

***U.S. MARKET PROSPECTS FOR
ALASKA POLLOCK LIVER OIL***

A Fishery Development Project by Eagle Fisheries, Inc. And Alaska Fisheries Development Foundation

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OCTOBER, 1988

INTRODUCTION

Even before there was a scientific understanding of the important effects of its Vitamin constituents, cod liver oil was a part of traditional preventive medicine. Ironically, increased technical understanding pushed cod liver oil into its market decline, as synthetic sources of Vitamins A and D became available. Then came the escalation of the fishery for Alaska pollock, a close cousin of the cod. As it happened, the prosecution of this fishery from land-based plants in Alaska, with its attendant waste disposal problems, coincided with the release of clinical studies suggesting that fish oil might be useful in the prevention and treatment of heart disease. This naturally led to a revived interest in the recovery of oil, including pollock liver oil, from processing wastes.

The project described here was initiated by Eagle Fisheries, Inc., a newcomer to the seafood processing business whose parent company had been long established in the marine transportation industry. Reed Wasson, founder of Eagle Fisheries, knew that waste utilization and disposal would play a major role in the long-term profitability of his groundfish processing operations on the island of Kodiak, Alaska. To evaluate the feasibility of recovering oil, a pilot scale rendering system was installed in the plant and quantities of both cod and pollock liver oil produced. Market opportunity, the other side of the commercial feasibility equation, is the subject of this report.

THE MARKET RESEARCH PLAN

The purpose of this project was to investigate the domestic market potential for Alaskan pollock liver oil. While experimental production of oil was being done at Eagle Fisheries' plant in Kodiak, preliminary market research was undertaken, to identify companies that might have interest in the oil. A brief questionnaire was sent to thirty such companies, and seven responses were received. Complete chemical analyses were performed on samples of the experimentally produced oil, so we would be able to provide specifications with samples. Samples were requested by four companies. Discussions with these prospective customers, together with further market investigations, enabled us to draw the conclusions presented in this paper.

DOMESTIC MARKETS FOR POLLOCK LIVER OIL

It was mentioned earlier that part of the impetus for this project was a recently heightened interest in fish oil from the medical community. The clinical studies that provoked this enthusiasm were not based on fish liver oil, but rather on fish body oil or seafood consumption. It is important to understand that in a marketing context, fish liver oil and fish body oils are perceived as very different from one another. Liver oil is marketed as a natural source of Vitamins A and D, while fish body oil, only recently introduced in the U.S., is perceived as a source of omega-3 fatty acids. Of course, body oils contain some vitamins and liver oils contain omega-3 fatty acids, but the difference in market perceptions persists, and has a strong influence in shaping attitudes toward pollock liver oil.

There is no existing market in the U.S. for Alaska pollock liver oil. This is not to say that pollock liver oil is not bought and sold in the U.S., but rather to emphasize that it has no product identity. Therefore, for purposes of this project, it was necessary to consider three different market strategies, each with its own set of constraints and conditions. Pollock liver oil could be marketed as (1) a vitamin supplement, (2) a source of omega-3 fatty acids, or (3) as a new product with unique benefits. Even if the third route is chosen, a basic understanding of the two existing markets is necessary, because they constitute the frames of reference used to evaluate new products.

The Vitamin Supplement Market

The standard product of the market for fish oil as a natural vitamin supplement, cod liver oil, is sold in liquid or capsule forms, mostly in health food stores or in the natural foods sections of supermarkets. The fact that much of the supply comes from Japan suggests that some of this product is actually pollock liver oil, or pollock liver oil spiked with Vitamin A. There is apparently no domestic supply.

A reliable estimate of the amount of cod liver oil sold in the U.S. is difficult to come by, primarily because Customs classification codes are not sufficiently detailed to isolate cod liver oil from other fish oils. Also it is likely that quantities of cod liver oil are imported as finished products and do not show up as "fishery products" in NMFS/Dept. of Commerce data. Further confusion results from the fact that pollock liver oil is not specifically assigned to any particular classification, and is undoubtedly being imported under several different categories. Finally, it is not possible to estimate what portion of the imported oil goes

into vitamin supplement products. Our "wild guess" for the size of the U.S. cod liver oil market (as vitamin supplements for human consumption) is 10,000 metric tons.

