

# Development Of An Underutilized Fish Species – Male Capelin (*Mallotus villosus*)

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## Introduction

Capelin, (*Mallotus villosus*) are found in abundance off the coast of Newfoundland and Labrador. During June and July each year several stocks migrate inshore to spawn. About one month prior to spawning, external sexual characteristics develop on the male. These changes are in the form of spawning ridges along the lateral line and enlarged fins, giving the male a robust appearance while the female retains its delicate silvery form. During this time, the males and the females are easily distinguishable and can be mechanically or manually separated. During the rest of the year, the sexes are almost indistinguishable.

Historically, capelin have been consumed locally in Newfoundland and Labrador in fresh or corned and dried form. Relatively large quantities have been used as fertilizer and as bait for other fisheries, zoofood and fishmeal. Most of the male capelin have been dumped.

In the latter part of the 1970's, an inshore capelin fishery began in Newfoundland, to supply mature roe-bearing female capelin to the Japanese market. The production of frozen roe-bearing female capelin has risen dramatically, from 369 mt valued at less than one million dollars Canadian in 1977, to 35,310 mt valued at 52 million dollars Canadian in 1990. Fig. 1 illustrates the increase in landings of Newfoundland capelin.

In recent years, Newfoundland processors have collectively exported annually an average of 35,000 mt of frozen roe-bearing female capelin. To arrive at this quantity of female capelin, at least an equal volume (ie. 35,000 mt) of male capelin must be harvested, and, indeed, much higher male-to-female ratios have been used. In 1987, it was

estimated that the catch production ratio was 2.5:1 (ie. 2.5 mt of mixed capelin were needed to produce one mt of female capelin). The capelin quota has conventionally been fixed on market demand for females. No adequate market for this surplus male capelin has been established and a very large percentage is discarded. This is a huge, potentially available, underutilized fish species.

During 1989 and 1990, the Canada/Newfoundland Inshore Fisheries Development Agreement (NIFDA) Discards Program provided funding for several projects dealing with the utilization of discarded male capelin. These projects are summarized below.

## Protein Supplement Project (Triposha)

### Objective

The project was designed to examine the possibility of producing an economical supplement fish protein isolate from male capelin.

### Purpose And Rationale

Traditional food materials of poor nutritional quality can be improved through the use of supplemental protein products. Fish has long been identified as a source of high-quality protein. Consequently the aim was to develop a dry soluble shelf stable powder derived principally from male capelin. This fish powder could be marketed alone as a source of high quality protein or combined into a composite product to improve the nutritional quality of traditional foods.

In early 1989, NIFDA in response to a project proposal by FADA (Fish Aid Development As-

sociation) provided funding for the Marine Institute to research and develop such a product.

A similar product is currently in use in Southeast Asia to provide supplemental nutrition to pregnant and nursing mothers and young children.

## Results

The successful development of a low-cost protein supplement depends on the utilization of a practical method of (a) reducing the lipid (fat) content of the raw material; this concurrently reduces the disagreeable fishy odour (present in the lipid fraction) and (b) the utilization of a non-destructive means of drying.

## Conclusion

A high-quality, functional supplemental fish protein isolate can be produced economically using

traditional food processing equipment, given a cheap source of starting material. Male capelin may be classified as such a cheap starting material. While the finished product may be produced economically, it remains to be seen whether reasonable markets for such a product exist.

## Pickled Capelin, Desalted And Dried

### Objective

This project was designed to determine the possibility of producing dried male capelin with low salt content as a source of human food for the Central African market or as a high priced pet food for the Scandinavian market.

### Purpose And Rationale

Traditional dried male capelin have long been produced from corned capelin during the "capelin

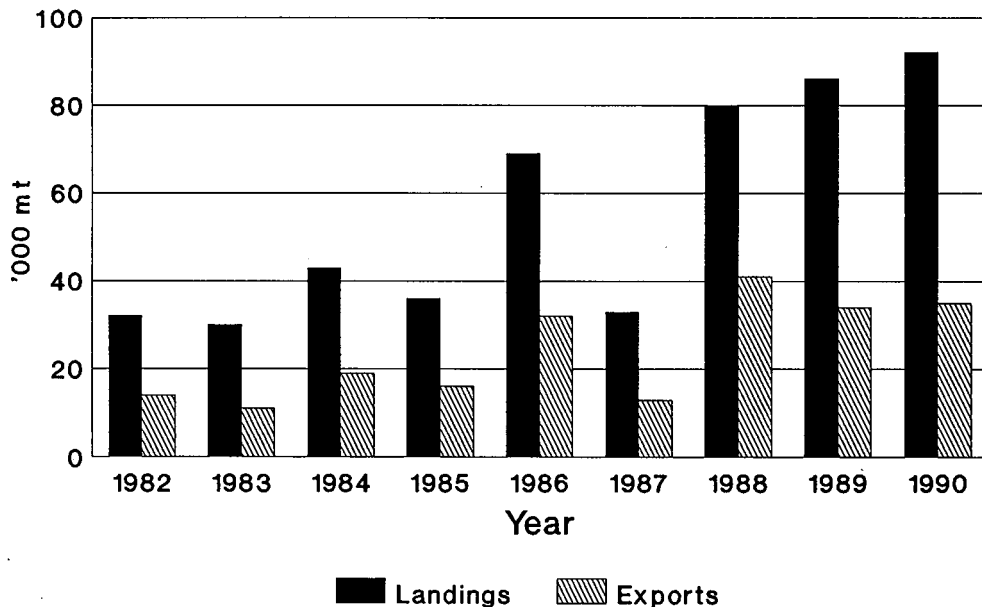


Fig. 1. Capelin landings and exports of Newfoundland and Labrador.

