

# **Fish vs Plant Sources of Omega-3 Fatty Acids**

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\* Please note that slide #25 has been corrected

# Outline

- **Dietary recommendations for:**
  - ALA, EPA + DHA
  - LA
- **Food sources of omega-3 fatty acids**
  - “Traditional” foods
  - Fortified foods
  - Supplements
- **Incorporating different sources of omega-3 fatty acids in the diet**
- **Environmental contaminants – cause for concern?**
- **Summary**

**DRI for Fatty Acids and  
Total Fat (for infants only) are based on a  
Nutrient Requirement Model**

AI is defined for:

- Linoleic acid
- $\alpha$ -linolenic acid
- Total fat (for infants only, 0-12 mos)

# AI for $\alpha$ -Linolenic Acid

- AI is based on the median intakes of  $\alpha$ -linolenic acid in the United States where the presence of n-3 polyunsaturated fatty acid deficiency is nonexistent
- AI for ALA is 1.6 g/d for men and 1.1 g/d for women

# Criteria and AIs\* for n-3 or $\alpha$ -Linolenic Acid (g/day)

<u>Life Stage</u>	<u>Criterion</u>	<u>Male</u>	<u>Female</u>
0-6 m	Milk intake	0.5	0.5
7-12 m	Milk + other foods	0.5	0.5
1-3 y	Median intake	0.7	0.7
4-8 y	Median intake	0.9	0.9
9-13 y	Median intake	1.2	1.0
14-18 y	Median intake	1.6	1.1
19 +	Median intake	1.6	1.1
Pregnancy	Median intake		1.4
Lactation	Median intake		1.3

\*Assumed adequate to prevent EFA deficiency (rare in the U.S. and Canada)

# AMDR for $\alpha$ -Linolenic Acid

- AMDR set at 0.6 to 1.2 % of energy intake
  - Lower boundary of the range meets the AI for  $\alpha$ -linolenic acid
  - Up to 10% of the range can be consumed as EPA and/or DHA
  - Growing body of literature suggests that diets higher in  $\alpha$ -linolenic acid, EPA and DHA may afford some degree of protection against CHD

# Recommendation for Fish Consumption

- Evidence suggests that consuming approximately two servings of fish per week (approximately 8 oz. total) may reduce the risk of mortality from coronary heart disease and that consuming EPA and DHA may reduce the risk of mortality from cardiovascular disease in people who have already experienced a cardiac event.

– Dietary Guidelines for Americans, 2005



# Recommendations for Fish Consumption

- National Cholesterol Education Program: recommends fish as a food item for people to choose more often (NCEP, 2002; Table V.2-6)
- World Health Organization: regular fish consumption (one to two servings per week; each serving should provide the equivalent of 200-500 mg/day EPA+DHA) (WHO, 2003)
- European Society for Cardiology: oil fish and n-3 fatty acids have particular protective properties for primary CVD prevention (De Backer et al., 2003, Priori et al., 2003, Van de Werf et al., 2003)
- United Kingdom Scientific Advisory Committee on Nutrition: consume at least two portions of fish per week, of which one should be oily, and provide 450 mg per day of EPA+DHA (Scientific Advisory Committee on Nutrition, 2004)
- American Diabetes Association: two or more servings of fish per week provide dietary n-3 polyunsaturated fats and are recommended (exception – commercially fried fish fillets); (Diabetes Care 2008; 31:S61-S78)

## International Recommendations for EPA+DHA for Primary Prevention of CHD

Agency/Organization	Year	Recommendation
Eurodiet Conference, Univ. of Crete	2000	200 mg/day EPA+DHA
France: AFFSA, CNERNA&CNRS	2001	500 mg/d EPA+DHA; DHA 120 mg min.
American Heart Assoc.	2002	Two servings/week of fish (preferably oily)
UK Scientific Advisory Comm. On Nutrition	2004	Fish twice/wk, one should be oily; min. intake EPA+DHA, 450 mg/day
ISSFAL	2004	500 mg EPA+DHA/ day
Australia & New Zealand	2005	442 mg EPA+DHA/day for men, 318 for women
Dutch Health Council	2006	Fish twice/wk, one should be oily, to achieve dietary reference intake of 450 mg/day of n-3 FA from fish
Superior Health Council of Belgium	2006	min. of 0.3 % en EPA+DHA for adults (~667 mg/d at 2000 kcal/d))
Am. Dietetic Assoc/Dietitians of Canada	2007	500 mg/day

Harris et al., 2008' Curr Atheroscler Rep. 10:503-509.

# Recommendations for Omega-3 Fatty Acids

## ◆ AHA Scientific Statement on Fish and Fish Oils

Population	Recommendation
Patients w/o documented CHD	Eat a variety of fish (preferably oily) at least twice a week, include oils and foods rich in ALA
Patients w/ documented CHD	Consume ~1 gm of EPA+DHA per day, preferably from fish, supplements could be used in consultation with a physician
Patients needing TG lowering	2 – 4 gm of EPA+DHA per day provided as capsule under a physician's care

# Fish Guidelines

- The consumption of two servings (~ 8 oz) per week of fish high in EPA and DHA is associated with reduced risk of both sudden death and CHD death in adults. (2005 Dietary Guidelines Advisory Committee)
- Women and children should include fish in their diets and can safely consume up to 12 ounces per week of cooked fish. (FDA/EPA Advisory)



*Advice for*

Women Who Might Become Pregnant

Women Who are Pregnant

Nursing Mothers

Young Children

*from the*

*U.S. Food and Drug Administration*

*U.S. Environmental Protection Agency*

**Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) advice for women who may become pregnant, pregnant women, nursing mothers, and young children – 2004**

**By following these 3 recommendations for selecting and eating fish or shellfish, women and young children will receive the benefits of eating fish and shellfish and be confident that they have reduced their exposure to the harmful effects of mercury.**

- Do not eat **Shark, Swordfish, King Mackerel, or Tilefish** because they contain high levels of mercury.
- Eat up to 12 ounces (2 average meals) a week of a variety of fish and shellfish that are lower in mercury. Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish. Another commonly eaten fish, albacore ("white") tuna has more mercury than canned light tuna. So, when choosing your two meals of fish and shellfish, you may eat up to 6 ounces (one average meal) of albacore tuna per week.
- Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas. If no advice is available, eat up to 6 ounces (one average meal) per week of fish you catch from local waters, but don't consume any other fish during that week.

