Atlantic Salmon Nutritional Profile and Benefits

A Review of Nutrition and Health Studies

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Nutritional characteristics and composition

Atlantic salmon is an oily fish, rich in omega-3 long-chain polyunsaturated fatty acids and a great source of lean protein. A three-ounce portion of farmed-raised Atlantic salmon provides approximately 208 calories with 20 grams of protein and 11 grams of fat. Atlantic salmon is also a good source of calcium, providing 13 mg per 3 ounces, and a good source of vitamin B-12. As stated, Atlantic salmon is rich in omega-3 fatty acids, specifically eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). In general, fish are the primary dietary source of long chain omega-3 fatty acids, making seafood essential to a healthy diet.

Omega-3 long chain fatty acids are critical for brain function, cardiovascular health, and fetal development. Both EPA and DHA function in numerous parts of the body, such as cell membranes, to provide fluidity and act in an anti-inflammatory capacity. DHA is a key component in the brain and retina cell membranes and thus is required for proper fetal development and healthy aging.[1]

DHA and EPA are considered conditionally essential fatty acids, or in other words, we are able to produce them endogenously from other food we eat. Both EPA and DHA can be synthesized from linolenic acid (ALA), an omega-3 fatty acid; however, their synthesis is dependent on adequate intake of ALA.[2] Most of the ALA consumed in our diet comes from plant sources including flax seed, walnuts, pecans, and hazelnuts. Conversion of ALA to EPA and DHA is dependent on adequate intake of ALA and also individual ability to convert ALA to the longer chain omega-3 fatty acids. Studies suggest that only ~2% to 10% of ALA is converted to EPA or DHA.[3,4] Adequate intake of DHA and EPA is difficult to achieve through intake of ALA alone and requires direct dietary consumption from sources rich in EPA and DHA.

DHA acts as a free fatty acid to inhibit the pro-inflammatory effects of fat tissue by blocking the action of toll-like receptors (TLR) and tumor necrosis factor-alpha (TNF-alpha), two critical components in the inflammatory signaling pathway. Furthermore, EPA is a precursor of eicosanoids. Eicosanoids include substances such as thromboxanes, prostaglandins, and leukotrienes, all of which are important in cellular processes, vasoconstriction, vasodilation, immune system response, and the inflammatory response.

It is important to eat salmon or other seafood sources to ensure you are getting the recommended amount of EPA plus DHA on a daily basis. The next section details why it is critical for all adults, especially pregnant women and aging adults, to consume enough of the sources high in long chain omega-3 fatty acids.

Health benefits of Atlantic salmon

Fatty fish, such as Atlantic salmon, are a high quality source of DHA and EPA. As a result, the US Department of Health and Human Services (DHHS) recommends adults, especially pregnant and nursing women and seniors consume 227-340 g (8-12 ounces) of seafood each week.[5] Consumption of 8-12 ounces may provide up to 250 mg EPA plus DHA per day. Furthermore, the American Heart Association recommends people eat fish at least two times per week to reduce the risk of cardiovascular disease (CVD).[6]

Fatty fish such as Atlantic salmon play a crucial role in the fight against preventable heart disease. In the United States, 610,000 people die of heart disease and 735,000 Americans have a heart attack every year.[7,8] EPA plus DHA helps to lower the risk of chronic inflammation and cardiovascular events by improving vascular permeability, plaque stability, and blood flow.[9] Together, EPA and DHA reduce the incidence of CVD[10,11], heart failure[10,12], and sudden cardiac death.[13,14] A large prospective study found that total intake of 250 to 500 mg/day EPA and DHA, approximately 8-12 ounces of Atlantic salmon, can reduce cardiac mortality by ~35%, an effect as great as or equal to statin therapy.[15] Further reports suggest that if people eat even more of these fatty acids there will be additional protective effects.[16]

Researchers at the Human Nutrition Research Center in Grand Forks North Dakota evaluated a group of 19 healthy human volunteers that were given three different portion sizes of farm-raised Atlantic salmon.[17] For a 4-week period, each person ate two weekly servings of one of the three portion diets which included: a 3.2 ounce portion diet, a 6.3 ounce portion diet, and a 9.5 ounce portion diet. Each volunteer waited 4 to 6 weeks between diets before switching to a new portion diet. Following the 4 to 6 week wash out period, each person ate the new portion diet for the next 4-week period.

