 cm, weight 15-30 g). The fish were caught in May, in the South China Sea. Representatives of this species are bony, lean and unpalatable 73.7% moisture, 0.9% fat, 23.9% protein, 1.5% ash). This species offeres no interest for food industry.

Abudefduf leucogaster, another species of Pomacentridae, 221
from the Great Australian Bight (body length 28-39 cm, weight

650-1535 g). Representatives of this species have a massive head and large fins. When dressed, they yield 32% head, 15% viscera (including 0.9% liver), 53% fully dressed body, 7.1% bones, 4.2% fins, 41.7% flesh with the skin on (in % of the total weight of the fish).

The flesh of Abudefduf leucogaster is white, firm delicious. It contains 65% moisture, 3% fat, 19.4% protein, 1.6% ash.

The liver contains 27.9% oil with 3900-4000 I.U. vitamin A per gram of oil (G. Dolbish's data). The fat content of the viscera does not exceed 11%, and no vitamin A has been detected in the fat.

According to A. Teplitskaya's data, the flesh of Abudefduf leucogaster contains the following water-soluble vitamins in the viscera is as follows: B_{12} - 12, B_2 - 600, Bc - 3000.

Chromis veroter, the third species examined, is a small fish measuring 16-18 cm and weighing 150-200 g. When dressed, it yields (in % of the total weight of the fish) 15% head, 68.5% fully dressed body (including 14.5% bones, 6.8% fins, 53.8% flesh with the skin on) and 9.6% viscera.

The flesh is lean (0.5% fat content), with a high (79.7%) moisture content; its content of protein is 18.4%, of ash 1.4%. This fish has no value for food purposes.

Trichodontidae family. Arctoscopus japonicus and Trichodon trichodon are the most abundantly represented species of this family.

These small fish (10-26 cm in length, 20-120 g in weight)

have a massive head, a bulky skeleton and large quantities of viscera. Relative weight of their flesh therefore does not exceed 31-32% of their total body weight. The flesh of Arctoscopus japonicus has a very high moisture content and is very poor in protein. It contains 80.4-83% moisture, 1.5-3.6% fat, 14.5-14.6% protein, 1.5-1.7% ash. Hydration index of the proteins contained in the flesh is as high as 5.5-6. Boiled or fried flesh of Trichodontidae has an inferior flavour. The two fish species examined have little value as food fish.

Stichaeidae family. Stichaeus punctatus caught in Peter the Great Bay, have been examined.

Stichaeidae have a long, flat body. Specimens measuring 45-51 cm in length and weighing 300-320 g, were studied. Their weight ratios are as follows: head 7%, viscera 9.3%, fully dressed body 83.7%. In spite of their bulky fins (14.6%) and vertebral column (12.1%). Stichaeidae yield fairly large quantities of flesh (61%).

TABLE 316

1 Вид	6 Район лова	12 Период лова	18 Вес рыбы, г	18 Пределы содержания, % влага	жир	белок	зола
2 Бельдюга	7 Зал. Петра Великого	13 Октябрь	95 105	87,0	0,7	11,3	1,1
3 Ликоды	8 Охотское море	14 Июль	310 2880	78,8 85,5	0,4 2,8	12,3 16,1	1,3 2,7
	9 Берингово море	15 Ноябрь	100 400	78,2 80,4	2,1 4,3	15,0 15,4	1,3 1,4
4 Запрора	10 Берингово море	16 Июль	945 1550	77,5	8,1	12,9	1,4
5 Ликограмма	11 То же	—	750 950	92,0	0,2	6,7	1,0

Table 316. Chemical composition of flesh in Zoarcidae.

1. Species 2. Zoarces elongatus 3. Liconidae species 4. Zaprora silenus 5. Lycogramma zesta 6. Fishing region 7. Peter the

Great Bay 8. Sea of Okhotsk 9. Bering Sea 10. Bering Sea 11. Same as above 12. Fishing period 13. October 14. July 15. November 16. July 17. Weight of the fish, g 18. Threshold contents, % 19. Moisture 20. Fat 21. Protein 22. Ash

TABLE 317

1 Части тела	5 Пределы содержания, %			
	6 влага	7 жир	8 белок	9 зола
2 Голова, кости, плавники	85,5—87,3	4,0—5,3	6,1—7.3	1,9—2,2
3 Печень	60,4	28,0	10,3	1,2
4 Внутренности без печени	88.6	2,3	7,9	1,1

Table 317.

