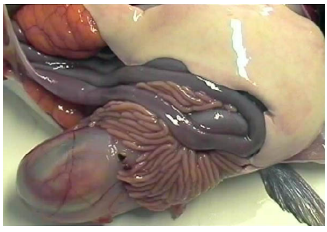
"FISHERY BY-PRODUCTS"

Increasing the use of fishery by-products for human consumption

Today, more than 90 million tons of fish and shellfish are being caught globally each year. Only about 50-60% of this catch is being used for human consumption, and 25%, i.e. approximately 20 tonnes, has been estimated by the FAO to be discarded and is therefore wasted. With the overexploitation of fisheries resources, it would be advisable to search for ways to utilise more of what is landed. This includes "waste" or by-products or what should really be called "rest raw materials".



SOURCE: EVA FALCH, SINTEF FISHERIES AND AQUACULTURE (NORWAY).

Numbers from Norway and UK estimate that most of the fish by-products are generated at processing plants on shore and used in fish meal production whereas the fishing fleet produces smaller quantities. The fleet seems to dump most of this rest raw material while the industry on shore to some extent finds use for the by-products.

In 2000, a total of 251 000 metric tons of by-products was created by the Norwegian cod fisheries alone. Of this amount, 114 000 tons were dumped while 137 000 were utilised. Only 33 000 tons of the by-products were used for human consumption which amount to about 13% of the total. The rest was used for the production of fishmeal, silage and animal feed. Some fish by-products that were used for human production include roe (canned, or as cod roe emulsion), liver (Eastern Europe), cleaned stomach and fried fish milt (as a snack).

The main objective of the **FISHERY BY-PRODUCTS** project was to **increase the utilisation of by-products from cod and carp species to produce value-added food ingredients**. The project focused on five *Gadidae* (cod) species: cod (*Gadus morhua*), saithe (*Gadus virens*), haddock (*Melanogrammus aeglefinus*), tusk (*Brosme brosme*), ling (*Molva molva*). Wild and cultured carp were also studied.

The project looked to gain a better insight in the **chemical composition and the stability** of by-product fractions, and more in particular the **protein and lipid fractions** of the viscera, liver, skin, bones and cut-offs. Cod by-products were collected from three different fishing grounds (Norway, Ireland and Iceland) and three different seasons, and carp by-products from three different seasons, so as to take into account variations in season, habitat, individual and species.

For all cod species, the highest lipid concentration was found in the liver, varying between 40 and 70%, and this was found to be higher in Norwegian than in Irish and Icelandic fish. All cod by-products, and especially the visceral fractions were found to be highly susceptible to lipid oxidation. Liver lipids were most stable. In carp products, total lipid content in the by-products appeared to vary with season, being lower in winter in most samples. Moreover, lipids were more susceptible for oxidation in the summer and spring compared to the winter.

Total protein content was highest in the cut-off fraction and lowest in the viscera and all the fractions showed variation in content with

Project acronym:
FISHERY BY-PRODUCTS

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Utilisation and stabilisation of by-products from cod species.

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"THE RESEARCH CONDUCTED IN THE FISHERY BY-PRODUCTS PROJECT HAS SHOWN THE POTENTIAL OF USING BY-PRODUCTS FOR PRODUCING VALUE-ADDED FOOD INGREDIENTS "

fishing ground, species and season. Maximum median proteolytic activity was approximately 20 times higher than in liver and 250 times higher than in cut-offs and was more affected by fishing ground than by species.

Based on the knowledge gained, the project furthermore focussed on **methods to sort and handle by-products, as well as on lipid and protein extraction and stabilisation processes**. The state-of-the-art regarding handling by-products was described. A method for automatic sorting of the by-products using imaging technology was proposed that had the potential to automatically recognize cod viscera components. Extraction of lipid and protein fractions was carried out using different methods: enzymatic, chemical and water extraction. Stabilisation of the by-products was tested using natural antioxidants and various packaging and processing methods (e.g. chilling, freezing, drying).

Finally, various potential applications were studied:

- Extracted lipids were screened for their **bioactive properties**. Although very little activity was detected, some lipids could be isolated that inhibit *Herpes simplex* replication and some that seemed to be active against the 2 microalgae associated to marine fouling .
- Project efforts were oriented towards extending the utility of fish collagen and gelatine as a substitute for mammalian gelatine and collagen **in pharmaceutical and cosmetic applications**. Protocols for the extraction of collagen from cod skin and bones were established, and later on adapted for use on carp.
- The effectiveness of collagen, tea, rosemary and chitin in the preservation of salmon steaks was studied, which led to the conclusion that there is potential to develop an edible film which incorporates the antioxidant properties of either tea or rosemary, plus the antimicrobial properties of chitin, and could be used to **extend the shelf-life of fish products**.
- Fish blood was added to black pudding mixtures (i.e. traditional Irish pork puddings) and the results of these pudding trials indicated the potential of fish blood as a **food ingredient**, although its addition to the pudding significantly increased the rate of oxidation recorded.

The research conducted in the FISHERY BY-PRODUCTS project has shown the potential of using by-products for producing value-added food ingredients and thus contributed to the sustainability of fisheries by decreasing environmental pollution while increasing the sector's profit.