Environment Canada | Environnement Canada
Fisheries and Marine Service | Service des pêches et des sciences de la mer

Processing and Product Development of Canned Capelin Products

by

Wolfgang Uebel

Product Development and Marketing Specialist

ATLANTIC CAPELIN

1973 NEWFOUNDLAND INSHORE CAPELIN DEVELOPMENT PROGRAM
(REGIONAL REPORT #5)

Environment Canada | Environnement Canada
Fisheries and Marine Service | Service des pêches et des sciences de la mer

Processing and Product Development of Canned Capelin Products

by

Wolfgang Uebel

Product Development and Marketing Specialist

ATLANTIC CAPELIN

1973 NEWFOUNDLAND INSHORE CAPELIN DEVELOPMENT PROGRAM

(REGIONAL REPORT #5)

FOREWORD

by

Andrew Duthie
Project Supervisor

This technical bulletin, which is designed for the secondary producer, outlines the processing and procedures which were developed for canned capelin products within the Product Development Phase of the 1973 Newfoundland Inshore Capelin Development Program.

The overall objective of the program, through co-operation with federal agencies, provincial governments and industry, was to develop and assist in the establishment of a viable inshore capelin industry in Newfoundland.

The program consisted of an assessment of the extent of the capelin supply, biological research, experimental harvesting, processing, product research, product development and market research.

Due to the multi-discipline nature of the program it was deemed essential to formulate a co-ordinated group strategy for the planning, development and management of the program at the Regional level. The following agencies actively participated in the program on a co-operative basis:

Federal Agencies:
(1) Environment Canada, Fisheries & Marine Service
(2) Department of Regional Economic Expansion
(3) Department of Industry, Trade and Commerce

Provincial Agencies:
(1) Province of Newfoundland, Department of Fisheries
(2) College of Fisheries, Navigation, Marine Engineering & Electronics

The most important factor of the entire program has been the direct involvement and participation by industry.

The program was carried out in three phases and designed in such a manner as to assist in the orderly development of the capelin industry from the ocean to the consumer.

Harvesting Phase: Completed with considerable success because of the introduction of the Scottish Ring-Net and Single Vessel Midwater Trawl techniques.

Product Development Phase: Progressed rapidly with the development of canned, marinated, smoked, breaded and cooked capelin products.

Marketing Phase: Currently, an inter-departmental marketing task force is investigating the market potential and market development aspects with respect to capelin products.

INTRODUCTION

Although capelin (Mallotus villosus) have been caught for centuries on Newfoundland beaches and used as bait, fertilizers, or stockpiled for winter food and feed, attempts of commercial exploitation of inshore stocks and exploration of offshore stocks have only been made since the late 1960's.

Since 1971, a rapidly growing demand for pre-spawning female capelin developed in Japan, and initiated efforts being made in harvesting and processing of this species in Newfoundland. While sales of pre-spawning, female capelin seemed to be secured for some future time, a very small portion of male capelin was expected to be utilized for human consumption, and then almost exclusively in the local Newfoundland market. Therefore, it seemed logical to investigate the possibility of converting greater portions of male capelin into food production. The processing, product development and marketing phases of this program have been designed for this purpose.

The main objectives of the processing and product development phases of the program were:

1. To observe, analyse, and, if possible, optimize presently employed handling and processing methods of capelin into semi-finished products.

2. To develop and pilot-produce, as far as possible, a variety of finished products from male capelin for a number of selected markets.

3. To collect preliminary technological and cost data related to processing and product development.

4. To assist industry in the implementation of new food processing lines for capelin.

The purposes of this booklet are:

1. To report the data collected as far as processing into semi-finished products and development of canned products is concerned.

2. To draw conclusions where possible, point out weaknesses of techniques now being used, and suggest alterations if applicable.

3. Through the foregoing, provide material to potential processors to assist in the planning and implementation of capelin processing.

CAPELIN HANDLING AND PROCESSING

General Data

Fresh male capelin measured 12 to 20 centimeters (cm) (5-8 in.) in length, with the average size being 15.2 cm. (6 in.). The average weight was 27 grams (gm) or 16.8 capelin per pound with a variation of 12 to 19 capelin per pound.

Fat content varied from .4 to 1.4%, and crude protein (N x 6.25) levelled at 13% (wet).

The bone structure is similar to that of trout, the flesh is grayish-white and the belly black-lined. Rigor Mortis occurred 2-8 hours after catching and lasted up to 50 hours, depending on temperatures and handling methods.

Because of the distinct differences in size, fat content, feeding habits, etc., of inshore and offshore capelin, modified technologies apply to their processing. To avoid confusion, a short differentiation as to their processing and handling influencing factors seems indicated.

1. **Inshore Capelin**

   Pre-spawning or post-spawning, containing up to 20% roe or milt, fat content below 1%, not feeding. From a processor's viewpoint the spawning schools from the Grand Banks have to be classified in this category.

