Fish Meal and Fish Oil

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INDUSTRY PROFILE

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C1A 7M8
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Fax: (403) 495-4507

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T2P 3S2
Tel.: (403) 292-4575
Fax: (403) 292-4578

British Columbia

Scotia Tower
Suite 900, 650 West Georgia Street
P.O. Box 11610
VANCOUVER, British Columbia
V6B 5H8
Tel.: (604) 666-0266
Fax: (604) 666-0277

ISTC Headquarters

C.D. Howe Building
1st Floor, East Tower
235 Queen Street
OTTAWA, Ontario
K1A 0H5
Tel.: (613) 952-ISTC
Fax: (613) 957-7942

EAITC Headquarters

InfoExport
Lester B. Pearson Building
125 Sussex Drive
OTTAWA, Ontario
K1A 0G2
Tel.: (613) 993-6435
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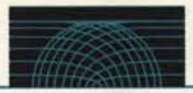

INDUSTRY PROFILE

1990–1991

FISH MEAL AND FISH OIL

FOREWORD

In a rapidly changing global trade environment, the international competitiveness of Canadian industry is the key to growth and prosperity. Promoting improved performance by Canadian firms in the global marketplace is a central element of the mandates of Industry, Science and Technology Canada and International Trade Canada. This Industry Profile is one of a series of papers in which Industry, Science and Technology Canada assesses, in a summary form, the current competitiveness of Canada's industrial sectors, taking into account technological, human resource and other critical factors. Industry, Science and Technology Canada and International Trade Canada assess the most recent changes in access to markets, including the implications of the Canada-U.S. Free Trade Agreement. Industry participants were consulted in the preparation of the profiles.

Ensuring that Canada remains prosperous over the next decade and into the next century is a challenge that affects us all. These profiles are intended to be informative and to serve as a basis for discussion of industrial prospects, strategic directions and the need for new approaches. This 1990–1991 series represents an updating and revision of the series published in 1988–1989. The Government will continue to update the series on a regular basis.

Michael H. Wilson
Minister of Industry, Science and Technology
and Minister for International Trade

Introduction

The Canadian seafood and marine products industry comprises firms engaged primarily in the processing and marketing of fish, shellfish and marine plants and animals as well as of by-products such as fish meal and fish oil. The industry may be divided geographically into east (Atlantic) coast, west (Pacific) coast and freshwater (inland) commercial fisheries. Establishments process fish taken by Canadian fish harvesters, produced by Canadian aquaculture (fish farming) operations or imported from foreign suppliers for further processing in Canada. Imported finished product is also marketed by the Canadian industry to complement its own product line.

Fish is perceived as being a healthful food. This perception is expected to sustain the growth in per-capita fish consumption since the late 1980s. Canadians in 1989 ate an estimated 7 kilograms of fish, which is low relative to the 70 kilograms of red meat and 28 kilograms of poultry consumed per capita that year, but is approximately double the world average.[1]

Canada, with the world's longest coastline and second-largest continental shelf, has important sovereign interests in three bordering oceans. In addition, some 7.5 percent of Canada's land surface is covered by fresh water, which represents 16 percent of the world's total surface area of fresh water.

The Canadian seafood and marine products industry is a major world exporter of such products. It provides hundreds of small communities with an important source of jobs and resources. The industry had a national output in 1990 worth about $3.3 billion, less than 1 percent of the gross domestic product (GDP). However, the industry's economic importance in the regions where its activities are concentrated is much greater than this value suggests. In Newfoundland, where

[1]Source: *Apparent Per Capita Food Consumption in Canada*, Parts I and II, Statistics Canada Catalogue Nos. 32-229 and 32-230, annual.

fishing and fishery processing provide the primary economic base for many communities, the industry accounts for 20 percent of the gross provincial product (GPP). The fishery processing industries in both Prince Edward Island and Nova Scotia in 1989 accounted for 16 percent of the GPP, in New Brunswick 5 percent, in British Columbia 3 percent, and in Quebec less than 1 percent. In the Northwest Territories, the northern regions of the Prairie provinces and some communities in all the coastal provinces, the commercial fishery is one of the few, and often the principal, economic activities available to many people, including some members of the Aboriginal population.

This profile is one of six that describe the fishery processing industry:

- *Seafood and Marine Products — Overview*
- *Seafood and Marine Products — East Coast*
- *Seafood and Marine Products — West Coast*
- *Seafood and Marine Products — Freshwater*
- *Fish Meal and Fish Oil*
- *Aquaculture*

Structure and Performance

Structure

The Canadian fish meal and fish oil industry consists primarily of plants operating in conjunction with fish processing facilities to convert leftover fish processing materials and, to a lesser extent, fish unfit for human consumption into meal or oil, using a wet reduction method.

Fish meal is a light-brown powdery substance and contains a high level of protein (60 to 75 percent), fat (about 8 to 10 percent), ash containing minerals such as calcium and phosphorous, and vitamins. Meal composition is largely determined by the species of fish. About three-quarters of Canadian fish meal output consists of groundfish meal produced from cod, flounder, haddock, redfish, etc., about one-fifth is higher-protein-content herring meal, and a small amount is "other aquatic meals" made from salmon, tuna or shellfish. Most fish meal is used across the country as a feed ingredient in the poultry, livestock and fish farming industries. The composition of the Canadian fish meal output is quite different from the world production, 90 percent of which is based on small pelagic species that are high in oil content such as herring, anchovies, sardines, anchovetas, menhaden, pilchard and capelin.