# AI for Linoleic Acid

- AI is based on the median intake of linoleic acid by different gender and life stage groups in the United States, where the presence of n-6 polyunsaturated fatty acid deficiency is nonexistent.
- AI for linoleic acid is 17 g/d for men 19-30 and 31-50 years of age and 12/g/d for women 19-30 and 31-50 years of age

# Criteria and AIs\* for Linoleic Acid (g/d)

<u>Life Stage</u>	<u>Criterion</u>	<u>Male</u>	<u>Female</u>
0-6 m	Milk intake	4.4	4.4
7-12 m	Milk + other foods	4.6	4.6
1-3 y	Median intake	7	7
4-8 y	Median intake	10	10
9-13 y	Median intake	12	10
14-18 y	Median intake	16	11
19 - 50 y	Median intake	17	12
> 50 y	Median intake	14	11
Pregnancy	Median intake		13
Lactation	Median intake		13

\*Assumed adequate to prevent EFA deficiency (rare in the U.S. and Canada)

# AMDR for Linoleic Acid

- set at 5-10 % of energy intake
  - Lower boundary meets the AI recommendation
  - Individual dietary intakes of linoleic acid in North America rarely exceed 10% energy
  - Epidemiological evidence for safety of intakes greater than 10% of energy is lacking
  - High intakes of linoleic acid create a pro-oxidant state that may pre-dispose an individual to several chronic diseases – CHD and cancer

## U.S. Intake of Omega-3 Fatty Acids for all Individuals, n=8,604

Fatty Acid	Mean	SE
$\alpha$ -linolenic acid	1.4 g	0.02
EPA	0.03 g	0.002
DHA	0.07 g	0.003

Usual Intake of n-3 Fatty acids (g) in U.S.  
(CSFII 1994-1996,1998)

	<u>Mean</u>	<u>10<sup>th</sup> % ile</u>	<u>95<sup>th</sup> % ile</u>
M, 19-30 y	1.77	1.07	2.87
M, 31-50y	1.86	1.11	3.08
F, 19-30y	1.26	0.76	2.10
F, 31-50y	1.28	0.80	2.08

# Average Daily Fish Consumption, 2003-2004 NHANES

Population Statistic	Women 16-45	Women 46+	Men 16-45	Men 46+
Average	13.4 (12.7, 13.9)	15.1 (14.3, 16.1)	18.3 (17.1, 19.2)	19.0 (18.0, 20.6)
10th %tile	0.1 (0.0, 0.9)	0.2 (0.0, 1.3)	0.2 (0.0, 1.2)	0.3 (0.0, 1.7)
25th %tile	2.8 (2.0, 3.6)	3.4 (2.7, 4.3)	3.7 (2.7, 4.6)	4.6 (3.5, 5.8)
50th %tile	7.2 (6.4, 7.9)	8.4 (7.4, 9.1)	9.6 (8.3, 10.6)	10.8 (9.5, 11.9)
75th %tile	16.3 (14.9, 17.7)	18.4 (16.9, 19.6)	21.9 (19.6, 23.1)	22.7 (21.0, 24.5)
90th %tile	32.3 (29.3, 34.4)	36.4 (33.7, 39.5)	43.7 (40.1, 47.6)	44.4 (40.5, 49.5)
95th %tile	46.4 (42.1, 50.7)	53.7 (47.4, 60.5)	65.5 (58.5, 74.7)	65.1 (58.2, 75.3)
99th %tile	88.3 (74.4, 114.3)	101.5 (85.0, 128.3)	136.0 (106.8, 179.3)	131.8 (108.3, 178.4)
NHANES average for comparison	10.3	14.2	16.8	20.8

Daily Fish Consumption (g/day); Median (5<sup>th</sup> percentile, 95th percentile)

# Total Fish & Other Seafood

- Measured in terms of ounce equivalents per day
- 8 ounces per week = 1.41 ounces/day
- 12 ounces per week = 1.71 ounces/day
- Up through the 75<sup>th</sup> percentile, adult intakes are below 8 ounces per week
- None of the women or young children showed intakes greater than 12 ounces per week, at the 95<sup>th</sup> percentile.

# Food Sources of ALA, EPA and DHA

## n-3 PUFAs

## Structure

## Food Sources

Alpha-Linolenic Acid (ALA)

18:3

Walnuts,  
flaxseed, canola  
oil, soybean oil

Eicosapentaenoic Acid (EPA)

20:5

Fatty fish, fish  
oils, high EPA oil

Docosahexaenoic Acid (DHA)

22:6

Fatty fish, fish  
oils, algal oils

## Approximate Content of n-3 PUFA in Seafood (can vary due to season, place of capture, etc.)

Seafood	g of n-3 PUFA/100g
Mackerel	1.8-5.3
Herring	1.2-3.1
Salmon	1.0-2.0
Trout	0.5-1.6
Tuna	0.5-1.6
Halibut	0.5-1.0
Shrimp	0.2-0.4
Cod and flounder	0.2

# Sources of Preformed EPA + DHA

Fish	Amount (g) in 3 oz serving
Kippered Herring	1.83
Pacific Oysters	1.17
Coho salmon (farmed)	1.09
Atlantic Mackerel	1.02
Coho salmon (wild)	0.90
Sardines	0.84
Tuna (canned albacore)	0.73
Halibut	0.40
Shrimp	0.27
Tuna (canned light)	0.23