2. **Offshore Capelin**

   Smaller and softer than inshore capelin, over-wintering stocks, heavily feeding, fat content 8-23%. None or very little roe or milt. Caught off Northern Newfoundland and off Labrador.

Carrying Aboard

Most capelin were loaded in bulk in the vessels and landed at processing plants within three hours of catching. Although the short transportation time may make it unnecessary to ice the fish, the product should not be exposed to sun and weather and ideally protected by a topping of ice and covered with a canopy. If longer shipping times are anticipated, sufficient ice should be taken on board and mixed into the fish at a ratio of 1 to 3. A top and bottome layer of ice should be imperative. Provision for good drainage of blood and melt-water through a perforated between-deck or other measures will considerably improve keepability and quality of the fish.

Boxing and icing of capelin on board the vessel would undoubtedly result in a prime quality raw material, since the fish can be iced equally, drained sufficiently, is not exposed to pressure as bulk loaded fish, and no damage occurs during unloading. However, the practicability and economics of boxing aboard needs to be determined for each specific case, particularly in view of the vessel structure.

Discharging From Vessel

Unloading took place by means of brailing, either with a dipnet or a bucket brailer. The unloading rate was about 2,500 lbs. per two men per hour, but it should be possible to at least double this rate by using improved equipment and trained personnel. The vessel's gear can be used for brailing. However, land-based hoists often operate at higher speeds, hence reducing unloading times.

Discharging food capelin by pumps is not recommended, especially if it is planned to segregate female capelin for the Japanese market. The pressure in the pumping system can force the roe from the female capelin, thus reducing the quality and price of the product.

Holding

Usually, capelin will be held for some time in raw material storage before processing. To provide and maintain its quality it should be packed in boxes and iced. The boxes should have a capacity not exceeding 100 to 150 lbs. to permit easy handling by two men and allow dumping into the processing line. The use of larger boxes necessitate the use of dip-nets to move the fish into the processing lines, thus causing damage and increase of wastage. The fish is also exposed to higher pressure which results in more rapid deterioration of the product. However, if large boxes are used to hold capelin, they should be filled with water prior to discharge to minimize damages. In cases where a fork lift with rotating forks or other dumping units are available, the use of larger boxes, e.g. with pallet dimension, is economical. These boxes should not be higher than two feet and designed to be stacked without transferring any weight onto the fish in the lower boxes, thus preventing excess pressure on the capelin.

Ice should be used at a ratio of at least 1 part of ice to 3 parts of fish, with a layer of ice at the bottom and the top and some ice mixed into the fish. Proper drainage of ice-water, blood, etc., should be provided to keep the fish as dry as possible, the boxes should be checked frequently and, if necessary, re-iced. Storage temperatures should be kept below 50°F or as low as possible and a controlled "first in — first out" method should be established.

Properly handled capelin can be kept at an acceptable quality level for up to five days under controlled conditions.

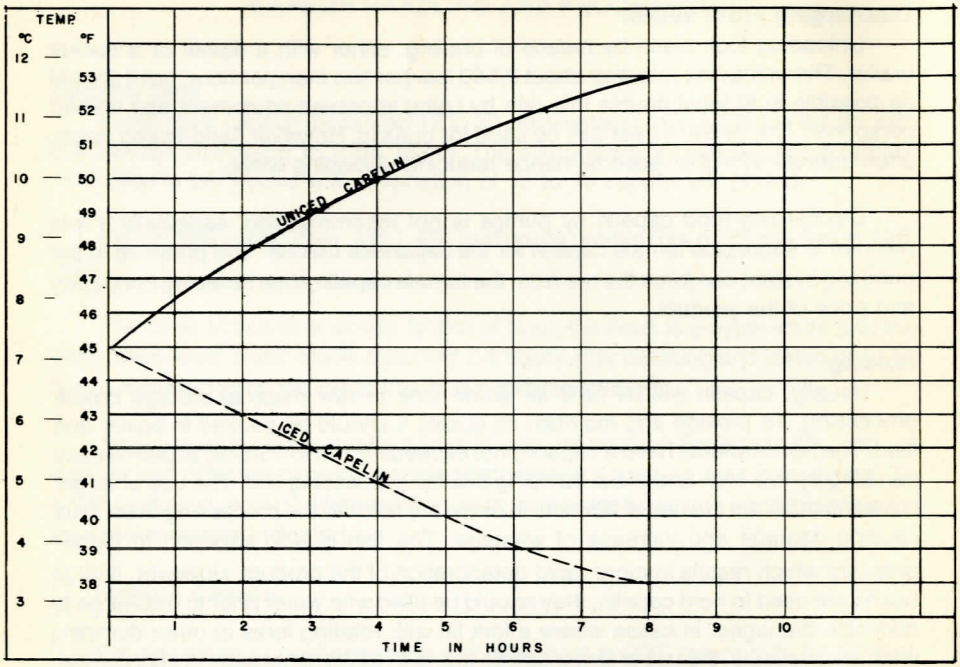


Figure 1

Graph shows temperature increase/decrease of uniced/iced fresh landed capelin during the first 8 hours. Storage temperature 56°F.