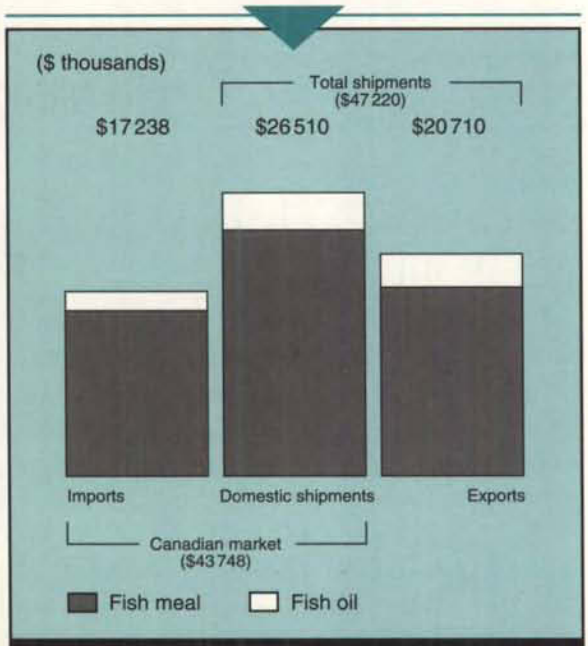

Figure 1 — Imports, Exports and Domestic Shipments, 1990

Fish oil produced by wet reduction is sometimes referred to as fish body oil in order to differentiate it from liver oil (e.g., cod liver oil) and from oils and fats rendered from the blubber of marine mammals such as seals and whales. Most fish oil is used in animal feeds or for industrial purposes. Because fish oil contains a high level of unsaturated fatty acids, the edible grade is consumed for its beneficial effect in the diet.

Canadian shipments of fish meal and fish oil in 1990 exceeded $47.2 million (Figure 1). Fish meal production is the larger of the two subsectors.

Fish meal shipments in 1990 were valued at nearly $40.6 million (68 020 tonnes). Of that amount, Canada exported 43.4 percent or $17.6 million (26 195 tonnes), primarily from east coast operations. The United States was the destination for 77 percent, while Taiwan accounted for 12 percent. Fish meal imports, mainly to the west coast, reached $15.4 million (28 153 tonnes), representing 40.2 percent of the Canadian fish meal market in 1990. Chile was the source for 78 percent of Canadian fish meal imports, the United States 21 percent, and other countries 1 percent. Fish meal imports largely are used as a feed source for the growing west coast aquaculture industry.

Shipments of fish oil in 1990 were just over $6.6 million (14 280 tonnes). Exports that year represented 46.8 percent of Canadian fish oil production, totalling $3.1 million (7 819 tonnes), and all were sent to the United States.

High-quality imports accounted for 33.9 percent of Canadian consumption, amounting to $1.8 million (5 343 tonnes). Japan provided 56 percent of fish oil imports, Norway 23 percent, and the United States 16 percent, with other countries making up the balance.

The most widely available raw materials of the Canadian fish meal and fish oil industry are the by-products of fish processing, which can include fish heads, tails, bones, trimming wastes and shells of crustaceans. Overaged and damaged fish no longer suitable for human consumption comprise a limited raw material source. A relatively large supply of fish carcasses is also available after the removal of the valuable roe (eggs), primarily from herring. A significant proportion of the discards, amounting to an estimated 300 000 tonnes per year in Canada, is not recovered for a variety of reasons, including long distances between geographically dispersed plants, high transportation costs, short seasons and the high capital investment required to set up a fish meal plant. About one-quarter of world landings are processed into fish meal and fish oil directly from the fish harvest.

The industry performs a dual task. First, it provides an environmentally acceptable outlet for the disposal of fish and fish parts that are unsuitable for human consumption and for processing wastes from filleting and canning operations. Second, it enhances the economic performance of the fishery by providing a fuller utilization of the resource.

The integrated meal plants in Canada draw most of their raw material from their own processing operations, although most fish meal producers accept offal (viscera) from other fish processors in the area. A few independent reduction plants obtain their raw material from smaller fish processors.

Canadian fish meal plants usually obtain their input materials at very low cost. However, seasonal variation of supply seriously affects the financial performance of the capital-intensive fish meal industry. Plants are not charged the harvesting costs of fish caught for a specific, higher-value utilization such as filleting or roe extraction. An opportunity cost is sometimes involved, since part of the raw material directed to reduction plants could have been separated to produce minced blocks or fish paste. The only material costs are those associated with handling and transportation, which are negligible for integrated plants. Most of the smaller fish meal plants obtain their raw material from inshore processors located within a short distance. Offal is usually delivered at no cost to a reduction facility in order to comply with environmental regulations requiring its clean disposal. When profitability permits, meal plants are willing to pay a minimal price for the raw material, which is about equal to the cost of transportation — between $20 and $40 per tonne.