<i>Dietary supplements</i>	<i>Amount (g) per capsule</i>
Cod liver oil	0.19
Fish body oils	0.30 – 0.6
<i>Prescription Products</i>	
Omega-3 acid ethyl esters (Lovaza, GSK)	0.85

## Content of EPA + DHA (mg/3 oz. sv) in 37 Commonly Consumed Types of Fish

◆ Orange Roughy	26	◆ Blue Crab	403
◆ Tilapia	115	◆ Flat Fish	426
◆ Mahi-Mahi	118	◆ Pollock	460
◆ Cod	134	◆ Sea Bass	648
◆ Catfish (farmed)	151	◆ Swordfish	696
◆ Catfish (wild)	201	◆ Shark (raw)	711
◆ Lt. Chunk Tuna	230	◆ White Tuna	733
◆ Yellowfin Tuna	237	◆ Sardines	835
◆ Clams	241	◆ Coho Salmon (wild)	900
◆ Mixed Shrimp	267	◆ Rainbow Trout (farmed)	981
◆ Skipjack Tuna	278	◆ Chum Salmon (canned)	999
◆ Scallops	310	◆ Mackerel (canned)	1046
◆ Dungeness Crab	335	◆ Sockeye Salmon (wild)	1046
◆ Walleye	338	◆ Coho Salmon (farmed)	1087
◆ King Crab	351	◆ Pink Salmon (wild)	1094
◆ Oysters (farmed)	374	◆ Bluefin Tuna	1279
◆ Halibut	395	◆ Atlantic Salmon (wild)	1564
		◆ Atlantic Salmon (farmed)	1825

# Ratio of DHA to EPA Varies in Fish

(cooked, 100g)

Fish	DHA, g	EPA, g	DHA/EPA
Blue Fish	0.67	0.32	2.1
Atlantic Cod	0.15	0.004	37.5
Pacific cod	0.17	0.10	1.7
Mackerel, Atlantic	0.70	0.50	1.5
Mackerel, Pacific	1.2	0.65	1.8
Salmon, Atlantic			
Wild	1.4	0.4	3.5
Farmed	1.5	0.7	2.1
Salmon, Coho			
Wild	0.7	0.4	1.8
Farmed	0.9	0.4	2.3

# Omega-3's: the Next Big Ingredient



# Examples of “Fortified Foods” with Omega-3 Fatty Acids . . . but what are we really getting?

Eggs, with DHA

Smart Balance Peanut Butter, with omega-3s from flax oil

1 percent Plus Milk, with omega-3s from fish oils

Tropicana, with omega-3s from fish oils (Tilapia, sardines and anchovies)