Grading

Two types of commercial grading machines for capelin are being built by various manufacturers and presently being used to segregate the sexes — the rotary-drum-type and the vibrating-bar-type. Both machines operate on the same principle. Cylindric or rectangular-shaped adjustable bars are set at a determined distance to one another. The opening increases towards the end of the machine. The bars incline towards the discharge end of the machines, and this, combined with the rotation of the drum or the vibration of the bars, causes the fish to travel through the machines. The smaller females drop through the bars in the first section of the machine, while the larger males are discharged at the end. Capacities of these machines vary from 1 to 10 tons of capelin per hour and grading accuracy of up to 80% females can be attained, depending on the ratio fo females to males, adjustment of machine, portion of immature, undersized male capelin in the catch and working load of machine, relative to its capacity. For high-volume production two or three machines can be put in a series to achieve optimum grading results.

It was obvious that all machines can damage the fish considerably, especially by forcing the roe from fully mature female capelin, the reason being that in the rotary-drum-type machine, the fish is exposed to the tumbling effect of the rotating drum and pressed through the bars by means of its own weight and the weight of the load. In the vibrating-bar-type machine, the fish is squeezed between the bars by means of its own weight and the vibration effect. These effects should not occur in machines using driven wire conveyors as opposed to vibrating bars, or in machines which convey and grade capelin through a system of round bars with large diameters rotating against each other, thus preventing pressing or squeezing of the product. These machines are in wide use in the food industry. However, it is not believed they have been utilized for capelin.

Cutting

Depending on the desired further processing, capelin may be cut into various products, either manually or with available machinery.

Nobbing

The head is removed, guts are pulled, milt — if any — remains in the fish, the tail normally stays on but can be removed if desired.

One machine type is available at a speed of 90 fish per-minute and can be operated by two persons, the yield being 65-70%.

Dressing

The head is removed, tail left on or removed, belly is cut open, guts and milt removed, most of the black belly lining is taken out.

One machine type with a speed of 90 fish per minute is available and can be operated by two persons.

Yield for tail-on product can be calculated at 55-65% depending on size of capelin and milt content. Yield for tail-off product is 50-60%.

Butterfly Filleting

The head is removed, belly cut open, guts, milt, black belly lining, backbone and sidebones are removed. Tail may stay on or be cut off, two fillets hanging together on back skin. One machine type at 90 fish per minute is available. An advanced model with a capacity of 300 fish per minute is expected to be in operation in the near future.

A yield of 40-50% can be expected, depending on size and milt content of the fish.

Filleting

Basically the same as butterflies, except the back skin is split, thus creating two single fillets. The skin can be removed in the same process.

Two machine types at 90 fish per minute each are available. Yield for skinless fillet is 35-40%.

One disadvantage of all cutting machines is their low capacity. At a speed of 90 fish per minute, an efficiency of 85% and an average weight per fish of 27 grams, the hourly input is 273 pounds raw material. Working at a yield of 50% and at an 8 hour working shift, 1,090 pounds of semi-finished or finished product can be produced. High speed cutting machines, e.g. 600 fish per minute, could probably be designed and built on the basis of the existing machines. However, as the usage of such machinery would be limited by the number of feed-in personnel which can be placed at one machine and the feed-in capacity of these employees, automatic feeders for high speed operation need to be developed at the same time.

Washing and Brining

Normally the water-spray system in the cutting machines will provide sufficient cleaning of the capelin. If an additional washing process is deemed necessary, a conventional drum-type washing machine can be used. Remains of black belly lining can be removed from dressed or butterflied capelin by high pressure water sprays.

If the capelin is individual quick frozen for later processing into products which require a certain salt content, treatment in a salt brine should take place before freezing. Before packing, the fish must be drained to avoid excess water in the package.

Packaging and Freezing

Depending upon the final use, the processed capelin can be I.Q.F. or frozen in blocks. If cod-block cartons are used for packing, a 20% lower weight has to be calculated for capelin. For example, a 16½ pound carton will only hold about 13 pounds of capelin.

Block freezing takes place preferably in plate freezers with a minimum freezing speed of 1 cm. per hour. For example, the center temperature of a 2 inch block should be 0°F or less after five hours freezing time. If the blocks are not wrapped in vapour-proof material, they should be glazed before they are stored in cold storage at 0°F or less.

Individual quick frozen products may be frozen in a blast cell, a freezing tunnel or a plate freezer, wrapped in vapour-proof materials and stored. However, I.Q.F. freezing in plate freezers is extremely time consuming and uneconomical.