Prior to the start of the study and after each 4-week period, the volunteer's blood was collected and examined to mark fatty acid levels and other heart disease risk indicators. The results showed that blood levels of EPA doubled after the volunteers consumed the 6.3-ounce portion diet and increased nearly threefold after they consumed the 9.5-ounce portion diet. Regardless of portion size diet, DHA levels were elevated by 50 percent from baseline values. Overall, eating more than two weekly servings of Atlantic salmon per week has a beneficial effect on fatty acid levels in the blood.

Atlantic salmon or other fish high in omega-3 fatty acids are known to increase the responsiveness of aspirin therapy, a treatment commonly used to manage and prevent heart disease. Therapeutic effectiveness of aspirin for anticoagulation therapy varies from person to person, with a low response to aspirin or aspirin resistance in 1% to 45% of people using this treatment. Supplementation of EPA and DHA, in patients with stable coronary artery disease (CAD), in combination with low-dose aspirin, is proven to be as effective as higher doses of aspirin use alone (up to 325 mg/d) for anticoagulation benefits.[18]

In addition to treatment and prevention of heart disease, omega-3 fatty acids have the potential to prevent and/or treat chronic mental health issues and age-related cognitive impairments.[19,20] Eating omega-3 fatty acids plays a role in the prevention of dementia and Alzheimer's disease (AD), a disease accounting for more than 70% of all cases of dementia and the fifth leading cause of death in persons aged 65 and older.[21,22] Omega-3 fatty acids are important to consider when considering brain health and function because DHA and EPA are essential for brain tissue membrane structure and nervous system function. DHA, in particular, is found in large amounts in neuron membrane phospholipids.

A large meta-analysis examined the relationship between dietary intake of omega-3 fatty acids and the risks of dementia and AD.[23] Wu and colleagues found that individuals had a lower risk of AD when they ate more fish. Specifically, people who consumed 500 grams or more of fish per week had a 16% lower risk of dementia and 36% lower risk of AD when compared with those in the lowest intake category.

In addition to omega-3 fatty acids ability to protect against AD and dementia, recent research suggests that EPA has anti-depressive properties. A meta-analysis of 19 trials on patients with either major depressive disorder (MDD) or depressive symptomatology but no diagnosis of MDD demonstrated that omega-3 fatty acids are of significant clinical benefit in the treatment of MDD and the associated symptoms when compared to a placebo.[24]

As mentioned previously, adequate intake of seafood is especially important for women that are pregnant, plan on becoming pregnant, or that are breast feeding. During pregnancy, EPA and DHA are associated with multiple benefits for the infant. During pregnancy, the placenta transfers nutrients, including DHA, from the mother to the fetus. The amount of omega-3 fatty acid in the fetus is directly related with the food that their mother eats, making it critical for the mother to eat adequate amounts of food high in EPA and DHA.[25]

Many pregnant women are concerned with eating large amounts of seafood during pregnancy because of the risk of methyl mercury poisoning. However, the current 2015 Dietary Guidelines for Americans (DGA) recommends that pregnant women consume 8 to 12 ounces of seafood per week to meet their increased need for omega-3 fatty acids. Pregnant women should limit their intake of white (albacore) tuna to no more than 6 ounces per week due to their high methyl mercury content. Furthermore, pregnant women should avoid tilefish, shark, swordfish, and king mackerel altogether.[5]

Omega-3 fatty acid are essential for optimal fetal development, especially fetal brain and eye development, and effect the length of gestation.[26] A recent observational study on over 2,000 pregnant women reported that seafood intake was associated with increases in cognitive scores and decreases in symptoms of autistic spectrum in the children at 14 months and again at 5 years old. Furthermore, there was a corresponding improvement in test scores for every additional 10 grams of fish per week over 500 grams.[27]

It is important that women get enough seafood during pregnancy because of its important for both maternal, fetal, and the babies health post-birth. All pregnant women should be advised on what seafood is safe to eat during pregnancy and what to avoid. Since Atlantic salmon is a good source of EPA plus DHA and healthy fats, pregnant women should be encouraged to eat between 8 to 12 ounces per week.

Atlantic salmon as a component of a healthy dietary pattern

Every five years the Department of Health and Human Services calls on a committee of top nutrition and health researchers to update and revise the current Dietary Guidelines for Americans (DGA). The DGAs examine the current scientific evidence as it relates to overall population health. The result is a set of recommendations aimed to help individuals achieve the best health outcomes related to their daily dietary intake. In the last two editions of the DGA, 2010 and 2015, seafood has been identified as a component of a healthy diet pattern with positive health benefits.[5,28]

The previous recommendations, 2010 DGA, and the most recent, 2015 DGA, both recommend that adults should consume at least 8 to 12 ounces of seafood per week, amounting to approximately 250 mg of EPA plus DHA per day. In 2010, the DGA committee recommended that seafood intake increase to 8 ounces per week or more for adults. According to the DGA committee from 2010, an 8 ounce amount provides energy, protein, selenium, vitamin D, and vitamin B-12. Furthermore, they

provide a higher proportion of total fatty acids from polyunsaturated and monounsaturated fatty acids relative to saturated fatty acids, specifically from fish rich in the long-chain eicosapentanoic acid (EPA) and docosahexonoic acid (DHA).