The wholesale price for refined cod liver oil in bulk can range from \$6 to \$10 per gallon (\$1.70 to \$2.85 per kilogram), making this market worth a total of perhaps \$25 million at the producer/refiner level. Retail prices for cod liver oil in health food stores and supermarkets are typically equivalent to \$12 to \$15 per kilogram for bottled liquid, or about \$2.50 to \$4.00 for a bottle of 100 capsules, which translates to \$25 to \$40 per kilogram. Wholesalers can purchase cod liver oil capsules in bulk from encapsulators for the equivalent of about \$9 to \$15/kg. Encapsulated fish liver oils with higher potencies of Vitamins A and D cost \$20 to \$30/kg at wholesale.

In order to be suitable for the vitamin supplement market, a fish liver oil must of course contain standardized amounts of vitamins A and D. The most common "cod liver oil" product is a 12-ounce amber glass bottle of refined oil, while the most common product form for "Vitamins A & D" is a 500-mg or 1000-mg soft gelatin capsule, containing 10,000 I.U. (International Units) Vitamin A and 400 I.U. Vitamin D. Cod liver oil in capsule form usually contains 1250 or 2500 I.U. Vitamin A per gram. Natural products of higher vitamin potency, referred to above, are probably prepared from liver oils of other species. In addition to a specified vitamin content, the refined oil must meet a set of requirements for purity and quality.

The Omega-3 Market

Two particular fatty acids found in many fish oils are now believed to have important positive effects on human cardiovascular health. These two fatty acids, EPA and DHA, are representatives of a category called "omega-3" fatty acids, and are found only in the lipids of aquatic organisms, and never in vegetable oils.

The omega-3 fish oil market was pioneered by a British company, Seven Seas Health Care, Ltd., with a product trademarked "MaxEPA." The original product was basically a refined fish oil, from a mixed bag of North Atlantic fish species, packed in 1000 mg (1 gram) soft gelatin capsules, with a standardized content of 180 mg EPA and 120 mg DHA per capsule. In addition to EPA and DHA content, a source oil for this market would also have to meet the same quality and purity standards as those in the vitamin supplement market.

When this project was begun, the U.S. market for omega-3 fatty acids, often dubbed "fish oil capsules," was booming. Retail sales had gone from \$3 million to about \$20 million in less than three years, and analysts were predicting a \$200 million market by 1990. In 1987, Americans popped at least 200 million omega-3 capsules, which required the import of about 200 metric tons of refined oil, at wholesale prices of \$600 to \$750 per metric ton.

Until 1986, most of the oil in omega-3 capsules came from one source in England, and until 1987, most of the companies marketing fish oil capsules at retail were relatively small. In our opinion, it was the diversification of the market and the entrance of two major pharmaceutical companies in 1987 that led ultimately to a collapse of the boom. The larger companies invested in national advertising campaigns, the nature of which caused the FDA to wonder whether the omega-3 fish oils ought to be regulated as drugs, and the diversity of suppliers allowed the agency to adopt a conservative policy without appearing to be singling out one company or one exporting country.

Early in 1988, the FDA sent warning letters to a number of marketers of omega-3 fish oil capsules explaining that the health claims being made on many labels would cause the agency to categorize the products as drugs, meaning that a long, expensive testing and approval process would be necessary for such products. There were even some indications that the FDA would halt the marketing of all omega-3 products. Although the agency's action affected only a few products directly, the entire market suffered a significant decline. There are no published estimates of current market size or value.

POLLOCK LIVER OIL -- THE PRODUCT

To assess the marketability of Alaskan pollock liver oil, it was first necessary to analyze it chemically. The results of those analyses are shown in Figures 1 and 2. The data in Figures 3 and 4 are provided for purposes of comparison.

