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Omega-3 Fatty Acid Content of Lake Superior Fish

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Fish and seafoods have recently increased in popularity due to reports of the health benefits of fish oils (omega-3 or N-3 fatty acids). People in the Midwest may feel dependent upon salt-water fish to get N-3 oils, based on misinformation and misconceptions concerning the N-3 content of freshwater fish. The truth is, freshwater fish do contain N-3 fatty acids, although as with salt-water fish, some fish are better sources of N-3 oils than others. Fish with high total lipid (fat) content from a cold water environment, saltwater or freshwater, are most desirable. In the Upper Midwest, we have a significant resource of these fish in Lake Superior, which is so cold it could almost be classified as an Arctic lake.

This publication provides a summary of the health benefits of N-3 fatty acids and reports recent findings on the fatty acid composition of Lake Superior fish.

Health Benefits of N-3 Fatty Acids

Studies of the Greenland Eskimos played an important part in stimulating interest in N-3 fatty acids. Their high intake of whale and seal oils was linked to a low incidence of cardiovascular disease by Dyerberg and Bang (1). During the past decade, researchers have sought clues to explain the benefits of fish oil and an enormous amount of scientific research along with a number of misconceptions have resulted.

The primary benefit of fish oil is the reduction of blood platelet activity, not blood cholesterol. Platelets are clot-forming cells which prevent excessive bleeding. Overly active blood platelets, however, may help to accelerate the buildup of plaque, which is a deposit of fatty-fibrous material in a blood vessel wall. The blood clots formed by blood platelets may become stuck in a plaque-narrowed artery and trigger a heart attack. Thus, N-3 fish oils can prevent heart attacks by reducing both blood clotting activity of platelets and the formation of plaque. N-3 oils also have an effect on blood lipids. They lower triglycerides, but not cholesterol. On the other hand, omega-6 (N-6) oils found in vegetable oils, eggs, and poultry are known to lower blood cholesterol but they increase the platelet activity of blood. Since reduction of clotting is a key step in preventing heart disease (2) it has been recommended that individuals decrease the N-6 to N-3 ratio in their diets from about 17 to about 6. This can best be done by eating more N-3 oils and less N-6 oils. Though both are polyunsaturated fats, N-3 oils are more polyunsaturated than N-6 oils due to different chemical structures. Both N-3 and N-6 oils are required in the diet.

N-3 Content of Fish

Fish can be categorized based on their oil and N-3 content. High oil fish which are a good source of N-3 include all types of salmon and tuna, sardines, herring, mackerel, black bass, bluefish, carp, pompano, and channel catfish. These high oil fish are usually prepared by baking or broiling, so the only N-6 fatty acids consumed are those naturally present in the fish and the health benefits are maintained.

Many popular fish are poor sources of N-3 fatty acids. These low oil fish are Atlantic cod, Pacific cod, flounder, grouper, haddock, pike, shark, snapper, sole, tilapia, and whiting (3).

They are often prepared by deep-fat frying in hydrogenated vegetable shortening. This raises the N-6 and saturated fat contents and the calorie content and further reduces health benefits.

Lake Superior Fish

Recent research at the University of Minnesota has determined that a number of Lake Superior species are excellent sources of N-3 fatty acids (4). There are several important features to consider about the fatty acid composition of Lake Superior fish.

Table 1 lists the proportions of each of the major groups of fatty acids (saturated, monounsaturated, etc.) for each Lake Superior fish and the ratio of N-3 to N-6 fatty acids (N-3/N-6). For example, Table 1 shows that 16% of the fat in a chub and 31 % of the fat in a burbot is saturated. However, the total fat content is so low in these fish that the saturated fat content per typical serving is negligible in burbot and small in chub.

The content of N-3 fatty acids and total fat content in Lake Superior fish are shown in Table 2. The N-3 contents are roughly comparable to those of saltwater fish. However, the N-6 content is higher (Table 1). Therefore, the ratio of N-3 oils to N-6 oils is better in saltwater fish than in Lake Superior fish. Table 2 also compares N-3 fatty acid contents of salmon, a high fat fish, and halibut, a low fat fish, to Lake Superior fish. Lake Superior fish, with the exception of burbot, easily exceed the N-3 content of halibut. Furthermore, the N-3 content of chub, herring, whitefish, lean lake trout or siscowet lake trout exceeds the N-3 content of chinook salmon, which is one of the best saltwater sources of N-3 fatty acids.