Smart Balance Omega PLUS Buttery Spread Balance Omega

Farms 1% Low-Fat Milk

Omega Farms Mild Cheddar Cheese

Omega Farms Nonfat Vanilla Yogurt

Kemps frozen yogurt

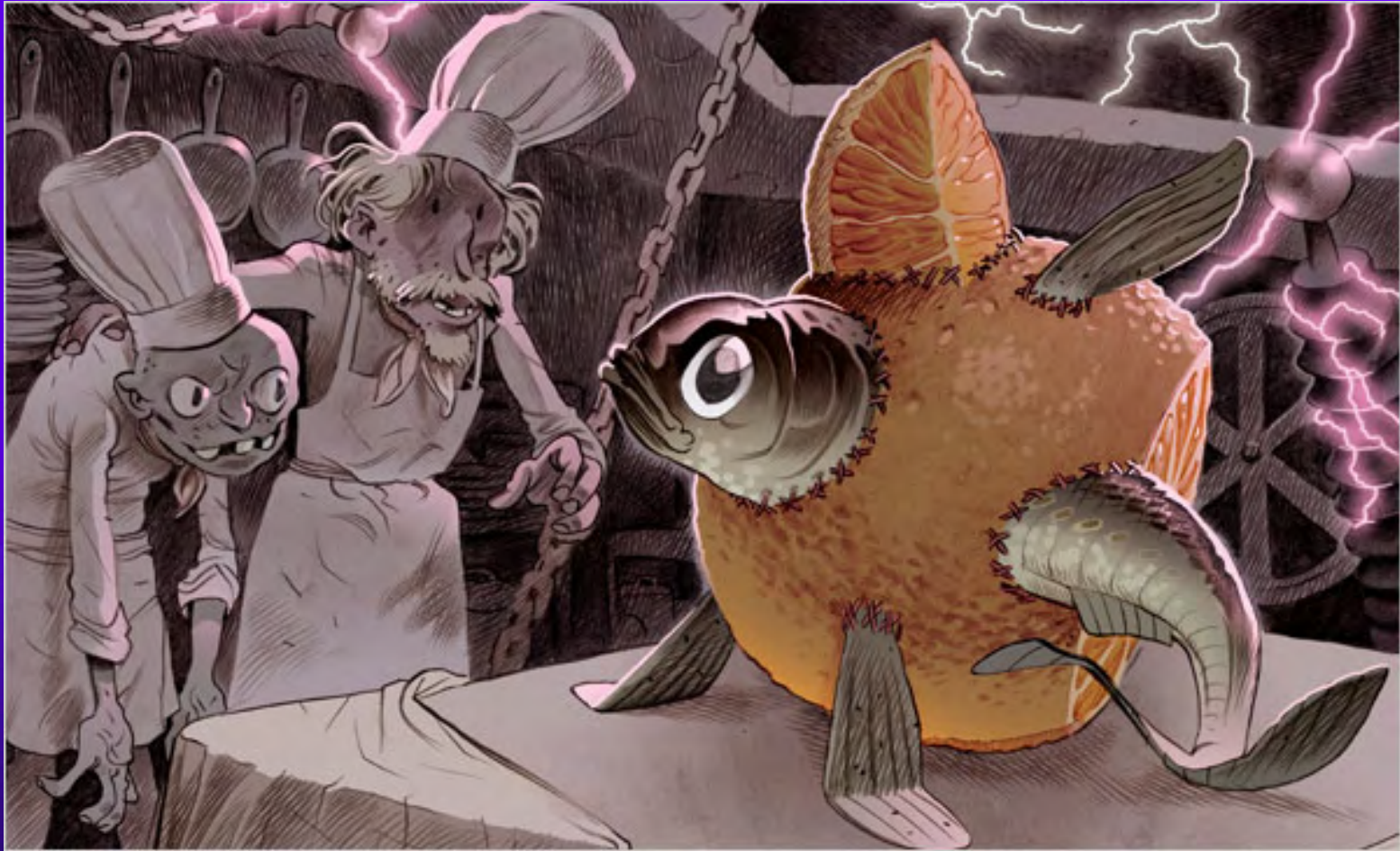
Wegmans bread and muffins

Arnold’s Omega-3 Bread

Breyers Yogurt



# Something Fishy Going On?



# Tropicana Healthy Heart Orange Juice - With Omega-3

Amount per Serving	
Calories 120	Calories from Fat 4
% Daily Value *	
<b>Total Fat 0.5g</b>	1%
Saturated Fat 0g	0%
Trans Fat 0g	
<b>Cholesterol 0mg</b>	0%
<b>Sodium 0mg</b>	0%
<b>Potassium 450mg</b>	13%
<b>Total Carbohydrate 26g</b>	9%
Dietary Fiber 0g	0%
Sugars 22g	
<b>Protein 2g</b>	4%



## Ingredients:

100% pure pasteurized orange juice and MEG-3\* (fish oil and fish gelatin).

\*Ingredient not found in regular orange juice Contains tilapia, sardine and anchovy; **Contains 50mg of EPA and DHA combined per serving,** which is 5% of the 1000mg Daily Value for a combination of EPA and DHA

Servings needed to meet %DV= 20

Calories = 2,400

Sugar = 440g

# The Eggland's Egg and the Ordinary Egg

Amount Per 1 large egg (50 g)	EB Egg (Large)	Ordinary Egg (Large)
Calories	70.0	75.0
Carbohydrate (g)	0	0
Protein (g)	6.3	6.3
Total Fat (g)	4.0	4.5
Saturated Fat (g)	1.2	1.6
Monounsaturated Fat (g)	1.9	1.9
Polyunsaturated Fat (g)	0.8	0.7
Omega 3 (mg)	100	37
<b>DHA (mg)</b>	<b>49</b>	<b>18</b>
<b>EPA (mg)</b>	<b>2</b>	<b>2</b>
<b>ALA (mg)</b>	<b>49</b>	<b>17</b>
Omega 6 (mg)	700	700
Trans Fatty Acid	0	0
Cholesterol (mg)	175	213
Sodium (mg)	60	60



# Designer eggs: an *eggcellent* idea—or more hype than they're cracked up to be?

- ◆ It would take **20 eggs** (and 1,400 calories) to meet the recommended intake of DHA/EPA . . .



. . . and only **one 8 oz serving** of salmon (~370 calories)

# The Next Generation of Pasta...PLUS™



1 serving = 100g

Calories = 370

ALA = 360mg (28% of DV)

DHA/EPA= 0g

Number of servings to meet  
% DV for ALA = 4

Calories = 1,480

Product	Protein g	Fat g	Omega-3* mg	Fiber g
<b>PLUS* (100g)</b>	<b>17</b>	<b>3</b>	<b>360</b>	<b>7</b>
Chicken breast (1 breast)	27	3	30	0
Ground beef 90% lean (1/2 Lb.)	21	10	190	0
Milk, 2% (8 fl. oz.)	8	5	120	0
Egg, hard-boiled (1 large)	6	5	40	0
Spinach (1/2 cup)	4	0	20	4
Broccoli (1/2 cup)	3	0	60	3
Salmon (3 oz.)	22	4	1725	0
Shrimp (boiled) (3 oz.)	18	1	375	0

\* 100g of Barilla PLUS\* (approx. 1 cup uncooked) provides 28% of the daily value for ALA omega-3 (1.3g).  
Source: USDA Nutritional Data Laboratory and ESHA Research

# Smart Balance Peanut Butter

1000 mg omega-3s per serving, which is 63% of 1.6 g daily value (DV) for ALA . . .



Serving Size	2 Tbsp
Calories	200
Total Fat	18g
Saturated	3g
Polyunsaturated	3g
ALA	1000mg
DHA +EPA	0mg
Monounsaturated	12g
Total Carbohydrate	6g
Fiber	2g
Sugar	1g
Protein	7g

. . . number of servings to meet %DV = 1.6

Calories = 320 kcal

Fat = 29g

# Omega-3s Popping Up in Unexpected Places

These additional products are ranked according to combined DHA/EPA content, from most to least

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Product	Serving Size	DHA/EPA (mg):
Egg Creations Liquid Egg	1/4 cup	260
Smart Balance Omega Plus	1 tablespoon	160
Gold Circle Farms Egg	1	150
Italica Omega-3 Olive Oil	1 tablespoon	120
Omega Farms Low-Fat Milk	8 ounces	75
Omega Farms Mild Cheddar Cheese	1 ounce	75
Omega Farms Nonfat Vanilla Yogurt	1 container	75
Silk Plus Omega-3 DHA Soymilk	8 ounces	32
Odwalla Vanilla Soymilk	8 ounces	32
Smart Balance Omega Cooking Oil	1 tablespoon	0
Health Valley Organic Golden Flax Cereal	3/4 cup	0