The Atlantic fishery produces 80 to 85 percent of the fish meal output from about 40 fish meal plants, with the balance from three plants in British Columbia. By world standards, Canadian plants are very small. A large regional plant in Denmark or Norway, for example, through efficiency of operations, economies of scale and plant automation, may produce 50 000 tonnes of fish meal a year. In contrast, total Canadian output of 68 020 tonnes produced in 43 plants in 1990 averaged less than 1 600 tonnes per plant. The five largest Canadian fish processors account for over 60 percent of fish meal production. The industry is entirely Canadian-owned.

World production in 1990 reached nearly 6.3 million tonnes of fish meal and an estimated 1.6 million tonnes of fish oil (see Table below).

Access to high-volume, low-value raw material is critical for fish meal production. Accordingly, the largest fishing nations have achieved leading positions in the reduction industry. Japan, Chile, Peru and the Commonwealth of Independent States (CIS) are at the forefront, accounting for nearly two-thirds of world output. Even the two largest Canadian producers, Fishery Products International Limited and National Sea Products Ltd., are dwarfed by South American reduction firms such as Pescaperu in Peru and Corpesca in Chile, which sell by the boatload to some of their customers. The United States, Denmark, South Africa, Thailand, Iceland and Norway are also significant players, collectively accounting for about 25 percent of world production.

International trade in fish meal is characterized by a limited number of exporting countries serving a large number of importers, as nearly all countries use fish meal. About half the world production is traded internationally. The top 10 exporters account for over 90 percent of world exports, led by Chile, Peru, Denmark and Iceland. A few large producers such as the United States, Japan and the CIS do not rank high

World Production of Fish Meal and Fish Oil

(thousands of tonnes)

	1987	1988	1989	1990	1991
Fish meal	6 508	6 846	6 897	6 293	6 306
Fish oil	1 411	1 523	1 593	1 600[a]	N/A

[a]ISTC estimate.

N/A: not available

Sources: International Association of Fish Meal and Oil Manufacturers (United Kingdom) for fish meal data; and Food and Agriculture Organization of the United Nations, *FAO Yearbook*, for fish oil data.

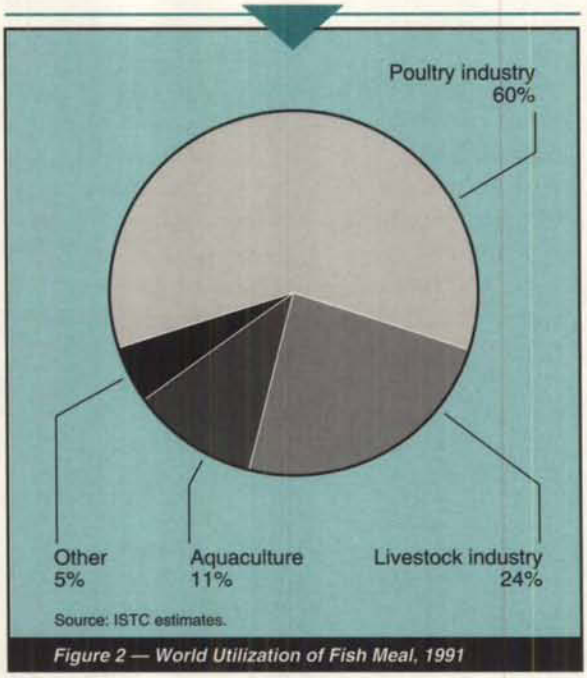

Figure 2 — World Utilization of Fish Meal, 1991

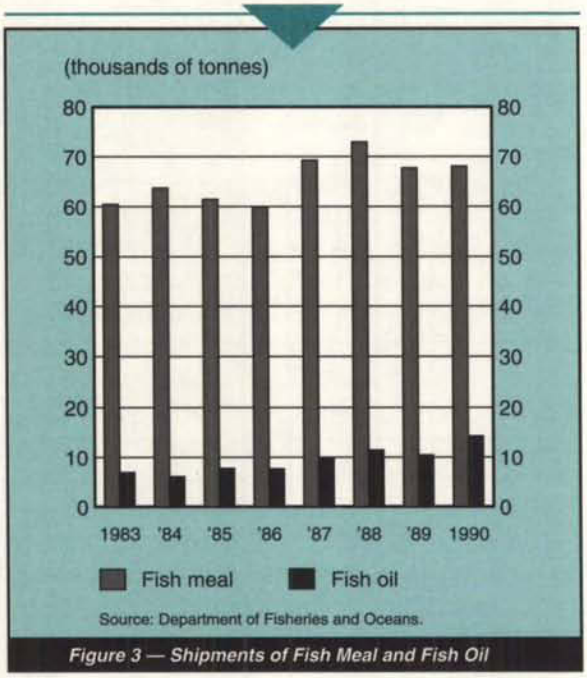

Figure 3 — Shipments of Fish Meal and Fish Oil

on the list of trading countries because domestic demand absorbs most of the output.

Canada has been a marginal player on the world stage because the raw material supply of its fish meal industry is limited. The Canadian share of global fish meal output fluctuated between 1.3 and 1.5 percent between 1978 and 1981 and declined to a steady 1 percent after 1984. The Canadian share of the world's fish oil output has been less than 1 percent.

Worldwide, the poultry industry is the largest user of fish meal, accounting for an estimated 60 percent of output in 1991 (Figure 2). This market provides a bright outlook for fish meal producers, as rising disposable incomes and a consumer preference for lighter meats favour increased poultry consumption in both developed and developing countries.