1. Body parts 2. Head, bones, fins 3. Liver 4. Viscera (except for the liver) 5. Threshold contents, % 6. Moisture 7. Fat 8. Protein 9. Ash

Stichaeidae are lean fish. Their flesh has the following composition (in%): moisture 77-80, fat 0.6-1.6, protein 18.2-20.1, ash 1.2-1.3.

The flesh of Stichaeidae is firm, slightly tough. Its boiled flesh is unpalatable. Its fried flesh has a somewhat better flavour. Smoked flesh of Stachaeidae is considerably more flavourous. This family should be probably be classified as fish which have little food value.

Zoarcidae and Licodinae. The following species have been examined: Zoarces elongatus, Lycodes brevicauda, Zaprora silenus and Lycogramma zesta.

Fish of these species have an elongate body with confluent caudal, dorsal and anal fins extending along the entire body length of the fish. The weight of the fish varies between 100 and 2800 g.

When dressed, these fish yield little flesh. Weight

ratios of their different body parts are as follows (in % of the body weight): head 15.3-27, viscera 8.3-26.4 (including 0.7-3.7% liver), fully dressed body 53.6-67.7 (including 10-13.3 bones and fins, 43.4-54.6 flesh with the skin on). According to E. Kleie's, 222
Z. Podoba's and T. Udelova's analyses, the flesh of the fish from the family examined has a high moisture content a low content of protein (Table 316).

The flesh of Licodinae contains 5.3-6.6 times more moisture than protein. Their flesh is very limp, watery, has an inferior flavour. It has unsatifactory organoleptic indices in a boiled state, but has a much better flavour when fried, though shrinks considerably. Only fried flesh of Zaprora has satisfactory organoliptic properties. Licodinae should be processed for fish meal.

According to E. Kleie's analyses, inedible parts of Lycogramma, its liver in particular, contain considerably greater quantities of oil; all the body tissues of this fish are poor in albuminous substances (Table 317).

Ammodytidae family. The Pacific species Ammodytes personatus, a small fish weighing 10-50 g, has an elongate body and a small head. When dressed, it yields a fairly large quantity of flesh.

Weight ratios of different body parts in the Ammodytes specimens caught in Peter the Great Bay and in the East China Sea in July and October, varied within a small range (in % of the overall weight of the fish): head 11.6-16.2, viscera 10.2-17.0,

fully dressed body 71.8-73.6, including fins and vertebral column (8.6-11.4) and unskinned flesh (60.6-64.2).

Fairly unstable contents of moisture, fat and albuminous substances have been established in the flesh of Ammodytidae (Table 318). This explains the fact that boiled flesh of these fish is watery and unpalatable, whereas fried flesh has a satisfactory flavour. Salted Ammodytidae have unsatisfactory organoleptic properties. The most successful canned product made with these fish is of the type "fried fish in tomato sauce". Freezing is the most expedient method of storing Ammodytidae for subsequent use for food purposes. 223

Gempylidae family. Thyrsites atum and Rexea salandri, which are commonly found in trawl catches from the New Zealand and Australian shelves, belong to this family.

Thursites atum has a streamlined body. Fish measuring 67-68 cm in length and weighing 1090-1770 g, predominate in the catches. Large fish attain a weight of 2500 g. Thursites atum have the following weight ratios of their different body parts (in % of the total weight of the fish): head 14.8-22.8, viscera 4.4-8.6 (including 1.3% liver), fully dressed body 67-74.3, bones 11.1-12.5, fins 0.7-3.6, flesh with the skin on 59.6-60.6.

TABLE 318

1 Район лова	Период лова 4	8 Вес рыбы, г	9 Пределы содержания, %			
			влага 10	жир 11	белок 12	зола 13
2 Зал. Петра Великого	5 Июль	25/50	73,0	10,5	14,2	2,0
		10/30	74,0	3,1	18,3	2,3
	6 Октябрь		75,0	4,2	20,5	2,4
			76,6	3,0	14,9	1,5
3 Восточно-Китайское море	7 Июль	—	80,6	3,1	18,9	2,7

Table 318. Composition of flesh in Ammodytidae.

1. Fishing region 2. Peter the Great Bay 3. East China Sea 4. Fishing period 5. July 6. October 7. July 8. Weight of the fish, g 9. Threshold contents, % 10. Moisture 11. Fat 12. Protein 13. Ash

TABLE 319

1 Части тела	7 Содержание (γ%) в сыром веществе			
	B_{12}	B_2	PP	Bc
2 Мясо	3	200	8060	160
3 Голова	2—3	300	4000	—
4 Икра	4,5	400	7000	—
5 Печень	154	800	7000	—
6 Кишечник и желудок	87	800	6000	—

Table 319.