The values in Figure 1 indicate the overall quality of the oil and its suitability for the vitamin supplement market. The data indicate significant variation from one batch to the next, which presents a serious marketing problem in itself. Without further study it is impossible to tell whether the variation originates in the raw material (livers) or is introduced by the processing regime.

FIGURE 1. CHEMICAL ANALYSES OF POLLOCK LIVER OIL

ANALYSES PERFORMED BY BIOMED, INC., SEATTLE, WASHINGTON
(except cholesterol, by NATIONAL MARINE FISHERIES SERVICE)

SAMPLE #	1	2	3	4
Water %	0.20	0.12	0.31	0.60
Protein %	0.13	<0.02	<0.02	<0.02
Iodine Value	137	134	166	148
Saponification Value	172	171	171	168
Free Fatty Acids %	0.8	0.6	7.0	7.2
Peroxide Value	8.0	11.4	5.2	5.6
Vitamin A I.U./gm	230	340	850	930
Vitamin D I.U./gm	280	180	110	< 40
Vitamin E I.U./gm	6.6	20	22	36
Cholesterol mg/100 gm	N.A.	419	433	430
Color (photometric)	16.9	1.0	12.8	25.9

FIGURE 2. FATTY ACID COMPOSITION OF POLLOCK LIVER OIL

ANALYSES PERFORMED BY NATIONAL MARINE FISHERIES SERVICE,
 UTILIZATION RESEARCH DIVISION, NORTHWEST & ALASKA
 FISHERIES CENTER, SEATTLE, WASHINGTON

FATTY ACID	SAMPLE NUMBER				
	1	2	3	4	5
14:0	3.8	3.8	4.6	4.2	4.8
16:0	13.1	13.1	13.5	13.7	17.5
16:1w7	7.3	7.2	6.7	6.7	7.2
18:0	2.7	2.8	2.1	2.3	3.0
18:1w9*	26.5	25.6	15.4	18.1	17.2
18:1w7	7.7	7.6	5.5	6.3	7.2
18:2w6	0.7	0.7	1.0	0.9	0.8
18:3w3	0.4	0.4	0.7	0.6	0.4
18:4w3	1.1	1.2	2.5	2.0	1.4
20:1w11	6.0	6.1	7.1	6.6	2.8
20:1w9	3.1	3.2	3.0	2.9	1.4
20:2w6	0.2	0.2	0.2	0.2	0.2
20:4w6	0.3	0.3	0.3	0.3	0.3
20:4w3	0.3	0.3	0.4	0.4	0.4
20:5w3 (EPA)	8.6	8.9	9.9	9.3	18.0
22:1w11	4.2	4.3	9.6	7.9	3.5
22:1w9	0.6	0.7	1.1	0.9	0.5
21:5w3	0.4	0.5	0.5	0.5	0.7
22:5w3	1.0	1.0	1.0	1.0	0.6
22:6w3 (DHA)	5.8	6.0	6.8	6.7	5.4
24:1w9	0.3	0.4	0.6	0.5	0.2
% ACC'TD FOR	94.1	94.3	92.5	92.0	93.5
* includes w-11 isomer also					

%					
SATURATED	19.6	19.7	20.2	20.2	25.3
EPA+DHA	14.4	14.9	16.7	16.0	23.4
OMEGA-3	17.6	18.3	21.8	20.5	26.9
OMEGA-6	1.2	1.2	1.5	1.4	1.3
W-7,9,11	55.7	55.1	49.0	49.9	40.0
W-6/W-3	0.068	0.066	0.069	0.068	0.048