The livestock industry absorbs an estimated 24 percent of worldwide fish meal shipments. Animal feed mixes contain relatively low percentages of fish meal. It is important in the diet of weaning pigs and is used to some extent in feed for cows and sheep, providing a portion of the amino acids essential for their growth. Small quantities of fish meal are also used in the manufacture of pet foods.

Both fish meal and fish oil are critically important ingredients in feed for farmed fish. The worldwide aquaculture industry in 1991 used an estimated 11 percent of the global fish meal output. The largest-volume users were farmers of prawns, salmon, eels and trout. Groundfish meal is primarily used in eel and prawn feed, whereas salmon and trout require a meal with very high protein and low ash content, obtained from oily fish. A high percentage of fish oil is used in high-energy diets for farmed salmon.

Performance

There is limited information available on the performance of fish meal plants. Since most of the operations are integrated with fish processing, cost-of-production data and separate reports on fish meal plant profitability are not available, even for publicly owned companies. Furthermore, most processors treat their reduction facilities as a necessary auxiliary operation.

Between 1983 and 1990, Canadian fish meal production fluctuated in value between $21.9 million and $48.9 million per year. On a volume basis, however, production remained relatively stable, ranging between 59 881 and 72 926 tonnes (Figure 3).

From the limited information available, it appears that fish meal plants are generally marginal operations, except when fish meal prices move well above the long-term trend. Fish meal prices are influenced by market trends for soybeans, which command a dominant position in the protein meal market.

Fish oil shipments during the same period had a value ranging from $2.0 million to $6.7 million from production that ranged between 6 064 and 14 280 tonnes per year. Fish oil as a share of total industry shipment value ranged between 6.5 and 14 percent.

Annual Canadian fish meal imports amounted to less than $2.0 million up to 1987. Imports jumped to almost $9.0 million (13 701 tonnes) in 1988 and to $15.4 million (28 153 tonnes) in 1990 in response to the growing feed requirements of the expanding salmon farming enterprises in British Columbia, and are expected to continue this upward trend. Transportation costs prevent B.C. users from obtaining herring meal from sources in Atlantic Canada. Fish meal exports in recent years have fluctuated widely in value (from $8.3 million in 1985 to $17.6 million in 1990) but not in volume (26 448 tonnes in 1985 and 26 195 tonnes in 1990).

Fish oil imports were worth under $1.0 million until 1986. Then imports of fish oil jumped to $2.3 million (583 tonnes) in 1987, and peaked at almost $3.2 million (3 658 tonnes) in 1988. Whereas imports decreased to $1.5 million (2 104 tonnes) in 1989, they increased slightly in value to $1.8 million in 1990, while volume more than doubled to 5 343 tonnes. Exports of fish oil remained fairly constant between 1983 and 1988, ranging from about $2.9 million (5 243 tonnes) in 1986 to $3.8 million (7 927 tonnes) in 1988. There was, however, a marked decline to less than $2.5 million (6 208 tonnes) in 1989, followed by a partial recovery in value to $3.1 million and a substantial recovery in volume to 7 819 tonnes in 1990.

Strengths and Weaknesses

Structural Factors

The major factors affecting the fish meal and fish oil industry are the availability of input material, fluctuation in world prices, cost structures, equipment efficiency, and the use of fish meal in the aquaculture industry.

The highly seasonal nature of fisheries, particularly for migratory pelagics such as herring and capelin, requires reduction plants to have the capacity to handle peak volumes of input material when they are available. For this reason, year-round efficiency in the Atlantic fish meal industry has been quite low. Plant utilization is around 55 percent. Additional processing of groundfish offal can improve an establishment's capacity utilization. However, recent quota reductions in Atlantic groundfish catches will reduce the volume of offal available from processors, thus worsening the overcapacity situation for some fish meal plants.

World fish meal prices have dropped below the Canadian cost of production. Having a fairly low output, Canada is a price taker in fish meal in a market where world production has been steadily increasing. The low profitability of the Canadian fish meal industry has hindered most companies from investing in productivity improvements. Because the nature of operations involves dealing with a raw material basically considered a waste, the handling and processing practices adopted have been poor. Using low-quality raw material and in many cases old, inefficient processing equipment, some plants have difficulty meeting product quality standards.

High fixed costs and low marginal profitability have forced the temporary or permanent closure of several plants. Most of the remaining fish meal plants, established 15 to 20 years ago, are technologically outmoded. Fixed costs are largely influenced by the capital structure and administration arrangements of the fish meal facility. The two major variable processing cost items are fuel (to evaporate the 70 to 80 percent water content in fish) and labour, which together account for 45 to 50 percent of total production costs in older, inefficient plants. In modern, energy-efficient and automated factories, these key cost components could be lowered to 34 to 38 percent. Transportation is another important cost factor. Because fish offal is a highly perishable, low-value commodity, it cannot be shipped far without costly chilling or freezing. To keep transportation charges down, many fish meal plants are located in coastal communities.

The age of the plant and operating conditions also influence the efficiency of production. The yield from an older fish meal plant may amount to 12 to 14 percent of the raw material volume, compared with a 20 to 22 percent yield in a state-of-the-art facility. However, modernization of facilities, sometimes assisted by governments to alleviate environmental problems, has been sporadic and piecemeal over the past decade.