scull" in June and July. The resulting product, when dried to a moisture content of 20% or less, often had a salt content of 12-16%. Attempts to dry capelin without salt during this time of the year resulted in the products being infested with flies and maggots.

## Results

The method developed enables male capelin to be salted in reusable 100kg barrels using a 'hard cure'. The barrels can then be held under proper chill conditions, with the liquid level kept properly topped up, for several months.

During September, October and November, these barrelled capelin can be desalted to about 1% salt level, wet weight. The desalted capelin can then be dried, either by sun-drying or mechanical dryer.

The resulting product would satisfy specifications for low-salt dried capelin, with a salt content less than 5%. Phase one of NIFDA's involvement in the product was to provide financial assistance to companies for the production of pilot quantities of this product for market analysis.

The production of pilot quantities identified a problem. The spreading of the desalted capelin on the racks for drying proved to be a very labour-intensive phase and one which threatened to endanger the profitability of the whole process. Without mechanical aid, it required one person-hour to position two flakes, spread 72 lb of capelin, and place the flakes into position for drying.

Consequently, NIFDA responded to a proposal from FADA to provide financial assistance to develop a 'capelin spreading device' to make the process more economically viable. The automatic spreading machine reduced the time necessary to spread the capelin. Final tests indicated that in one person-hour, use of the spreader resulted in 12 flakes, with approximately 430 lb of capelin spread and readied for drying.

## Conclusion

It was proven that good quality low-salt, dried capelin could be produced using this method.

Furthermore, the labour-cost savings realized by using the automatic spreader during the latter part of the project proved that the process was economically viable. A further test involving 100,000 lb of 'hard cure' capelin, utilizing the automatic spreader, will take place within the next couple of months.

## Capelin Pub Snack

### Objective

To produce an acceptable smoked pub snack product from male capelin; one that is safe, desirable, of consistent quality and capable of being kept without refrigeration.

### Purpose And Rationale

A pub snack product has been produced previously in Newfoundland in an effort to utilize male capelin and to cater to a local taste preference for capelin. Production was sporadic and product consistency with regard to smoke, moisture and salt content were difficult to maintain. Although the product was popular it had limited shelf life unless frozen.

### Results

A range of smoked pub snacks was produced from frozen and pickled male capelin. These were produced from round capelin, knobbed capelin, and tail-off butterfly fillets. The aim was to select the most desirable product for subsequent market survey. It was obvious that the butterfly fillet was the most attractive and that it was superior to the round or knobbed capelin. It was also easier to smoke the butterfly fillet and to reduce its high moisture content. The Baader 561 machine was used for knobbing, while the Baader 134 machine was used for filleting the male capelin.

Hot and cold smoked products were also produced. In cold smoking, the temperature does not exceed 30°C and the product is not cooked. In hot smoking, a temperature of 70°C or higher is attained and the product is cooked. The hot

smoked product was drier, took on a smoke flavour and a better colour, had a better overall appearance, and required a much shorter time to smoke (hot smoking of butterfly fillets took two hours compared to 5 hours for the cold smoking process).

Different concentrations of brine, sugar, dye and varied smoking times were used to produce a range of products. Sugar and salt are commonly used to prevent or limit the growth of microorganisms and were selected as optional preservatives. Different concentrations of brine (30°-70° brine), sugar (0%-20%), annatto dye (0-6 mls of dye/4.5 l of water), dipping times (15-60 seconds) and hot smoking times ( $\frac{1}{2}$  -  $3\frac{1}{2}$  hours) were used to produce a wide range of smoked (butterfly fillet) products.

A taste panel found that the most preferred smoked capelin pub snack had the following specifications:

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Type	: Butterfly fillet
Dye (annatto)	: Nil
Sugar concentration	: Nil
Brine concentration	: 30° brine
Brining or dip time	: 45 seconds
Smoke time	: 30° C ( $\frac{1}{2}$ hour) - 50° C ( $\frac{1}{2}$ hour) - 70° ( $\frac{1}{2}$ hour) - 90° ( $\frac{1}{2}$ hour) Break ( $\frac{1}{4}$ hour)
Salt (water phase)	: >9%
Moisture content	: 48% - 52%
Water activity (Aw)	: <0.93

*Notes:*

1. 30° brine is produced by adding 3.91 kg of fine salt (NaCl) to 45.5 kg of water.
  2. An allowance of 15 min is given to clear the smoke at the end of the smoke time.
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Three types of packaging used were:

- vacuum pack,
- shrink pack, and
- modified atmosphere pack (M.A.P.)