1. Body parts 2. Flesh 3. Head 4. Roe 5. Liver 6. Intestines and stomach 7. Contents (γ%) in raw tissues

The flesh contains 69.1-74% moisture, 3.9-7.8% fat, 18.9-21.5% protein and 1.2-1.8% ash. According to the data of Zhovett (1958) and other authors, a fully dressed body contains 67.8-69.9% moisture, 3.8-7.4% fat, 19.7-20.6% protein; the highest fat content has been recorded in the bony parts of the fish body (6-8%). The fish is more oily in April than in November (6.5-7.4 and 3.8-3.9% fat, respectively).

The flesh of Thyrsites atum contains 3.2-3.6 times more moisture than protein. Its flesh is therefore firm, and its fried flesh may even be somewhat dry. The flesh encloses a multitude of small bones and has an average flavour. It must be noted that the flesh of large Thyrsites atum specimens abounds in parasites.

The large Thrsites atum caught in the region of New Zealand, have little food value. According to G. Dolbish's data

the liver and viscera of these fish contain little oil (2.2-2.6%), but have a high vitamin content: 4640 I.U. per gram liver (210000 I.U. per gram liver oil) and 81600 I.U. per gram stomach tissue (81600 I.U. per gram tissue fat).

A. Teplitskaya has demonstrated that intestinal, stomach and liver tissues of Thyrsites atum have a high concentration of vitamin B_{12} (Table 319).

Fairly large specimens of Rexea solandri (measuring 78 cm in length and weighing 3270 g) are found occasionally in trawl catches from New Zealand waters. Weight ratios of their different body parts are as follows: head 22.3%, viscera 13.1% (including 9.8% liver), fully dressed body 64.6%, bones 10.1%, fins 0.9%, flesh with the skin on 53.5%.

According to O. Mel'nikova's data, the flesh contains 71.5% moisture, 8.7% fat, 19.5% protein and 1.2% ash. The flesh is firm, has an inferior flavour. 224

A. Teplitskaya established in the flesh the following vitamins: B_{12} (5.5 γ%), Bc (100 γ%), B_2 (200 γ%) and PP (8000 γ%).

Rexea should be classified as fish suitable for food purposes.

Acanthuridae family. Two species have been examined: Acanthurus thomposoni and Naso unicornis. These fish are average in size (33-36 cm) and weigh (0.7-0.85 kg). When dressed, they yield (in % of the total weight of the fish) 18-14.5 head, 66-70 fully dressed body (including 10-11 bones, 2.9-5.2 fins, 50-59 flesh with the skin on), 8-9 viscera.

The flesh of both species is lean (up to 0.5% fat) with a high content of moisture (78.8-79%); it contains 18.5-19.3% protein and 1.6-1.8% ash.

Neither species is suitable for food purposes.

Trichiuridae family. Trichiurus haumela is found throughout the Far Eastern seas.

Trichiurus haumela appear in Peter the Great Bay in August and remain there until October, often forming large concentrations. This fish has a long, laterally compressed body measuring up to 1500 cm in length (commonly measures 600-900 cm). They attain 1000-1800 g in weight (commonly weight 500-700 g).

Weight ratios of different body parts in the Trichiurus haumela caught in different zones of Peter the Great Bay, Gulf of Tonkin and New Zealand waters, vary (according to the data of I. Denisov, I. Varpakhovskii, E. Kleie et al.) within the following range: head 10.9-16%, fully dressed body 72.2-81.8%, viscera 5.7-12.6% (including 3.1-6% liver). When dressed, the body yields (in % of the weight of the undressed fish) 3.4-4.2% skin, 1.2-2.7% tail, 5.7-14.6% bones, 54.6-67.2% flesh.

According to the data from the analyses carried out by N. Nikonova, E. Kleie and V. Rudakova, the large Trichiurus found in Peter the Great Bay, have a high content of fat in their flesh, as well as in other body parts. The small Trichiurus caught in more southerly situated regions, have (according to the data of A. Lisachenko, M. Sycheva et al.)an average fat content (Table 320).

Judging from the data found in the literature, the content of fat in the flesh of the small Trichiurus from the Yellow and East Ching Seas, is 2.4-6.2%.

The high fat content in the body of the Trichiurus specimens caught in the Southern Primor'e, makes this species superior to the others.

Data from M. Syromyatnikova's and A. Teplitskaya's analyses on the content of vitamins from the group B in the body tissues of Trichiurus, are presented in Table 321.