# Omega-3 “Fortified Foods” . . .what are they really made of?

<b>Product</b>	<b>ALA (milligrams)</b>	<b>Source</b>
Egg Creations Liquid Egg	40	Fish oil
Smart Balance Omega Plus Buttery Spread	40	Fish, soybean, canola
Gold Circle Farms Egg	75	Micro-algae
EggLand's Best Egg	48	Sea kelp, canola
Silk Plus Omega-3 DHA Soymilk	368	DHA algae oil, flax
Odwalla Vanilla Soymilk	298	DHA algal oil,soybeans
Smart Balance Omega Cooking Oil	1,230	Canola and soy oil
Smart Balance Omega Natural Peanut Butter	1,000	Flaxseed oil
Health Valley Organic Golden Flax Cereal	1,000	Flaxseed
Barilla Plus Multigrain Rotini Pasta	360	Flaxseed

# Bottom Line . . .

Not all food sources of omega-3 fats are created equal. Here are the amounts of DHA and EPA, the omega-3 fats backed by the most promising studies, in some foods:

<b>Food</b>	<b>DHA+EPA (mg)</b>
◆ Atlantic salmon, farmed (6 oz. cooked)	<b>3,650</b>
◆ Coho salmon, farmed (6 oz. cooked)	<b>2,180</b>
◆ Swordfish (6 oz. cooked)	<b>1,390</b>
◆ Bumblebee salmon (Red, Pink or Blueback, 3 oz.)	<b>1,200</b>
◆ Sardines in vegetable oil, drained (3 oz.)	<b>840</b>
◆ Fish sticks (6) <b>680</b> Shrimp (3 oz.)	<b>270</b>
◆ Smart Balance Omega Plus Buttery Spread (1 tbsp.)	<b>160</b>
◆ Land O Lakes Omega-3 Eggs (1)	<b>150</b>
◆ Breyers Smart DHA Omega-3 yogurt (6 oz.)	<b>30</b>
◆ Horizon Organic DHA Omega-3 milk (1 cup)	<b>30</b>
◆ Silk Plus Omega-3 DHA Soy Milk (1 cup)	<b>30</b>

# Buyer Beware . . . even a smart shopper can be fooled

Here are a few examples of tricky labeling:

- ◆ **Breyer's Smart! Yogurt** doesn't say that each serving has just 32 mg of DHA—as much as you'd get in *three-quarters of a teaspoon of salmon*. And Breyer's vague "boost your brain" claim needs no evidence.
- ◆ **Silk Soymilk Plus Omega-3 DHA's** label boasts that each cup of milk has "400 mg of beneficial Omega-3," but only the most diligent label readers will notice that the soy milk only contains 32 mg of DHA per serving—*again, the amount in just a bite of salmon*. The remaining omega-3s are ALA (which just about everyone gets enough of, thanks to soy and canola oil).
- ◆ **Kashi Go Lean Crunch! Honey Almond Flax** cereal advertises 500 mg of omega-3, but doesn't specify whether it's ALA, DHA or EPA. **Unless the label promises EPA or DHA (and lists fish, fish oil or algal oil on the ingredient label), it's safe to assume that any omega-3 claim refers to ALA**—especially when the product contains flax, soybean oil, or canola oil.
- ◆ **Land O Lakes Omega-3 All-Natural Eggs'** label states "Contains 350 mg of omega-3 fatty acids per serving." However, tests by an independent laboratory found that less than half of this omega-3 is DHA and EPA.



Will this REALLY make your child smarter . .  
or just overweight?



Mr. Cookie contains 25mg of omega-3 fatty acids (DHA) and (EPA), and is trans-fat free. One cookie meets <3% of the recommended intake

## Mr. Cookie

1 cookie = 280 kcal

Total Fat = 13g

Saturated = 4g

Omega-6 = 1.5g

Omega-3 = 0.5g

Number of cookies  
needed to meet  
%DV = 33 cookies

Calories = 9,240

# How to Incorporate More Omega-3 Into Your Diet

## Top Ten Food Sources of Omega-3 Fatty Acids

Food	Serving size	Calories	Amount (g)	DV %	Rating
Flaxseeds	2 tbs	95.3	3.51	146.3	excellent
Walnuts	0.25 cup	163.5	2.27	94.6	excellent
Salmon, chinook, baked/broiled	4 oz-wt	261.9	2.09	87.1	excellent
Winter squash, baked, cubes	1 cup	80.0	0.34	14.2	good
Tofu, raw	4 oz-wt	86.2	0.36	15.0	good
Halibut, baked/broiled	4 oz-wt	158.8	0.62	25.8	good
Soybeans, cooked	1 cup	297.6	1.03	42.9	good
Shrimp, steamed/boiled	4 oz-wt	112.3	0.37	15.4	good
Snapper, baked/broiled	4 oz-wt	145.2	0.36	15.0	good
Scallops, baked/broiled	4 oz-wt	151.7	0.35	14.6	good

# DHA and EPA Content of Supplements (per capsule)

	Calories	DHA,mg	EPA, mg	DHA/EPA
ABC Vitamin Life	10	240	360	0.67
Max EPA	10	120	180	0.67
Herbal Remedies	5	150	200	0.75
Omega Max	10	240	360	0.67
Nordic Naturals (Ultimate Omega)	10	225	325	0.69
nutraOrigin	10	240	420	0.58

# Choosing the Best Supplement



- ◆ **International Fish Oil Standards (IFOS)** - is a "watch dog" for fish oil supplements. Always look for a supplement with their seal of approval.
- ◆ **The IFOS tests for purity and potency.** When you find a supplement with the IFOS seal of approval, you get a high quality supplement meeting the strictest standards. And it has the highest level of beneficial Omega 3 and the lowest level of impurities like dioxins and PCBs.
- ◆ **Pharmaceutical grade fish oil** - Purified through a process called molecular distillation, pharmaceutical fish oil results in pure odorless and tasteless oil
- ◆ **DHA and EPA** - Choose a supplement that has adequate DHA and EPA, preferably more DHA
- ◆ **Read the label** - Many supplements contain additives, artificial colorings, artificial flavorings, and preservatives.