Stockpiling Round Capelin for Later Processing

During the relatively short capelin run it is normally necessary to freeze and stock pile round capelin for processing during the off-season. This method was practiced during the Program on approximately 250,000 pounds of capelin, which were of acceptable quality for processing after being in storage for up to eight months.

PRODUCT DEVELOPMENT OF CANNED CAPELIN

Planning

The planning stages for the development of canned products are outlined briefly as follows:

1. Collection and discussion of product ideas, including a preliminary formulation of products and their likely market prospects for the target markets in the United States, Europe and Canada.

2. Obtaining information as to availability, origin, retail prices, retail and wholesale margins, etc. of comparable products, namely canned herring and sardines. During the course of this investigation new product ideas evolved and other original ideas were discarded.

3. At this point the question arose as to whether completely new products should be developed or the conventional herring and sardine product lines should be modified to suit capelin. It was decided to follow both alternatives, with priority being given to modified products. It was also felt that market acceptance of a new species of fish could be assessed and tested at a faster rate, if the consumer could associate the products with similar ones already established in the market. If the new product was accepted, new product lines could then be introduced in another phase.

4. The preliminary product formulations were specified, and detailed product standards determined and screened in line with the following:

   (a) Time, funds and equipment available for the necessary development work and pilot runs.

   (b) Estimated production cost at commercial level and competitiveness of consequent retail prices.

   (c) Anticipated consumer acceptance of the products.

5. Hand samples of the screened products were produced, tested by a group of panelists and re-formulated if the results indicated this to be necessary. This procedure was repeated until the products were approved for a pilot run.

6. About 14,000 — 3¼ ounce aluminum snack cans of the following were produced:

(a) Nobbed Capelin	Origin of Capelin
Smoked, salt added	Inshore and Offshore
Smoked, soya oil added	Inshore and Offshore
Steamed, in tomato wine sauce	Offshore
Steamed, in mustard sauce	Offshore
Steamed, soya oil added	Offshore

		Origin of Capelin
(b)	Dressed Capelin	
	Smoked, salt added	Inshore
	Smoked, soya oil added	Inshore
	Smoked, in tomato wine sauce	Inshore
	Smoked, in mustard sauce	Inshore
	Smoked, soya oil and vegetables added	Inshore
	Steamed, in oil	Inshore
	Steamed, in tomato wine sauce	Inshore
	Steamed, in mustard sauce	Inshore
(c)	Butterflied Capelin	
	Smoked, salt added	Inshore
	Smoked, soya oil added	Inshore
(d)	Capelin Fillets	
	Smoked, soya oil added	Inshore

Raw Material

Fresh or frozen capelin may be used for canning. Preference, however, should be given to the fresh product because of its lower price, compared to frozen fish, which bears the cost of freezing, storage, thawing, etc. Also, the yield from fresh material is 3-10% higher as compared to frozen capelin, depending on the type of packaging, freezing speed and thawing. Finally, fresh canned fish is considered to be of superior quality, as frozen fish tends to become strawy, dry and chewy in the canning process.

The relatively short harvesting period of inshore capelin will, however, necessitate the use of a stock-piled frozen product to a great extent in order to increase the processing period and optimize the utilization of production capacities.

Thawing of Frozen Capelin

If frozen capelin is used in the canning process, it has to be thawed before further processing. During the Program defrosting was carried out in a thawing frame, in which the blocks were defrosted with cold water spray. It is important that the spray nozzels produce a mist of water and not a jet of water which damages the fish and increases the wash-out effect. The water temperature should not rise above 65°F. The thawing time for an unglazed two-inch block with wrapping material removed was 3½ hours at a water temperature of 59°F and a water consumption of 1.45 gallons per pound of fish. For heavily glazed or wrapped blocks, thawing times up to 5 hours for a 2 inch block can apply. The disadvantage of this method is that the defrosted top and bottom layers remain on the block, thus insulating the still frozen centerparts. The advantage is the comparable low investment cost of the equipment.

Thawing by still air is extremely time and space consuming, cannot be controlled, results in a lower quality of raw material, and should be avoided if possible.

Good thawing results have been obtained on herring blocks in vacuum-tunnel-thawers and in continuous thawing machines, using saturated air as a heat transfer medium and ensuring immediate removal of defrosted fish from the block. These machines could be successfully employed in capelin processing.

A thawing loss of 3-10% can be anticipated, depending on the thawing method and the initial speed used to freeze the block. Generally, the faster the freezing, the smaller the ice crystals formed in the cellular tissue, hence the less damage to the tissues and less dripping losses during thawing.

Brining

If the capelin is to be packed in oil or in its own juice, the fish has to be salted in a brine before further processing. The desired salt concentration of canned smoked fish in North American and European markets is 1.5-2% of the finished product. To achieve this level, three basic types of brining can be used:

1. Low salt concentration — long retention time, e.g. a brine with 4% by weight salt (15° salinometer) is prepared and mixed with fish at a weight ratio fo 1-1. Minimum retention time should be ½ hour and there is no maximum retention time, as the fish would pick up no more than 2% salt. The disadvantage of this method is that fish and brine have to be measured to obtain a consistent salt concentration, and, due to the long minimum retention time, it will be difficult to automate the process at reasonable cost and size of equipment. The advantage is its relative security against over or undersalting.