FIGURE 3. CHARACTERISTICS FOR SOME EUROPEAN LIVER OILS
REPORTED IN 1949

OIL	IODINE VALUE	SAPON. VALUE	VITAMIN A I.U./gm	VITAMIN D I.U./gm
Cod Liver	160-175	182-187	800-1,500	60-120
Saithe liver	160-175	182-188	800-2,500	80-200
Ling Liver	135-160	180-185	2,000-5,000	100-200
Haddock liver	160-180	184-190	800-1,200	50-100
Dogfish liver	110-145	150-165	1,000-2,000	10-30
Porbeagle liver	170-190	178-185	1,000-1,500	50-100
Halibut liver	150-165	165-175	20,000-200,000	1,000-2,000

FIGURE 4. FATTY ACID DISTRIBUTIONS FOR COD LIVER OIL
FROM VARIOUS SOURCES REPORTED 1962-1964

FATTY ACID	WEIGHT %, SAMPLE #				
	1	2	3	4	5
14:0	--	2.8	2.9	2.8	3.5
15:0	tr.	0.3	--	0.4	0.5
16:0	12.0	11.6	14.6	10.7	10.4
16:1	5.0	8.6	6.2	6.9	12.2
17:0	1.0	0.3	--	1.2	0.1
18:0	3.0	2.7	3.5	3.7	1.2
18:1	24.0	25.2	39.0	23.9	19.6
18:2	1.0	2.5	1.7	1.5	0.8
18:3	1.0	0.7	0.3	0.9	0.2
18:4	1.0	2.2	--	2.6	0.7
20:1	9.0	13.1	9.1	8.8	14.6
20:4	1.0	--	2.1	1.0	1.7
20:5	8.0	9.3	2.6	6.0	5.0
22:1	5.0	6.3	4.6	5.3	13.3
22:5	1.0	1.0	1.5	1.3	2.0
22:6	19.0	8.6	9.7	14.3	10.5

Figures 3 and 4
Extracted from: Bailey's Industrial Oil and Fat Products,
Fourth Edition, ed. D. Swern, 1979, v.1 p.452

The four samples of Alaskan pollock liver oil shown in Figure 1 were all produced during a short period of time in the spring of 1987, at the beginning of the spawning season. As the fish prepares for spawning, its physiology and chemical composition changes rapidly, and this may account for the variation between samples. The spawning condition of the fish might also be related to the oxidative stability of the oil, and to its vitamin potency, but again it must be emphasized that the data are not sufficient to support or refute these theories.

None of the samples described in Figure 1 represents a product that is particularly attractive for the vitamin supplement market. The main reason for this is that the Vitamin A content is lower than the market standard. This could be turned into a positive point, for those concerned about Vitamin A toxicity, but the product could not command a price as high as that of the standard potency, and its market would be more limited.

In all four of the samples, there appear to be problems with the oil becoming oxidized. In samples 1 and 2, the peroxide value is too high, and in samples 3 and 4, the free fatty acid level is too great (and peroxide values marginal).

Quality parameters such as oxidation, color, and purity play a "first tier" role in determining the marketability of an oil, but they can be controlled and improved by the processor, using relatively simple technology. In contrast, the fatty acid profile of the oil (shown in Figure 2 for five samples) is a natural characteristic, and can not be easily or predictably manipulated during processing.

For the omega-3 market, it is primarily the amount of EPA (eicosapentaenoic acid) in the oil that determines its value. The amount of DHA (docosahexaenoic acid) is less important, but frequently the market requires a combined EPA + DHA level of 30 per cent. Many of the companies marketing omega-3 capsules feel it is necessary to match the label claim of the trademarked MaxEPA product (18% EPA, 12% DHA) in order to be competitive.

As the data in Figure 2 indicate, none of the samples of pollock liver oil analysed for this project achieves a total EPA + DHA level of 30 per cent. However, the fatty acid profile of sample 5, an oil rendered from the livers of non-spawning pollock, shows there can be tremendous seasonal variation in omega-3 content. At least during part of the year, Alaska pollock liver oil can be expected to contain more than 15% EPA and more than 5% DHA. The total omega-3 level in this product would be about the same as salmon oil, but with a higher EPA content. Salmon oil holds a small

share of the omega-3 market in the U.S.; typically it is Atlantic salmon oil from Norway, purchased by encapsulators at about \$2.50 per kilogram.