# Four Most Commonly Farmed Fish

- ◆ Atlantic Salmon
- ◆ Trout
- ◆ Tilapia
- ◆ Catfish

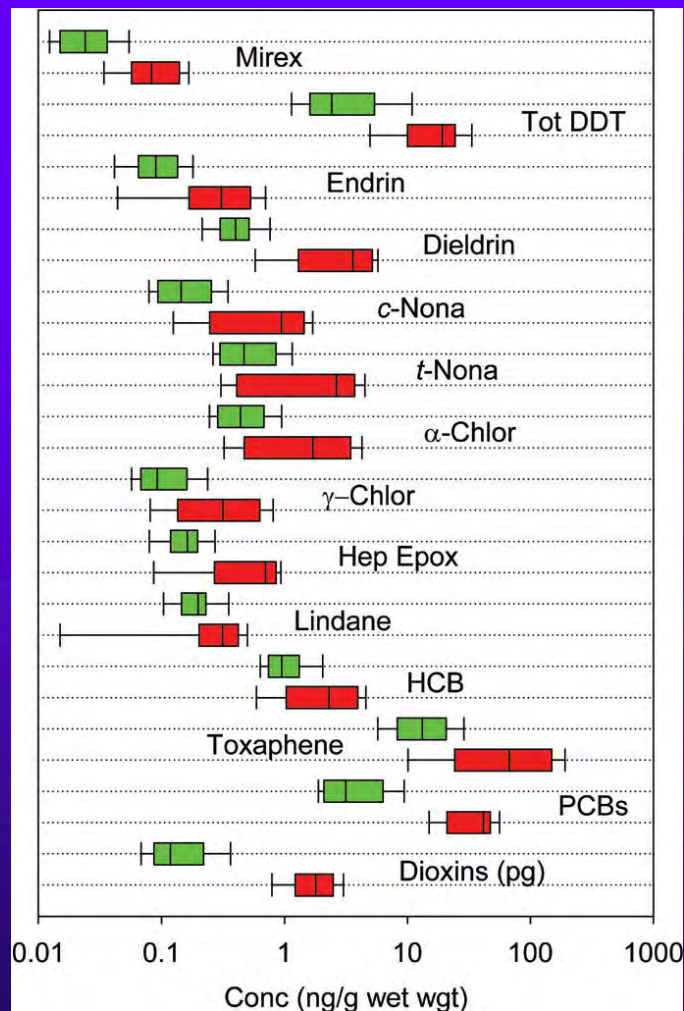
Weaver et al., The Content of Favorable and Unfavorable PUFA Found in Commonly Eaten Fish. J Am Diet Assoc, 108:1178-1185, 2008

## Fatty Acid (g) Profile of Farmed and Wild Popular Fish (100g cooked portions)

	Tilapia	Catfish		Atlantic Salmon		Rainbow Trout	
Fatty Acid		Farmed	Wild	Farmed	Wild	Farmed	Wild
C 18:2	0.3	1.0	0.14	0.7	0.2	0.95	0.3
EPA+ DHA	0.3	0.15	0.24	2.2	1.8	1.2	1.0

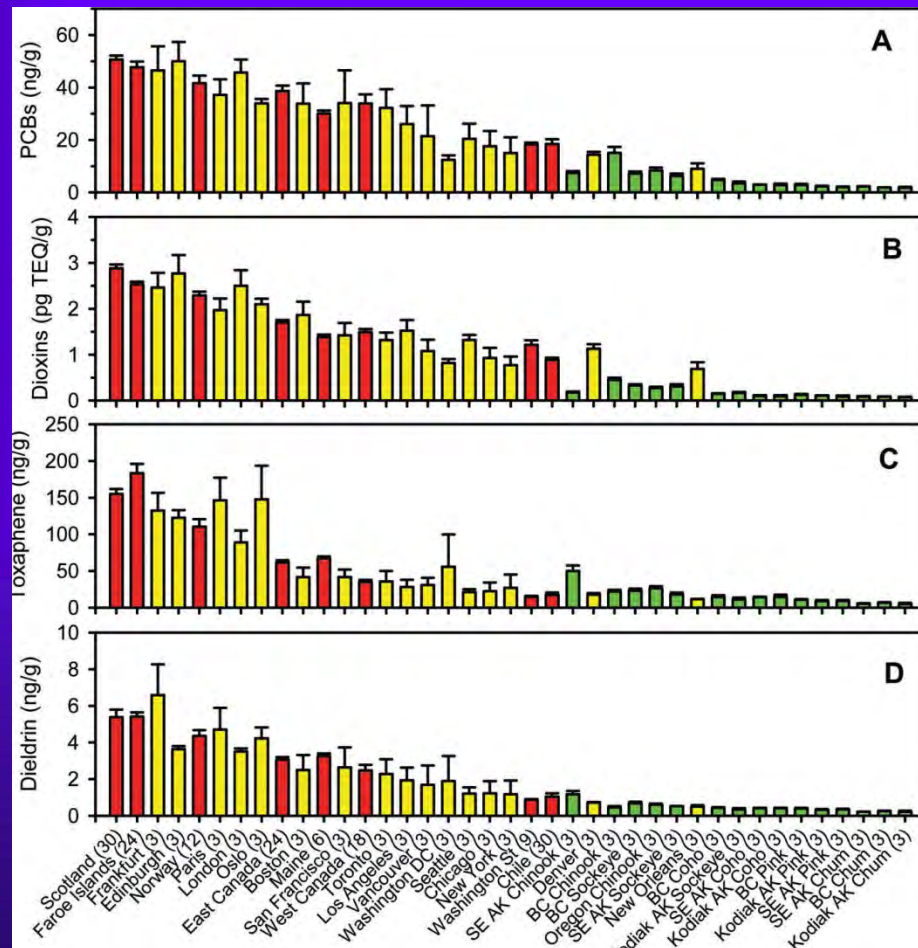
USDA Nutrient Data Lab  
[www.nal.usda.gov/fnic/foodcomp](http://www.nal.usda.gov/fnic/foodcomp)