2. Medium salt concentration — medium retention time. This method was employed during the pilot runs. Dressed capelin was brined for 8 minutes in a 6% by weight (23° salinometer) salt brine, with a 1.5-1.8% salt concentration in the finished product being achieved. This process was chosen because it is easy to control and can be employed in a continuous processing line.

3. High salt concentration — short retention time. This method requires very high salt concentrations, e.g. 22% by weight salt (85° salinometer) and retention times of 2½-3 minutes, and could be employed where effective control is provided. It is obvious that at a total retention time of 2½ minutes, 30 seconds more or less, brining would considerably change the final salt content of the fish. It must be questioned whether such variations can be avoided in the industrial practice.

The above mentioned retention times relate to dressed capelin and have to be increased by 50% for nobbed products, because the flesh is not as exposed to the brine. For butterflies and fillets, retention times have to be decreased for the same reason. The temperature of brine and fish in all cases was about 60°F and retention times of the salt concentration of the brine must be changed if other temperatures apply.

During the course of the taste panelling, the specific capelin flavour was associated with "rancid", and it was believed that most consumers would consider

this to be an off-flavour. This flavour was eliminated by the use of .6% acetic acid in the brine. Higher concentrations should be avoided, as they cause softening of the flesh. Because of its lower cost, 80% acetic acid concentrate should be used rather than vinegar.

The use of polyphosphates in the brine did not show any recognizable improvements in the finished products.

Smoking

Smoking of capelin can take place in a batch-type smoke house or in a continuous working smoker, as was used in the pilot production. Capelin for canning purposes should be hot-smoked at temperatures between 80° and 100°C (176°-212°F) for the following reasons:

1. To ensure shortest possible smoking time, which in turn increases the efficiency of the smoking unit and keeps its size at reasonable dimensions.

2. To prevent cloudiness of oil in the cans by coagulating the proteins prior to retorting.

3. To provide fastest possible drying.

To achieve a uniformly smoked product, the smoking unit must be designed to provide equal treatment for each single fish of one batch and ensure reproductable conditions for each batch. This is only possible where smoking time, temperature, humidity, air velocity and amount of smoke in the chamber can be controlled, either manually, or, preferably, through automatic controls.

During the pilot runs, a smoking time of 34 minutes at 98°C (208°F), an air velocity of 8 meters (24 feet) per second, and a relative humidity of 40%, resulted in an acceptable product. Within this processing time, the capelin is cooked, dried and smoked.

To obtain uniform drying and coloring of the capelin,the water-budget of the smoker is of utmost importance and must be carefully adjusted and kept balanced at all times. If the smoking unit is charged above its load-limit, a wet product with fat and protein separations and an unequal color will be the result. To determine the maximum load of a smoker, the following procedure can be employed:

1. Measure temperature and relative humidity at fresh air intake. To determine the water content of 1 cubic meter air, find the saturation point for the temperature on chart Fig. 2, divide by 100 and multiply with the percent of relative humidity determined.

EXAMPLE:

Relative humidity at fresh air intake 65%.
Temperature at fresh air intake 26°C (79°F).

Find 26°C at temperature abscissa of Fig. 2, go straight up to curve, and read the saturation for this temperature at the co-ordinate, in this case it is 24 g. of water per cubic meter of air. Divided by 100 and multiplied by 65, the result is 15.6 g. of water in one cubic meter of air.

Multiplied with the total intake of cubic meter air per one hour, and divided by 1,000, the total water intake expressed in kilos per hour is determined.

2. Determine the input of fish per hour and the percentage of drying losses to calculate the amount of water evaporating from the capelin in a one hour period.

EXAMPLE:
Input per hour, 1,000 kilos (2,200 lbs.)
Drying loss — 23%

$$\frac{1.000 \times 23}{100} = 230 \text{ kilos (506 lbs.) of water evaporating per hour}$$

3. Add the results of Nos. 1 and 2. The result represents the total load of water the smoker is charged with in a one hour period. Term this Figure "C".

4. Determine the water content of 1 cubic meter exhaust air by measuring temperature and relative humidity and calculate as described under 1.

5. Determine the air in cubic meters exhausted from the smoker in one hour by multiplying the total area of the exhaust system expressed in square meters by the air speed in meters per hour.

EXAMPLE:
4 exhaust pipes with 20 cm. (8 inch) dia. each.
Air speed at end of all pipes 10 m. (30 feet) per second.
$(.1 m^2 \times 3.14) \times 4 \text{ (pipes)} \times 10 \frac{m}{sec} \times 3{,}600 \text{ sec.} = 45{,}216$ cubic meters per hour.