Viscera of this fish contain up to 2420 I.U. vitamin A (20000-25000 I.U. per gram of tissue fat).

T. Mori (1956) recorded 170 γ% thiamin in the flesh of Trichiurus. When salted, this fish has organoleptic properties similar to those of salt herring. The flesh of heavily salted Trichiurus from Peter the Great Bay contains 13.7-20.8% fat, 15.8-20.9% protein and 16-18.9% ash and salt.

When Trichiurus is used for food, it should be prepared in the form of fish cakes or dumplings. Its boiled flesh is white, but unpalatable. The stock is cloudy, dark-coloured and equally unpalatable.

TABLE 320

1 Район лова	6 Месяц	15 Вес рыбы, г	16 Части тела	30 Пределы содержания, % 31 влага	32 жир	33 белок	34 зола
2 Зал. Петра Великого	7 Август—сентябрь	800—950	17 Рыба без разделки	63,3 64,5	8,4 18,8	16,9 20,4	2,2 2,9
	8 Август	750—1100	18 Мясо	62,6 68,3	9,7 19,6	16,0 21,6	1,3 1,4
	9 Сентябрь	950—1000	19 Мясо	61,4 65,6	19,9 20,6	16,1 18,0	1,3 1,7
	10 Август—сентябрь	800—1100	20 Головы, плавники	67,0 68,4	12,6 13,8	10,6 17,9	4,8 8,4
		800—1100	21 Внутренности	66,7 69,7	11,4 16,3	14,3 16,9	0,9 1,6
3 Восточно-Китайское море	11 Январь	190	22 Мясо	76,6	5,0	17,1	1,3
	12 Ноябрь	120—440	23 Мясо	78,2	1,2	19,6	1,5
			24 Плавники и головы	73,2 74,5	2,8 3,3	14,8 17,5	6,5 7,4
			25 Внутренности	78,0	3,3	17,0	1,7
	—	490	26 Мясо	71,5	5,1	21,8	1,3
4 Северный Тонкинский залив	13 Август	530—900	27 Мясо	76,6 77,6	0,4 0,7	19,9 21,0	1,6 1,7
5 Большой Австралийский залив	14 Август	—	28 Мясо	75,9	1,0	21,4	11,3
			29 Внутренности	76,1	3,7	18,8	1,4

Table 320. Chemical composition of different body parts in Trichiurus haumela.

1. Fishing region 2. Peter the Great Bay 3. East China Sea 4. Northern Gulf of Tonkin 5. Great Australian Bight 6. Months 7. August-September 8. August 9. September 10. August-September 11. January 12. November 13. August 14. August 15. Weight of the fish, g 16. Body parts 17. Undressed fish 18. Flesh 19. Flesh 20. Head, fins 21. Viscera 22. Flesh 23. Flesh 24. Fins and head 25. Viscera 26. Flesh 27. Flesh 28. Flesh 29. Viscera 30. Threshold contents, % 31. Moisture 32. Fat 33. Protein 34. Ash

The skin of Trachiurus contains 4.3-9% guanine and is therefore a valuable source of this substance.

The whole fish can be processed for fish meal or oil, but the meal thus obtained has a high fat content. 225

The oil extracted from the flesh of Trichiurus haumela, is nearly colourless, but is similar in odour and flavour of herring oil. At room temperature it precipitates and abundant residue of solid glycerides. According to the data from E. Lagovskaya's analyses, the body fat has d^{15}_{4}-0.9304-0.9318, n^{20}_{D}-1.4790-1.4810, saponification number 145.6-197.5, iodine number 160.9-178.7. Fatty acids contain 22% saturated acids, 43% acids of the oleic series and 35% highly unsaturated acids. The oil contains 0.1-0.2% unsaponifiable substances. The fat becomes readily oxidized and rancid.

Liver oil of Trichiurus haumela is bright-yellow in colour and has the following physico-chemical properties: d^{15}_{4} - 0.9406, n^{20}_{D}-1.4808, saponification number 193.1, iodine number 156.9, unsaponifiable substances 0.9-1.2%.

TABLE 321.

1 Части тела	6 Содержание (γ%) в сыром веществе			
	B_{12}	B_2	PP	Bc
2 Мясо	3,6—4,5	100—400	2000—6500	100—200
3 Голова	2,5—5,5	200—300	2000—4000	150—170
4 Внутренности без печени	44—118	700—1600	2000—6000	500—600
5 Печень	190	1600—6200	19000	

Table 321.

1. Body parts 2. Flesh 3. Head 4. Viscera (excepting liver)

5. Liver 6. Contents (γ%) in raw tissues.