Responses from the four companies who received samples of pollock liver oil were illuminating but not enthusiastic. All of the respondents felt that the oil would need to be refined and standardized before they would be able to use it in their products. Even in the refined state, they believed the pollock oil would be relegated to the lower end of the price spectrum, because both its vitamin potency and its omega-3 content are on the lower end of the market's acceptable range.

CONCLUSION: PRODUCT DEVELOPMENT AND MARKETING STRATEGY

Two major factors make the marketing of pollock liver oil for edible uses in the U.S. very problematical. First, the product does not fit the standards of any existing market concept. Instead it is a hybrid between two products, cod liver oil and omega-3 fish oil. The hybrid is apparently not as good a vitamin source as cod liver oil, and not as good an omega-3 source as MaxEPA(TM) or sardine oil from Japan.

Another major difficulty is that pollock liver oil has no identity in the market, and therefore an extensive customer education campaign is necessary. Before committing to such a campaign, one would want to identify a target market that could produce enough profit to repay its costs.

It is also clear from the results of this study that, under present market conditions, the cost of refining must be borne by the producer of pollock liver oil. This is partly because the companies that sell fish oil are generally inexperienced with its processing, and accustomed to purchasing refined oil. At the beginning of this project, it was hoped that with very fresh raw material, pollock liver oil could be made that was high enough quality to be sold without further refining. However, even if it were possible to preserve the oil's quality during primary processing, refining is still necessary to achieve consistent specifications in the finished product. The processor could also use the refining stage as an opportunity to add value to the oil by chemical processing or enrichment, to suit a particular application or customer.

APPENDICES:

Examples of promotional materials for
omega-3 fish oils and cod liver oil.

WHY are Eskimos
Virtually **FREE** of Coronary Heart
Disease?

Yet it's the **Number 1** cause
of death in the United States.

This has been a puzzling question for
decades, but researchers may now have
discovered the answer



**FISH
OILS**

Although Eskimos traditionally eat high-fat foods, they also consume large quantities of fish. Cold-water fish oils are the major source of the polyunsaturated Omega-3 factors, EPA and DHA.

Medical scientists world-wide are strongly linking the presence of Omega-3 factors in the diet with good cardiovascular health.

WHAT ARE SOME OF THE HEALTH BENEFITS OF FISH OILS?

Reputable medical journals world-wide are reporting health benefits from Omega-3 factors in dietary fish oils including:

- ★ Reduced risk of heart disease
- ★ Lower blood cholesterol and triglyceride levels
- ★ Decreased risk of high blood pressure
- ★ Minimized blood clot formation
- ★ Decreased likelihood of atherosclerosis (hardening of the arteries)

DO ALL FISH OILS PROVIDE BENEFICIAL AMOUNTS OF OMEGA-3 FACTORS?

The right kind of fish must be consumed in order to receive adequate amounts of Omega-3 factors. A 4 ounce serving of Salmon can contain 3,600 mg. of Omega-3 fatty acids whereas a 4 ounce serving of cod, a low-fat fish, contains only 300 mg.

The higher the fat content of the fish, the more Omega-3 [EPA & DHA] they contain. Fish commonly found in cold water have the highest fat content and, therefore, provide more Omega-3 factors. These fish include: Salmon, mackerel, menhaden, herring and sardines.

HOW MUCH FISH OIL SHOULD I INCLUDE IN MY DIET?

<i>Eskimos consume an average of</i>	13,000 milligrams EPA per day.
<i>Coastal Japanese consume about</i>	5,500 milligrams EPA per day.
<i>Most Americans consume only</i>	20 milligrams EPA per day.

Recognizing the health benefits from increasing the consumption of Omega-3 fatty acids, the *U.S. Department of Health and Human Services* is recommending individuals at least double their consumption of fish. Although it is too early in the research to recommend a specific intake of fish, 1/4 pound of salmon per day, which equates to approximately 1,350 mg. of EPA, has consistently demonstrated beneficial changes in the blood.