# Concentrations of Contaminants in Farmed Salmon



Concentrations (in ng/g wet weight, except dioxins) of 14 contaminants found in farm-raised (red bars) and wild (green bars) salmon. The vertical lines represent the 10th, 50th, and 90th percentiles, and the boxes represent the 25th to 75th percentiles. Dioxins are in pg of World Health Organization toxic equivalents (WHO-TEQs) per g of wet weight and include polychlorinated dibenzo-*p*-dioxins and dibenzofurans and dioxin-like PCBs. Typically 75% of the total TEQ was due to the dioxin-like PCBs. Other abbreviations are as follows: Tot DDT, the *p,p* and *o,p* isomers of DDT, DDD, and DDE; Nona, nonachlor; Chlor, chlordane; Hep Epox, heptachlor epoxide.

# Concentrations of Contaminants in Farmed Salmon



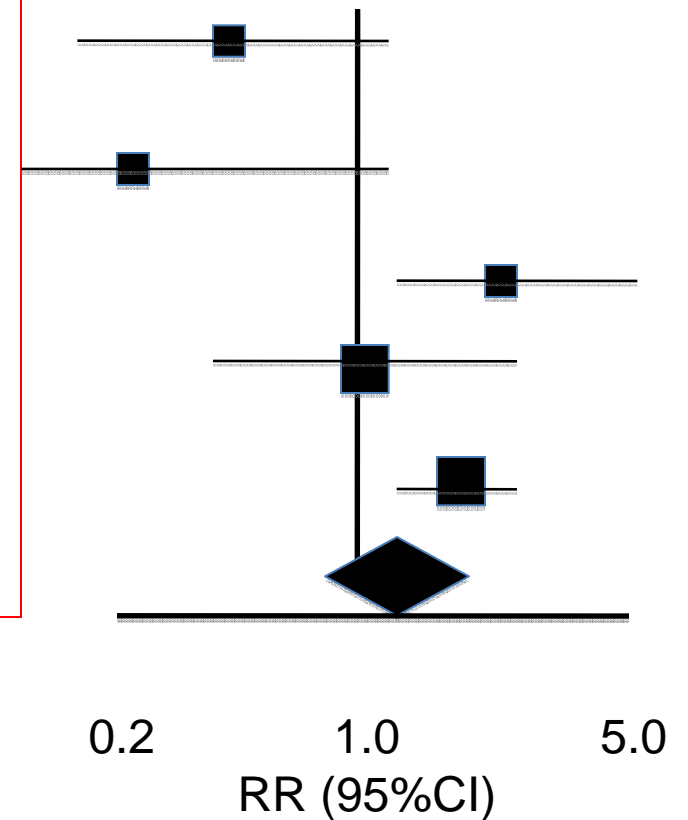
Concentrations of (A) PCBs in ng/g wet weight, (B) dioxins in pg of WHO-TEQ/g wet weight, (C) toxaphene in ng/g wet weight, and (D) dieldrin in ng/g wet weight in farmed, supermarket, and wild salmon. The concentrations are all given as functions of the locations where the salmon were grown or purchased.

Red represents farmed salmon, green represents wild salmon, and yellow represents salmon purchased at supermarkets.

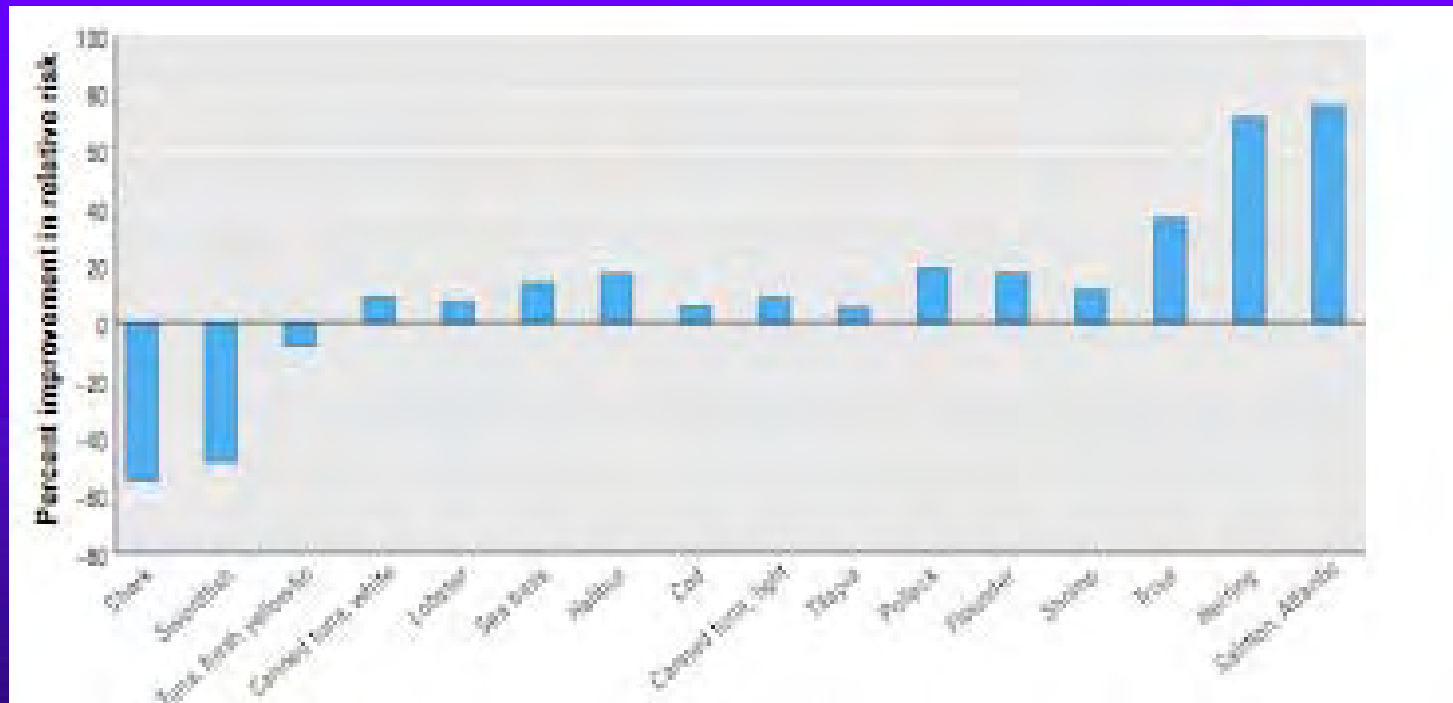
The error bars represent standard errors. The number of samples is given in parentheses after the location identifier. The locations are sequenced by average contaminant rank.