In reviewing the National Health and Nutrition Examination Survey (NHANES) data, the DGA committee 2015 found that the U.S. population has low seafood intake. Across all age groups, and for both males and females, only 10 percent of the population meets the 2010 intake recommendations.[5] The same report found that intake was highest in adult men and women but remains low relative to recommendations. Men between the ages of 51 to 70 years old have the highest intake of seafood, yet only 21% of men in this age range meet the current recommendations.

The 2015 DGA also encourages the consumption of wild or farmed seafood, aiming to improve the nutrient profile of certain farmed seafood species through improved feeding and processing systems. The evidence reviewed by the 2015 DGA committee demonstrates that, in the species examined, that farm-raised seafood has as much or more EPA and DHA per serving as wild caught species.

Atlantic Salmon and other fish species

As clearly demonstrated, adequate intake of seafood rich in omega-3 fatty acids, especially DHA and EPA, is associated with reduced risk of CVD, brain function and health, and fetal development. Of the top ten most popularly consumed fish in the US, salmon, including Atlantic, has the highest total EPA plus DHA content. Based on the results of a recent study on the fatty acid profile of fish in the United States, Atlantic Salmon is one of only eleven species that provides the recommended amount of EPA plus DHA each week if a total of 8 ounces are consumed.[29]

In this same study, the content of EPA plus DHA was the same, if not higher, in farm-raised species compared to wild caught. According to other research, wild-caught fatty acid profiles are variable and dependent on changes in environmental conditions. On the other hand, farm-raised species composition is more static because it is dependent on the amount and composition of the feed.[30]

You can see in the table below that according the a recent study of 76 finfish species from commercial seafood vendors in the United States that the content of total fat and the overall fatty acid profile varies widely from species to species. Of the species examined, farmed Atlantic salmon third highest concentration of EPA and fourth highest concentration of DHA per 100 grams out of the 76 species.

According to the National Marine Fisheries Service, Atlantic salmon is also considered on of the “top ten species” or most commonly consumed finfish in the US. Atlantic salmon has the highest concentration of EPA plus DHA out of the “top ten species”, which includes Chinook, Sockeye, and Coho salmon.[32] Overall, farmed Atlantic Salmon has the highest concentration of EPA plus DHA, with 20% to 70% more serving.

Overall, Atlantic salmon is an essential component of a healthy diet, in both the short term and long term. Based only on its nutrient profile, Salmon can provide all of the necessary and essential fat in a healthy, adult diet. In addition to the ideal fatty acid profile, Atlantic Salmon has a high portion of protein per 3 ounce serving. Furthermore, eating the recommended 8 to 12 ounces of Atlantic

salmon is proven to be beneficial for specific populations including people with heart disease, Alzheimer's, dementia, depression disorders, and women who plan on or are pregnant.

As the research suggest, it should be the goal of all healthy, adult individuals in the United States to eat at least 8 ounces of Atlantic salmon per week.

Species	Total fat (g/100 g)	Omega-3 *	Omega-6 *	SFA *	MUFA *	PUFA *	EPA *	DHA *
Atlantic Salmon (F)	16.47	2,544	2,530	2,983	5,290	5,212	664	845
Coho, Salmon (W)	3.48	894	66	687	757	979	227	74
Chum, Salmon (W)	3.77	740	60	840	1,541	898	233	79
Pink, Salmon (W)	4.4	607	162	810	1,348	811	182	333
Chinook, Salmon (W)	7.20	1,525	140	1,908	6,682	1,738	496	184
Chinook, Salmon (F)	14.18	2,179	1,173	3,730	1,908	3,485	737	272
Trout, Lake	5.47	1,216	409	1,157	1,787	1,662	234	571
Tilapia	2.47	125	370	744	764	498	5.9	70
Walleye	2.05	401	131	303	461	545	109	186

All nutritional values were obtained from [31]USDA's Nutrient Database for Standard Reference, Release 26 & [29]Cladis, Kleiner, Freiser, & Santerre, *Lipids*; 2014(49):1005-1018
*Reported in mg/100 g
(F) = farmed, (W) = wild

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