WHY FISH OIL CAPSULES?

Unfortunately, many people do not like the taste of fish or prefer the more palatable, non-oily types of fish. Fish oil capsules were developed as a convenient supplemental source of Omega-3 factors that does not require a drastic change in dietary habits.

Fish oil capsules are intended to be a part of a total dietary plan which should include exercise, no smoking and the reduction of saturated fat in the diet.

WHICH FISH OIL SUPPLEMENTS ARE BEST?

Fish oil supplements are not all the same. To make the right choice you must know what to look for in a fish oil supplement.

- *Some fish oils are higher in the Omega-3 factors than others.*
- *Some fish oils contain cholesterol.*
- *Some fish oils can become rancid because they do not contain an antioxidant, like natural-source Vitamin E.*
- *Some fish oils are from fish living in polluted waters containing PCB's, mercury, cadmium or other toxic materials. Other fish oils have been tested and shown to be contaminant-free.*

There are many fish oil products on the market, but none are superior to Carlson. Carlson Salmon Oil is extracted from the deep, unpolluted waters of Norway. Researchers have used Salmon Oil to study the health benefits of EPA because it is naturally rich in the important Omega-3 factors.

In addition, natural-source Vitamin E is in every capsule to protect the freshness of the salmon oil.

And . . . each batch is laboratory tested to **GUARANTEE POTENCY.**



Always insist on *Carlson*[®] **SALMON OIL.**
Not all fish oils are of the same high potency and quality!

Something Special About Carlson Fish Oils:

Some of the fish richest in the beneficial omega-3 fatty acids are salmon, sardines and mackerel.

These fish contain 5 to 10 times more Omega-3 fatty acids than other common seafood including perch, flounder, catfish, cod, haddock, red snapper, sole, lobster, swordfish, crab and shrimp.

Just 4 Carlson Fish Oil capsules supply as much omega-3 factors as a ¼ pound serving of fresh salmon, sardines or mackerel.



Carlson® **FISH OILS**

Your Health Is Worth It !

- ▶ Each 1000 mg. FISH OIL capsule provides 570 mg. of Omega-3 fatty acids consisting of 330 mg. of EPA, 220 mg. of DHA and 20 mg. of alpha linolenic acid.
- ▶ Cholesterol-free.
- ▶ Natural Vitamin E (d-alpha tocopherol) added to preserve the freshness of the fish oils.
- ▶ No Vitamin A or D present.
- ▶ PCB-free. Mercury-free. Cadmium-free. Arsenic-free. Lead-free.
- ▶ No Preservatives, Sweeteners, Salt, Artificial Colors or Flavors are added.
- ▶ Potency & Quality **GUARANTEED** by Laboratory Analysis.

PARTIAL LIST OF REFERENCES:

The New England Journal of Medicine (April 10, 1986) pp. 937-942. Knapp, H.R. Reilly, I.A.G., Alessandrini, P. and Fitzgerald, G.A., In Vivo Indexes of Platelet and Vascular Function during Fish-Oil Administration in Patients with Atherosclerosis.

The New England Journal of Medicine (May 9, 1985) pp. 1205-1209. Kromhout, D., Bosschleter, E.B. and Coulander, C., The Inverse Relation Between Fish Consumption and 20-Year Mortality from Coronary Heart Disease.

The New England Journal of Medicine (May 9, 1985) pp. 1210-1216. Phillipson, B.E., Rothrock, D.W., Conner, W.E., Harris, W.S. and Illingworth, D.R., Reduction of Plasma Lipids, Lipoproteins, and Apoproteins by Dietary Fish Oils in Patients with Hypertriglyceridemia.

The Lancet (January 26, 1985) pp. 184-187. J.M., Michalek, A.V., Lininger, L., Huyck, C., Bigauette, J., Timchalk, M.A., Rynes, R.I., Zieminski, J., and Bartholomew, L.E., Effects of Manipulation of Dietary Fatty Acids on Clinical Manifestations of Rheumatoid Arthritis.