6. Multiply the result of No. 4 by the result of No. 5 to obtain the total amount of water discharged from the smoker in one hour. Term this Figure "D".

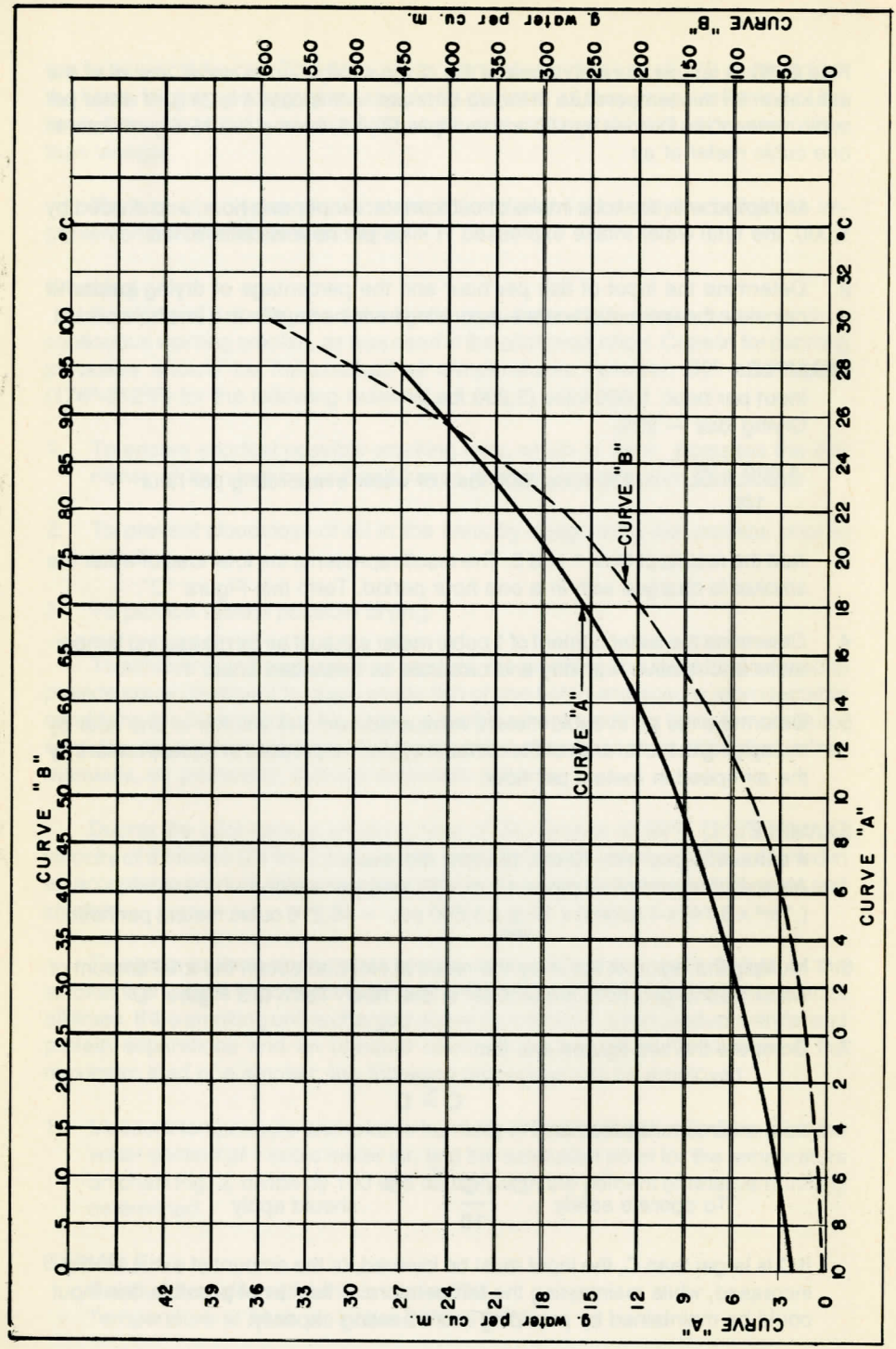
7. Compare the two figures and find

$$C \leqq D$$

as a minimum requirement.

To operate safely $C + \frac{C}{10} \leqq D$ should apply

If D is larger than C, the input must be lowered, or the amount of exhausted air increased, while maintaining the temperature. If this is not possible, the input could be maintained by providing more heating capacity.



Firgure 2

Saturation Points of Air. (In grams of water per cubic meter of air.)

During the pilot runs, the smoking losses of dressed capelin averaged 23.4% with a range from 20% to 30%.

Oak wood was used to generate smoke. However, any tupe of hardwood is recommended, either alone or in combination with soft wood. The use of pure soft wood chips or too great a portion of it in a mixture should be avoided, because it can create a scabrous and bitter taste in the product. Good quality oak chips for smoking purposes do not contain too much bark, which could cause extreme darkening of the smoked product in the retort, caused by its high content of tannin. The tar components of the wood are also mainly represented in the bark. the tar condensates in the smoke chamber, thus increasing the cleaning cost.