The demand for fish meal will continue to grow to meet fish farmers' needs for top-quality feed to protect their investment. Whereas fish meal constitutes a fairly low percentage of feed mixes used for early-weaning pigs and poultry (3 to 10 percent), fish feed formulations contain as much as 60 percent fish meal by weight. Considerable research is being done to evaluate lower-priced formulations of diets for fish, especially salmon. Meanwhile, because feed purchases account for the largest cost element (about 50 percent) in salmon aquaculture, a secure supply of competitively priced fish meal is of critical importance to industry viability.

Trade-Related Factors

Fish meal and fish oil generally are in constant demand. Since they have become essential ingredients of animal feed mixes, their movement across borders is basically unrestricted.

Fish meal is usually classified and priced according to its percentage of protein, and is traded as a well-defined protein commodity on a number of exchanges. Soymeal, which accounts for 60 percent of the 100 million tonnes of protein meal produced worldwide, is the key determinant of international fish meal prices. Fish meal and soybean meal, after

allowing for different levels of protein, are interchangeable in most feed formulations.

Historically, fish oil has been the more widely traded form of reduction product. Fish oil is a versatile product, and the tanning industry, paint and varnish manufacturers as well as producers of lubricants use significant volumes. During the 1980s, the international fish feed industry became an important user of fish oils. In Europe, hardened fish oils with the undesirable odours and impurities removed are used on a large scale in margarine and shortening in the Netherlands, Germany and the United Kingdom. The recently discovered health-promoting properties of omega-3 fatty acids commonly found in fish have augmented demand for fish oil in concentrated form for human consumption.

Multilateral trade negotiations under the General Agreement on Tariffs and Trade (GATT) have resulted in decreasing tariff rates on fish meal and fish oil over the years. With few exceptions, customs duties are either zero or set at a minimum rate, usually less than 5 percent of the product's value. One exception occurs in the European Community (EC), where the Common Agricultural Policy (CAP) to maintain high prices for agricultural products, such as oilseeds, grown by member states provides an incentive for feed producers to use competitively priced imported fish meal in feed mixes. The customs duty on fish meal and fish oil is low but, to keep imports in check, variable import levies can be assessed. These range between 5 and 17 percent of the import's value. EC imports of fish meal for human consumption carry a 13 percent duty and a possible 15 percent levy.

As a result of the Canada-U.S. Free Trade Agreement (FTA), which was implemented on 1 January 1989, fish meal and fish oil traded between Canada and the United States have become duty-free. Even before that date, a large proportion of imports from the United States had been entering Canada duty-free as fish solubles (cooking liquor concentrates from fish meal production).

All fish meal and fish oil enter Japan duty-free. Although Japan's very high standards can act as an indirect barrier for some countries, Canada's exports to Japan meet its standards. Fish meal and fish oil production in Japan, one of the largest fishing nations, is well over one million tonnes, which approximates the annual level of domestic consumption. Although Japan is self-sufficient in fish meal, it exports about 200 000 tonnes to Taiwan and imports a similar quantity from other countries.

On 12 August 1992, Canada, Mexico and the United States completed the negotiation of a North American Free Trade Agreement (NAFTA). The Agreement, when ratified by each country, will come into force on 1 January 1994. The NAFTA will phase out tariffs on virtually all Canadian exports to Mexico over 10 years, with a small number being eliminated over 15 years. The NAFTA will also eliminate most Mexican import licensing requirements and open up major government procurement opportunities in Mexico. It will also streamline customs procedures, and make them more certain and less subject to unilateral interpretation. Further, it will liberalize Mexico's investment policies, thus providing opportunities for Canadian investors.

Additional clauses in the NAFTA will liberalize trade in a number of areas including land transportation and other service sectors. The NAFTA is the first trade agreement to contain provisions for the protection of intellectual property rights. The NAFTA also clarifies North American content rules and obliges U.S. and Canadian energy regulators to avoid disruption of contractual arrangements. It improves dispute settlement mechanisms contained in the FTA and reduces the scope for using standards as barriers to trade. The NAFTA extends Canada's duty drawback provisions for two years, beyond the elimination provided for in the FTA, to 1996 and then replaces duty drawback with a permanent duty refund system.

Technological Factors

Nearly all world-class fish meal plants use the traditional reduction process. Although the basic technology used in the reduction industry is well established, there is no "best" method of manufacturing fish meal. Selection of the most appropriate technology depends on a number of factors such as the available species, capacity, energy costs and other economic considerations, environmental considerations and final product specifications.

A large number of Canadian plants are old, operate at relatively low overall efficiency and have low outputs. Moreover, about half of the plants in the Atlantic provinces produce meal at high temperatures, which causes some protein degradation in the final product.

The nutritional value of fish meal can be significantly improved using lower temperatures and shorter drying times. Production of low-temperature (LT) fish meal requires expert process control and improved drying methods. Stringent control of hygiene is also necessary to guarantee microbiological safety of the final product. In Canada, LT meal production is in its infancy. A variety of modern equipment from suppliers in Norway and Denmark is readily available, and the added expense associated with higher equipment costs is recoverable because LT meal is in great demand at a premium price by aquaculture and fur-bearing animal farms. According to some industry sources, high-quality fish meal comparable with the LT product can be produced on conventional equipment. The difficulty is that the raw material must be fresh and the

process must be rigidly controlled by skilled operators, who may not be readily available or affordable for many plants.