The Journal of the American Medical Association (February 12, 1982) pp. 729-731. Medical News: "It's Not Fishy: Fruit of the Sea May Foil Cardiovascular Disease."

The Lancet (March 1980) pp. 441-444. Seiss, W., Roth, P.P., Scherer, B.C., Bohlig, B., Weber, P.C., Platelet Membrane Fatty Acids, Platelet Aggregation and Thromboxane Formation during Mackerel Diet.

Transactions of the Association of American Physicians (1980). Harris, W.S. and Connor, W.E., The Effects of Salmon Oil Upon Plasma Lipids, Lipoproteins, and Triglyceride Clearance.

The Lancet (December 1979) pp. 1249-1250. Van Gent, C.M., Luten, J.B., Rulter, A. and Bronsgeest-Schoute, H.C., Effect on Serum Lipid Levels of Omega-3 Fatty Acids of Ingesting Fish Oil Concentrate.

The British Medical Journal (April 1979) p. 1144. Sinclair, H.M., Fats and Atheroma.

The Lancet (July 1978) p. 117. Dyerberg, J., Bang, J.O. Stoffer-son, E., Moncada, S. and Vane, J.R., Eicosapentaenoic Acid and Prevention of Thrombosis and Atherosclerosis.

The American Heart Association Diet, Cholesterol And Your Heart; High Blood Pressure: Facts You Need to Know. The American Heart Association, 1984.

National Institute of Health Consensus Development Panel: Lowering blood cholesterol to prevent heart disease. JAMA 1985;253:2060-2066.

A list of over 50 medical references sent upon request.

J. R. Carlson Laboratories, inc.
15 College, Arlington Hts., Il 60004



Product information:

COD LIVER OIL (OLEUM MORRHUAE); Medicinal grade.

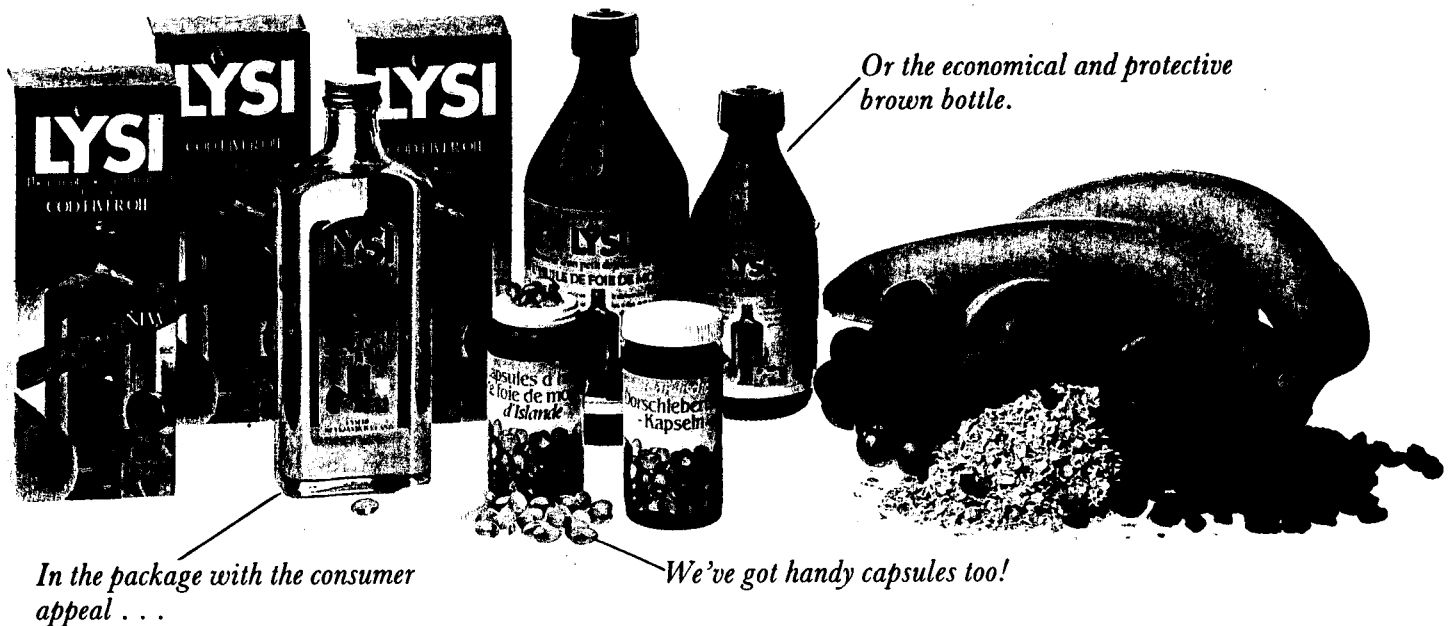
Cod liver oil is the oil obtained from the fresh liver of the cod, *Gadus callarias* L and other species of *Gadus*, refined and clarified by filtration at about 0°C