Another striking feature of the Lake Superior fish is a high content of monounsaturated oil, the type of fatty acid found in olive and canola oils. Recent medical research indicates that monounsaturated oils are more effective than N-6 polyunsaturated oils in lowering blood cholesterol.

The results of the freshwater/ saltwater fish comparisons clearly establish that some freshwater fish are good sources of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), two types of N-3 fatty acids. Lake Superior fish are a valuable source of N-3 fatty acids despite a less desirable N-3/N-6 ratio than saltwater fish. Adding 100 grams a day of Lake Superior fish, except burbot, to the current U.S. diet (5,6) would result in a marked, favorable change in the N-3/N-6 ratio (4).

Rancidity

Most medical authorities suggest eating fish twice per week. Unfortunately, deep-fried, lowoil content fish seem to be the most popular in the U.S. This is partly because fish with a high oil content, which provide greater health benefits, often taste fishy. The fishy taste is due to rancidity. Because of the highly polyunsaturated nature of fish oils they tend to rapidly turn rancid in the fish. Polyunsaturated fatty acids break down by reacting with oxygen. Usually, only tiny quantities of fatty acids turn rancid,

Table 1. Fatty Acid Composition of Muscle Tissue from Lake Superior Fish

Fatty Acid Class	Chub	Herring	Smelt	Whitefish	Burbot	Lean Lake Trout	Siscowet Lake Trout
Saturated	16.8	28.2	23.0	17.3	31.0	17.8	21.1
Monounsaturated	41.5	20.1	33.7	33.8	32.1	36.9	45.0
Polyunsaturated N-3	26.4	33.7	37.6	32.5	26.0	29.7	24.1
Polyunsaturated N-6	10.9	14.3	17.1	12.6	15.5	12.8	10.7
Polyunsaturated, total	37.3	48.0	54.7	45.1	41.5	42.5	34.8
N-3 to N-6 ratio	2.4	2.4	2.2	2.6	1.7	2.3	2.3

Note: Calculated as relative percentage of total fat content (100%).

so the nutritional value of the fish is maintained. However, a fishy odor results. Proper storage and prompt consumption can alleviate this problem.

Storage and Preparation of Fish

To avoid rancidity and get maximum nutritional benefit and flavor, the following guidelines are recommended:

Storebought fresh fish: Eat within three days of purchase. Because home freezers are not very efficient, freezing is not recommended.

Freshly caught freshwater fish: Freeze with tight plastic wrap. Freezing takes approximately 48 hours and fish can be frozen up to four months.

Storebought frozen fish: Make sure the packaging is intact. Store frozen no longer than one month.

To get maximum health benefits from the N-3 oils in fish, it is recommended that you prepare them without additional oil by baking, broiling, or grilling. Mark your kitchen calendar to remind yourself to eat fish regularly and use your frozen fish in an appropriate timeframe.

Lake Superior fish are available in many supermarkets in the Midwest, especially in the Twin Cities. Restaurants in the Lake Superior area serve fresh lake trout, whitefish, and lake herring when available.

Summary

Certain saltwater fish are good sources of N-3 fatty acids. High oil content, freshwater fish found in cold water lakes, such as Lake Superior, are an equally good source of these fatty acids. Significant health benefits related to coronary heart disease prevention have been attributed to the consumption of N-3 fatty acids. Proper storage methods and short storage periods can alleviate the development of rancidity, a potential problem in fish with a high oil content.

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Table 2. Comparative Fat and Fatty Acid Contents In Grams per 100 Gram Serving

Fish	Total Fat	EPA[a]	DHA[b]	EPA + DHA	N-30[c]
Halibut, Pacific	2.3	0.1	0.3	0.4	0.6
Salmon, Chinook	10.4	0.8	0.6	1.4	1.7
Chub	13.2	0.7	0.8	1.5	3.5
Herring	10.8	0.5	0.6	1.1	3.6
Smelt	3.3	0.3	0.2	0.5	1.2
Whitefish	10.4	0.7	0.2	1.6	3.4
Burbot	1.0	0.1	0.1	0.2	0.3
Lean lake trout	11.0	0.5	1.0	1.5	3.0
Siscowet lake trout	25.7	1.2	1.8	3.0	6.2

[a]Eicosapentaenoic acid
[b]Docosahexaenoic acid
[c]Includes EPA + DHA + α-linolenic. EPA and DHA are the N-3 fatty acids unique to fish.

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