The vacuum pack gave the best results as the product kept well without refrigeration for more than four months at room temperature. The product must exceed 9% salt in the water phase to prevent growth of *Clostridium botulinum*. Results were quite promising in the modified atmosphere pack, where the composition of gases were in the following proportion: (1) 75% nitrogen and 25% carbon dioxide, (2) 30% nitrogen, 10% oxygen and 60% carbon dioxide. As this was a more expensive packaged product, only limited studies were conducted.

Samples of the selected pub snack produced on a pilot scale were used to conduct the market study. Samples were distributed to pubs and convenience stores in St. John's. Out of a total of 367 surveyed, 90% liked the product and were interested in buying it.

### Conclusion

The vacuum packed, butterfly fillet, hot smoked product kept well without refrigeration. This product passed the test of consumer acceptability which was ascertained through a market survey carried at pubs and convenience stores in St. John's. The objective set out in this project was achieved.

### Process Summary

The following is a brief description of the processing of smoked capelin pub snack (also see Fig. 2).

1. Butterfly fillets were produced using previously frozen (thawed overnight) male capelin using the Baader 134.
2. The fillets were washed automatically during the filleting process.

3. The fillets were sorted to weed out the defective fillets (4% defective fillet level was acceptable).
4. Approximately 6.7 kg of fillets in a perforated pan were dipped and agitated manually in a 30° brine for 45 sec. The salt content of the fillet was approximately 2.0% at the stage before smoking.
5. The fillets were racked and smoked for a total of two hours at temperatures increasing at half hour intervals (30°C, 50°C, 70°C, and 90°C, respectively). The humidity in the smoker must be regulated to produce a desirable smoked product.
6. The product was taken out of the smoker and cooled to room temperature for 15 minutes. (This prevents condensation of the moisture in the vacuum pack.)
7. The product was packed with three fillets in each package.

8. Each package was checked for proper vacuum sealing. (The badly sealed package will develop moulds within a couple of weeks, when stored at room temperature. This may be used as a practical additional check against poor sealing).

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Chandra, C. V., and Samson L. 1991. Capelin pub snack project report. Canada/Newfoundland Inshore Fisheries Development Agreement, St. John's, Newfoundland.

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### Discussion

In the discussion, Mr Madakia explained that the capelin in these studies were harvested before the spawning season, and that desalting of the salted capelin was done by placing them in water at low temperature.

Since preservation made use of only 9% NaCl, Mr Madakia was asked whether there were cases of *Clostridium botulinum* poisoning in Newfoundland. He said that so far no cases had been reported. Dr Strom remarked that in Norway where analysis of the internal contents of the capelin were conducted, no case of *C. botulinum* infection had been reported but there had been some cases of bacillus infection.

Discussing the packaging of capelin pub snack, Mr Madakia explained that trials of vacuum-pack and modified atmospheric pack (MAP) did not show significant differences. However, the use of vacuum pack had been pursued because this method was cheaper than MAP. Furthermore, products in vacuum pack have kept well at room temperature for more than four months.

The Chairman commended the study for its successful utilization of a material formerly dumped as waste to produce fish products.

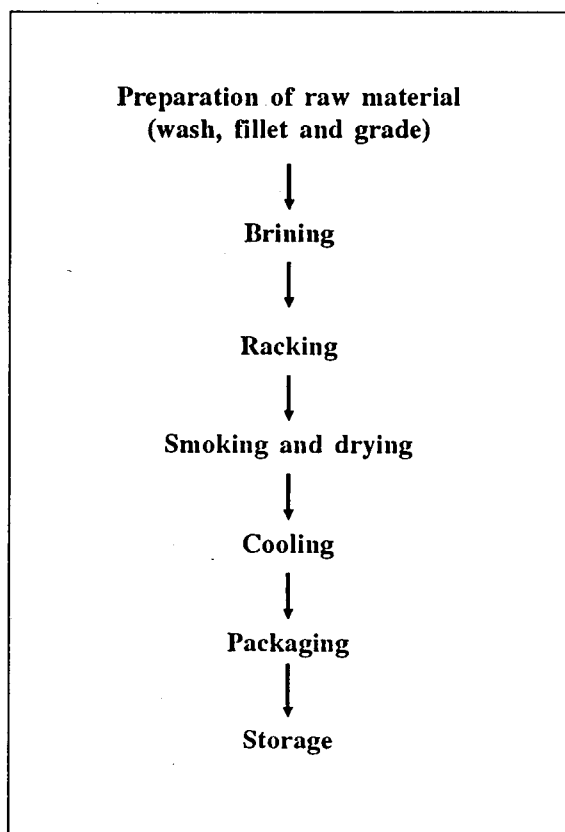


Fig. 2. Flow chart of the process