Description:	A pale yellow liquid; odour and taste slightly fishy, but not rancid.
Solubility:	Practically insoluble in ethanol (96%), miscible with ether, chloroform and petroleum (boiling range 40°C to 60°C).
Iodine value:	150 to 180
Refractive Index:	1.478 to 1.482
Saponification value:	180 to 190
Weight per ml at 20°C:	0.917 to 0.924
Free Fatty Acid:	Max 0.25%
Unsaponifiable matter:	Max 1.5%
*Vitamin A content:	Min 1200 i.u./g
*Vitamin D content:	Min 120 i.u./g
*Vitamin E content:	Min 200 mg/kg
Stearine:	Remains bright when cooled to and kept at 0°C for 3 hours.
Eicosapentaenoic acid (EPA)	8%
Docosahexaenoic acid (DHA)	9%
Storage	Cod Liver Oil should be kept in a well filled, well closed container, protected from light.
Packing:	220 g bottle 230 g bottle 460 g bottle 920 g tin 3.5 kg tin 24 kg drum 190 kg drum All drums and bottles are purged with nitrogen.

**THIS PRODUCT CONFIRMS TO VARIOUS PHARMACOPEIAS INCLUDING
BP, USP AND DAB7.**

*Higher or lower vitamin potency can be provided upon request.

INTRODUCING: LÝSI COD LIVER OIL



In the package with the consumer appeal . . .

Or the economical and protective brown bottle.

We've got handy capsules too!

The Health Food Success from the Pure Waters of the North.

The cold, clear unpolluted waters of the North Atlantic around Iceland. In a matter of hours, the fresh Icelandic cod liver is transformed into a superb Health Food product. And this immediacy and the fast processing to preserve the pure, natural freshness is one of the reasons why we at LÝSI HF have become one of the world's leading producers of cod liver oil.

LÝSI Cod Liver Oil. Rich in Vitamins A and D. And it reduces Cholesterol!

In children it encourages growth, improves eyesight and makes for strong teeth and sturdy bones. It builds up resistance to colds and other ailments and is a traditional remedy for arthritis. But new research also indicates that it reduces the cholesterol in the blood due to its richness in poly-unsaturated fatty acids such as EPA and DHA and thus an effective prevention against coronary diseases.

Mint, Fruit or Natural – which will be your favourite flavour?

The LÝSI Cod Liver oil now comes in three flavours. We think that it tastes better than any other cod liver oil. We *know* that it is catching on fast in the U. S. and Scandinavia. Now it comes to you . . . Put the LÝSI range among your health food bestsellers.

**It is Natural Goodness Rediscovered.
A Pure Natural Health Product for a Lifetime of Good Health!**



LÝSI HF. Leading Producers and Exporters.
Grandavegur 42. P.O. Box 625, Reykjavik, Iceland. Tel: 1-28777. Telex 2001.