Once the type or mixture of wood used for the smoking process has been decided upon, it should be a matter of course to always use the same type or mixture, to provide a standard quality product.

Steaming

If the capelin is to be packed as a cooked product in sauces or oil, pre-cooking must take place before the cans are sealed. This process will remove a certain quantity of water from the fish, and prevent excessive shrinkage in the retorting process. Excess water in the can reduces the appearance of the product and can cause a breakdown of the sauces.

During the pilot runs, the capelin was packed raw into cans and treated for 12 minutes in saturated steam of 80°C (176°F). After steaming the cans were drained, with the average weight loss from this process being 11%. When pre-cooked, the capelin is too soft for manual packing and, therefore, should be packed into the cans prior to heat treatment. The expected drainage loss must be considered when the fish weight is determined at time of filling.

Packing Fish into Cans

The back of a smoked, canned capelin is of a dark-brown color, while the sides are silvery golden. Therefore, it was decided to improve the appearance of the fish in the opened can by showing as much of the brighter sides of the capelin as possible and as little of the dark backs as necessary. This was achieved by packing the first capelin with the belly towards one side of the can, the next fish with its belly covering the back of the first, etc. All dressed and nobbed products were one-layer-packed, with the tails overlapping at the middle of the can. Untrained personnel packed up to 80 cans per hour, and it is believed that after appropriate training, packing speed could reach 300 cans per person per hour.

The minimum net weight of fish at time of filling was as outlined below:

1. All "salt added' products — 100% of declared net weight.
2. "Smoked, in oil" products — 80% of declared net weight, except "smoked, vegetables and oil added", where the fish weight was 70% of declared net weight plus 10% vegetables.

3. All products in sauces — 60% of declared net weight plus 40% sauce. It should be mentioned that the North American market normally prefers a higher fish portion in sauce products, e.g. 70-75% of declared net weight.

4. "Steamed capelin in oil" — 75% of declared net weight.

To increase the efficency of the packers and provide a uniform pack, consideration should be given to cutting the capelin into standardized lengths tailored for the specific can used, and to accept a somewhat lower yield ex the cutting process.

Sauce and Oil Utilization

1. **Oil**

For all sample production, soya oil was used. However, it can be substituted by any other tastless vegetable oil such as rape-seed, corn, cotton-seed or olive oil. The type of oil used will depend on its availability and cost as well as on market requirements and the price level attained for the finished products.

2. **Sauce**

Where possible, some sauce should be put into the empty can prior to packing the capelin to prevent the fish from sticking onto the can after sterilization. The remainder of the sauce is applied on top and it should be ensured that no air enclosures remain in the can which would cause oxidation and discoloration of the product. If necessary, air can be evacuated before seaming. To prevent "flipper-condition", the cans should not be overfilled. Especially high viscose sauce can contribute heavily to overfilling conditions and this fact should be considered in the formulation of sauce recipes.

Seaming

Seaming machines for square or oval-shaped cans are limited to a seaming speed of about 60 cans per minute by their specific design. The smaller the corner-radius of a can, the lower should the seaming speed of the machine be to ensure a safe operation.

The aluminum-snack-can used during pilot production was sealed at a speed of 54 cans per minute. The applied standards for overlap were:

1. A minimum of 45% and a maximum of 65% in the corners,

2. A 20% higher tolerance level for both sides.

A code was embossed on the lids, determining the production day, type of product and the sealing machine number. Overfilled or unequally filled aluminum cans are easily damaged and wasted in the sealing machine.

Sterilization

The sealed cans were sterilized in an overpressure retort for 25 minutes at 116°C (240°F) and 2 atmospheres overpressure (28 psi). The cooking took place in water heated by live steam injection. The steam jets should be designed to cause turbulence of the water, thus providing equal temperature conditions throughout the retort. Cooling took place with cold water under pressure and the calculated Fo-value for the cans was 7.

Lower temperature and extended processing times, e.g. 112°C (233°F) at 60 minutes, can be employed for smoked products in oil or with salt added. However, this should not be applied to products containing sauces where long processing times can cause discolorations and a "burned" flavour, especailly in tomato sauces. Short sterilization times at high temperatures provide the best quality sauce products and increase efficiency of the retorting capacities; but measures must be taken to ensure absolute equal temperature conditions for every part of the retort.

Cleaning, Drying, Labelling of cans

After retorting, the cans were cleaned in hot water, dried with warm air, hand-wrapped, labelled, and packed into master-cartons. Wrapping and labelling speed of a trained worker can reach 30 cans per minute.

Can Fabrication

Cans for pilot runs were fabricated from cold rolled aluminum, coated with an approved lacquering. The thickness of the aluminum strips was .29 mm. (gauge #28) and the inside lacquering 3.5 g. per square meter (5 opbb) and withstands the deep drawing process and sterilization temperatures. The cans were drawn in a 40-ton crank press employing a cut-draw-cut operated double-die-tool.