The global expansion of distant-water fishing and fish processing aboard factory freezer trawlers has brought about increased installation of on-board fish meal plants. Introduced in the late 1950s, compact reduction units of flexible design have improved catch utilization and have reduced the operating costs of factory trawlers by using fish oil as fuel. Although space limitations usually preclude use of evaporation equipment that would result in higher yields, high fish meal prices have created a strong interest in offshore production. To date, a few hundred vessels (including several in Alaska and one in Canada) have acquired on-board fish meal plants. In addition to providing a use for offal and fish that are not part of the main catch, these fish meal plants reduce protein waste and marine pollution.

During the past few years, significant technological changes have been taking place in cooking, drying, pollution abatement and process control of fish meal and fish oil. Improvements in energy efficiency, labour utilization, hygiene and product quality are the main objectives of recent engineering innovations. Protection of the environment and automation have also been assuming greater importance in the fish meal industry.

Other Factors

International bodies are concerned about the large-scale use of fish for animal feed instead of human food. As well, several countries heavily involved in fish meal production and exports have large populations in need of affordable protein diets. In some countries, aquaculture feed requirements are in direct competition with human nutritional needs. These conflicting interests could exert significant influence on the long-term policy for fish utilization.

The current level of exploitation of small pelagics is probably close to its limit. Fish meal produced from these oily species is the richest in protein and is therefore in increasing demand by the salmonid aquaculture industry. As world aquaculture production expands, its fish meal requirements will also rise and could absorb well over one million tonnes by the end of the 1990s. Without increased fish meal supplies, aquaculture will have to compete for feed with the poultry and hog industries, although these prime users could substitute vegetable protein meals for fish meal. Any decrease in supply or increase in demand could drive up fish meal prices. As feed constitutes the largest element of aquaculture production costs, such a development could jeopardize the economic viability of salmon farming. Feed manufacturers in British Columbia have already been experiencing shortages in the local supply of high-protein meal, which has led them to search for increasing volumes of competitively priced anchovy meal from South America. Less than fully utilized Canadian pelagic resources, such as capelin and mackerel, might be used in the future to alleviate fish meal supply constraints on the Atlantic coast. However, regulations under the *Fisheries Act* currently prohibit the use of fish suitable for human consumption for reduction purposes.

The wet reduction process gives off offensive odours, which makes it nearly impossible to establish new fish meal plants in populated areas. The equipment to protect environmental integrity is costly and is as yet virtually unused in Canada. In the handful of plants established or upgraded during the 1980s, acquisition of used equipment was common. With increasing concern for product quality and the environment, fish meal plants will probably be forced to upgrade raw material handling practices and to adopt modern technology in both manufacturing and pollution control.

Evolving Environment

The domestic fish meal and fish oil industry has been largely production-driven and, with a few exceptions, producers have been paying limited attention to the market, customer's needs, innovation and even, in some cases, to product quality. However, improved profitability of fish processors from 1986 to 1988, strong fish meal markets, environmental regulations and the special demand from the aquaculture industry have led to renewed interest in fuller by-product utilization. There is encouraging evidence that the industry is becoming more aware of changing market conditions and of the need to keep in step with international developments in technology and product diversification.

The emergence of large-scale fish farming has provided new impetus to scientific interest in the nutritional composition and properties, such as digestibility, of fish meal. Because salmon feeds contain up to 60 percent fish meal by weight, research is being done to evaluate lower-priced diet formulations. The main objective is to improve feed conversion ratios. Fish feed producers accept only top-quality fish meal, so fish meal producers will be increasingly required to guarantee the quality and consistency of the final product.

Growing interest in by-product utilization and value-added products also has encouraged research. Although Canadian involvement in these efforts has been modest to date, there is a growing awareness in Canada of the need to improve seafood utilization through various methods, including the extraction of special substances such as chitin, insulin, glue or pearl essence. Fish protein concentrate (FPC), a high-quality meal produced under hygienic conditions and fit for human

consumption (mainly to supplement the protein needs of developing countries), is another area for research. A number of initiatives also address the issue of a more economic utilization of waste or "secondary raw material" through composting, silage and hydrolyzed fish products.

Competitiveness Assessment

Demand for fish meal is expected to remain buoyant. Developing countries lacking coastal resources will require increasing quantities of animal protein to feed their populations and therefore will turn to fish meal for their expanding livestock and poultry industries. Aquaculture feed requirements are expected to continue to provide strong demand. In this respect, there are opportunities for Canadian plants to develop ties with the CIS, China and South America. Long-term contracts, joint ventures, technical co-operation, technology transfer and acquisition of facilities are possible initiatives.

The outlook for fish oil, with the possible exception of herring oil, is less optimistic. Although the traditional industrial users will probably continue to absorb available quantities, markets could remain relatively depressed by the huge world supplies of vegetable oils. In the United States, demand for fish oil would get a significant boost if its use in margarine were allowed. Recently, menhaden fish oil has been accorded "GRAS" (generally recognized as safe) status by the U.S. Food and Drug Administration, which is an interim step in the final approval process.