Sauce Fabrication

A tomato wine sauce and a mustard sauce were developed. The sauces were cold prepared as is recommended for all sauces for canning purposes. Cooking of sauce prior to canning will result in:

1. Discoloration and off-flavours, through reactions of sugars with fat and acid under the influence of heat and oxygen.

2. Destruction of vitamins and decrease of spiciness, thus necessitating over-spicing and subsequent increase of cost.

3. "Dead-cooked" sauce with no water-binding potential left in the starches. During the retorting process, quantities of water cook out from the fish and must be absorbed by starches to prevent "water-islands" in the sauce.

To obtain a smooth, creamy sauce, a mixture of gums and emulsifiers should be used and it should be noted that sauces containing too much wheat flour are sticky and give a dull mouth feel. As the sauce is mixed with 60 or more per cent of fish in the can, spices tend to weaken during the retorting process and in storage, salt, sugar, acid and spices must be overdosed in the raw sauce to accomplish the desired final product.

The use of spice extracts or flavours can assist to standardize the product and, as natural spices vary substantially in strength, can also decrease the cost in many cases. However, as natural spices can bind a great amount of water, the starch composition of the sauce has to be reformulated if extracts are used instead of natural spices.

TOMATO WINE SAUCE RECIPE

		Percent
1.	Water	41.490
2.	Purity Gum	.900
3.	Locus Bean Gum	.450
4.	Guar Gum	.300
5.	Soya Oil	15.000
6.	Lecithine	.400
7.	Tomato Paste — 28% Refractrometric	26.000
8.	Salt	2.500
9.	Sugar	8.000
10.	Acetic Acid — 80%	1.250
11.	Mustard Paste	1.000
12.	Citric Acid	.080
13.	Ascorbic Acid	.030
14.	White Wine	2.000
15.	Pepper, ground, white	.150
16.	Nutmeg, ground	.050
17.	Chilis, ground	.100
18.	Onion Powder	.150
19.	Worcestershire Sauce	.150
20.	Tabasco	.050

Preparation

1. Mix Nos. 1 to 4 and homogenize for 8 minutes.
2. Add 5 and 6 and homogenize for 2 minutes.
3. Add items 7 to 14 and homogenize for 3 minutes.
4. Add rest of ingredients and give 3 minutes to mix.

Analysis of sauce

Water	62.0 %
Salt	2.7 %
Total Acid as Acetic Acid	2.3%
PH	3.9
Refractometric Value	18 at 18°C (65°F)
Viscosity	5,600 cp at 18°C (65°F)

Process Modifications for Offshore, High Fat Capelin

The above process was employed in the processing of inshore, low fat capelin. Offshore capelin with fat content ranging from 14% to 23% were processed during the same period and modifications of the process were required. It was extremely difficult to handle this high fat fish, as the slightest mechanical contact causes the fish to lose its skin. Capelin with fat content of 14% to 16% were processed into acceptable products, whereas, products with 20 or more per cent fat were not believed to be acceptable in their appearance.

FOR FURTHER INFORMATION CONTACT:

M. Barnes, Chief,
Industrial Development Branch,
Fisheries and Marine Service,
Environment Canada,
P. O. Box 5667,
St. John's, Newfoundland.

Telephone: 726-7330

ACKNOWLEDGEMENT

The success of the processing and product development phases of this Program largely reflects the valuable support received by Fishery Officer James Cheeseman of Stephenville, who was seconded to the Program as Field Supervisor for several months. His devotion to this Program and his active participation contributed greatly to this report.

I also would like to thank Mr. Lou Patterson for his professional advice and assistance during the pilot production at the (PAC) Atlantic Plant in Stephenville.

Edited By:

E. P. Quigley,
Information Officer,
Fisheries & Marine Service,
Environment Canada,
P. O. Box 5667,
St. John's, Newfoundland.

ATLANTIC CAPELIN

SMOKED

SOYA OIL ADDED

EXPERIMENTAL PACK

PRODUCT OF NEWFOUNDLAND, CANADA

ENVIRONMENT CANADA, FISHERIES AND MARINE SERVICE, NEWFOUNDLAND REGION • PROVINCE OF NEWFOUNDLAND, DEPARTMENT OF FISHERIES •

ATLANTIC CAPELIN

SLIGHTLY SMOKED WITH
VEGETABLES, SOYA OIL ADDED
3¼ OZS. (100 Grms.) NET WEIGHT

1973 NEWFOUNDLAND INSHORE CAPELIN DEVELOPMENT PROGRAM

DEPARTMENT OF REGIONAL ECONOMIC EXPANSION • PRODUCT OF NEWFOUNDLAND, CANADA • SAMPLE PACK • COLLEGE OF FISHERIES