Although these developments are propelling the fish meal industry on a more dynamic course, its traditional structure is not expected to change significantly over the medium term. Falling stocks of groundfish and the less-than-satisfactory financial performance of the industry could adversely impact on investment decisions. Construction of a few modern facilities is still expected, as well as modernization of several fish meal plants, particularly those owned by profitable firms. First in line for new investment will be companies with a direct interest in fish farming. Stricter environmental regulations will inevitably necessitate investment in pollution abatement equipment. However, the need to retain existing facilities for the disposal of offal could ensure the short-term survival of smaller plants in remote areas.

Large facilities will have to adopt modern technology if they wish to remain competitive. World-class reduction industries need adequate revenues to cover the costs of harvesting and processing the fish and also to generate acceptable returns on the capital invested in vessels and meal plants. Research and development will have to play an increasing role in preserving the quality of raw materials and in improving the energy efficiency of fish meal plants.

Improved material handling and operating practices could enhance productivity, lower processing costs and reduce energy and labour requirements. Pollution control and quality of raw material can, in some cases, require attention. In planning the modernization of their plants, a few companies have taken advantage of the Technology Inflow Program (TIP) of External Affairs and International Trade Canada and have visited equipment manufacturers and meal plants in Scandinavia with a view to exploring technology transfer opportunities.

Because of increasing competitive pressures from major exporting countries, where trade is handled by central marketing organizations, and with the duty-free movement of fish meal between Canada and the United States, domestic producers have to become more efficient in production and more innovative in marketing. Opportunities for product diversification and better profitability include the production of LT meal for aquaculture, oils for the pharmaceuticals industry, joint ventures with feed manufacturers and co-operative arrangements with offshore producers and users. The monitoring of industry marketing trends and technology developments could be significantly enhanced through much broader Canadian participation in the work of the International Association of Fish Meal and Oil Manufacturers (IAFOM) based in the United Kingdom.

For further information concerning the subject matter contained in this profile or on the initiative listed on page 13, contact

Food Products Branch
Industry, Science and Technology Canada
Attention: Fish Meal and Fish Oil
235 Queen Street
OTTAWA, Ontario
K1A 0H5
Tel.: (613) 941-4263
Fax: (613) 941-3776

PRINCIPAL STATISTICS[a]

	1983	1984	1985	1986	1987	1988	1989	1990
Fish meal								
Shipments								
($ thousands)	29 402	27 738	21 889	22 181	32 613	48 843	45 913	40 570
(tonnes)	60 429	63 699	61 408	59 881	69 257	72 926	67 673	68 020
Fish oil								
Shipments								
($ thousands)	2 039	2 457	3 525	3 240	3 986	5 422	4 921	6 650
(tonnes)	6 900	6 064	7 728	7 630	9 786	11 437	10 431	14 280

[a]Data for 1983 and 1984 are provided by the Department of Fisheries and Oceans (DFO), *Canadian Fisheries Annual Statistical Review*; data for 1985 to 1990 are taken from DFO's *Canadian Fisheries Statistical Highlights*.

TRADE STATISTICS

	1983	1984	1985	1986	1987	1988[a]	1989[a]	1990[a]
Fish meal								
Exports[b]								
($ thousands)	12 052	11 687	8 287	9 276	13 677	15 064	11 241	17 600
(tonnes)	24 817	21 703	26 448	20 007	23 394	19 622	14 343	26 195
Domestic shipments								
($ thousands)	17 350	16 051	13 602	12 905	18 936	33 779	34 672	22 970
(tonnes)	35 612	41 996	34 960	39 874	45 863	53 304	53 330	41 825
Imports[b]								
($ thousands)	1 499	1 745	193	1 323	1 941	8 951	13 357	15 421
(tonnes)	6 061	5 570	742	2 994	4 334	13 701	17 706	28 153
Canadian market								
($ thousands)	18 849	17 796	13 795	14 228	20 877	42 730	48 029	38 391
(tonnes)	41 673	47 566	35 702	42 868	50 197	67 005	71 036	69 978
Exports (% of shipments value)	41.0	42.1	37.9	41.8	41.9	30.8	24.5	43.4
Imports (% of Canadian market value)	8.0	9.8	1.4	9.3	9.3	20.9	27.8	40.2
Fish oil								
Exports[b]								
($ thousands)	3 523	3 283	3 544	2 875	3 147	3 777	2 459	3 110
(tonnes)	7 454	6 242	6 236	5 243	6 958	7 927	6 208	7 819
Domestic shipments								
($ thousands)	–[c]	–[c]	–[c]	365	839	1 645	2 462	3 540
(tonnes)	–[c]	–[c]	–[c]	2 387	2 828	3 510	4 223	6 461
Imports[b]								
($ thousands)	660	564	620	880	2 308	3 186	1 551	1 817
(tonnes)	750	272	359	468	583	3 658	2 104	5 343
Canadian market								
($ thousands)	–[c]	–[c]	–[c]	1 245	3 147	4 831	4 013	5 357
(tonnes)	–[c]	–[c]	–[c]	2 855	3 411	7 168	6 327	11 804
Exports (% of shipments value)	–[c]	–[c]	–[c]	88.7	79.0	69.7	50.0	46.8
Imports (% of Canadian market value)	–[c]	–[c]	–[c]	70.7	73.3	65.9	38.6	33.9

[a]It is important to note that data for 1988 and after are based on the Harmonized Commodity Description and Coding System (HS). Prior to 1988, the shipments, exports and imports data were classified using the Industrial Commodity Classification (ICC), the Export Commodity Classification (XCC) and the Canadian International Trade Classification (CITC), respectively. Although the data are shown as a continuous historical series, users are reminded that HS and previous classifications are not fully compatible. Therefore, changes in the levels for 1988 and after reflect not only changes in shipment, export and import trends, but also changes in the classification systems. It is impossible to assess with any degree of precision the respective contribution of each of these two factors to the total reported changes in these levels.

[b]Data for 1983 and 1984 are provided by DFO's *Canadian Fisheries Annual Statistical Review;* data for 1985 to 1990 are taken from DFO's *Canadian Fisheries Statistical Highlights*, as supplied by Statistics Canada, International Trade Division.

[c]Negative values arise from the calculation of "Domestic shipments" and "Canadian market" for fish oil for one or both of the following reasons: valuation of exports differs from that of shipments, which exclude transportation costs; and shipments represent inventory reduction in the period under review. Consequently, it is not possible to calculate a meaningful figures for "Exports (% of shipments value)" or for "Imports (% of Canadian market value)."

SOURCES OF IMPORTS[a] (% of total value)

	1983	1984	1985	1986	1987	1988[b]	1989[b]	1990[b]
Fish meal								
United States	99	33	100	54	65	50	17	21
Chile	–	66	–	46	–	44	77	78
Other	1	1	–	–	35	6	6	1
Fish oil								
United States	31	2	1	31	36	28	14	16
United Kingdom	17	25	19	–	–	–	N/A	N/A
Norway	10	29	14	25	30	27	38	23
Japan	–	–	–	13	–	23	37	56
Other	42	44	66	31	34	22	N/A	N/A

[a]Data for 1983 and 1984 are provided by DFO's *Canadian Fisheries Annual Statistical Review;* data for 1985 to 1990 are taken from DFO's *Canadian Fisheries Statistical Highlights*, as supplied by Statistics Canada, International Trade Division.

[b]Although the data are shown as a continuous historical series, users are reminded that HS and previous classifications are not fully compatible. Therefore, changes in the levels for 1988 and after reflect not only changes in import trends, but also changes in the classification systems.

N/A: not available

DESTINATIONS OF EXPORTS[a] (% of total value)

	1983	1984	1985	1986	1987	1988[b]	1989[b]	1990[b]
Fish meal								
United States	55	58	76	71	68	56	64	77
United Kingdom	29	17	8	–	–	–	N/A	N/A
Taiwan	6	18	12	16	–	17	2	12
Japan	–	–	–	–	–	14	N/A	N/A
Other	10	7	4	13	32	13	N/A	N/A
Fish oil								
United States	73	86	87	98	85	75	95	100
Norway	–	–	–	–	–	11	N/A	–
Other	27	14	13	2	15	14	N/A	–

[a]Data for 1983 and 1984 are provided by DFO's *Canadian Fisheries Annual Statistical Review;* data for 1985 to 1990 are taken from DFO's *Canadian Fisheries Statistical Highlights*, as supplied by Statistics Canada, International Trade Division.

[b]Although the data are shown as a continuous historical series, users are reminded that HS and previous classifications are not fully compatible. Therefore, changes in the levels for 1988 and after reflect not only changes in export trends, but also changes in the classification systems.

N/A: not available

MAJOR FIRMS

Name	Country of ownership	Location of major plants
British Columbia Packers Ltd.	Canada	Richmond, British Columbia
Comeau's Sea Foods Limited	Canada	Saulnierville, Nova Scotia
Connors Bros., Limited	Canada	Blacks Harbour, New Brunswick Isle aux Morts, Newfoundland
Fishery Products International Limited	Canada	Burin, Newfoundland Catalina, Newfoundland Harbour Breton, Newfoundland Marystown, Newfoundland St. Anthony, Newfoundland
National Sea Products Ltd.	Canada	Lunenburg, Nova Scotia La Scie, Newfoundland
West Coast Reduction Ltd.	Canada	Vancouver, British Columbia

INDUSTRY ASSOCIATIONS

Fisheries Council of British Columbia
Suite 706, 1155 Robson Street
VANCOUVER, British Columbia
V6E 1B5
Tel.: (604) 684-6454
Fax: (604) 684-5109

Fisheries Council of Canada
Suite 806, 141 Laurier Avenue West
OTTAWA, Ontario
K1P 5J3
Tel.: (613) 238-7751
Fax: (613) 238-3542

SECTORAL STUDIES AND INITIATIVES

For further information on the following initiative, contact Industry, Science and Technology Canada (see address on page 8).

Seafood and Marine Products Sector Campaign
In 1990, Industry, Science and Technology Canada (ISTC) launched a Seafood and Marine Products Sector Campaign. Sector campaigns are initiatives by ISTC conducted jointly with the private sector, other levels of government and other federal departments to improve the long-run international competitiveness of industry sectors. The Seafood and Marine Products Sector Campaign contains initiatives related to the development of markets, technology, aquaculture and human resources.

For copies of the studies and VHS videotapes prepared under this Campaign, contact

Food Products Branch
Industry, Science and Technology Canada
Attention: Seafood and Marine Products Directorate
235 Queen Street
OTTAWA, Ontario
K1A 0H5
Tel.: (613) 954-2926
Fax: (613) 941-3776

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