# Risk of Incident CHD with Higher Levels of Mercury Exposure

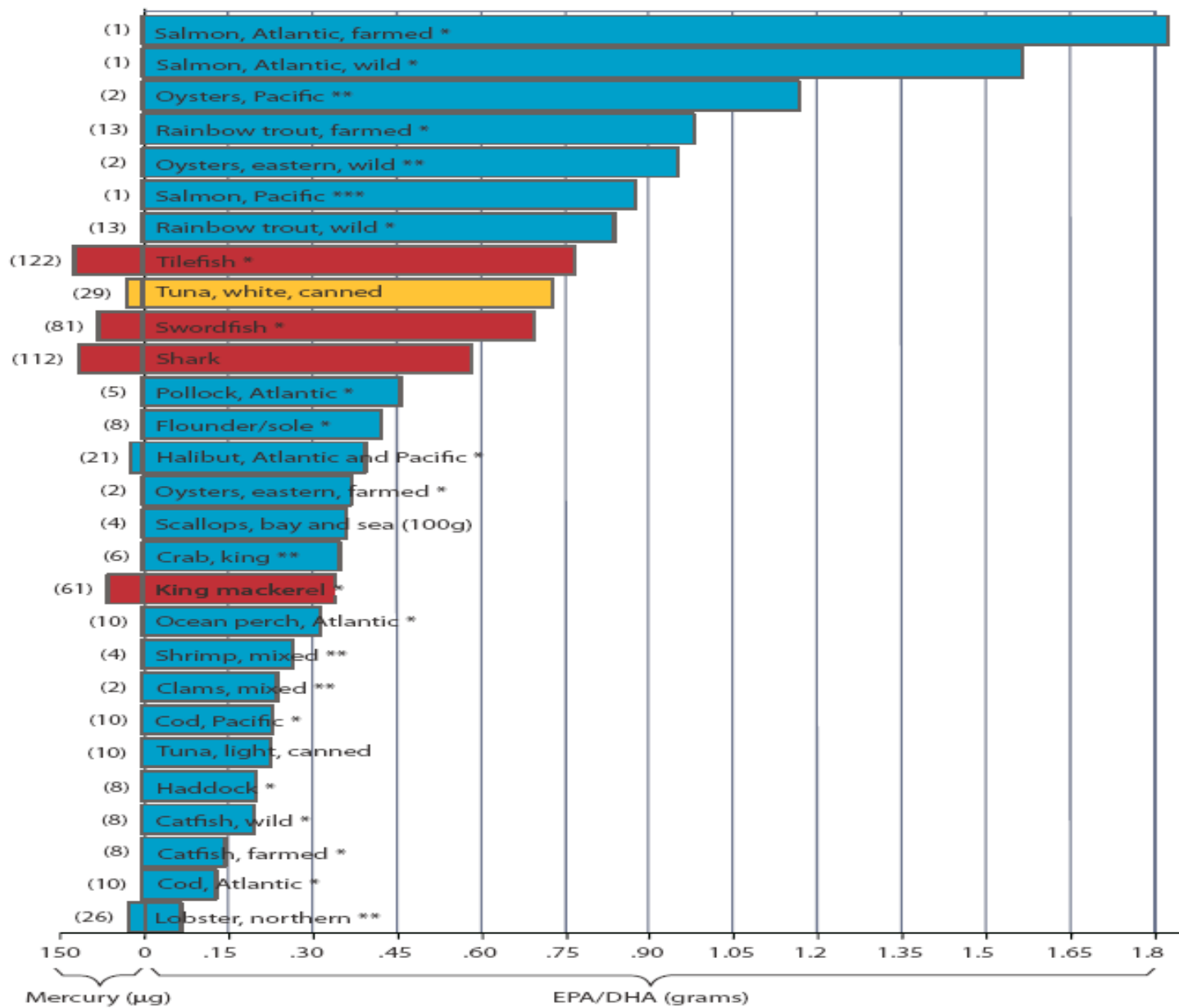
Source	Study Design	# Events	RR(95% CI)
Ahlqwist et al., 1999	Prospective	87	0.71(0.4-1.3)
Hallgren et al., 2001	Prospective	78	0.51(0.2-1.2)
Guallar et al., 2002	Retrospective	684	2.16(1.1-4.3)
Yoshizawa et al., 2002	Prospective	470	1.03(0.7-1.7)
Virtanen et al., 2005	Prospective	282	1.66(1.2-2.3)
<b>Overall</b>			<b>1.12(0.7-1.8)</b>



## Estimated Net Effect of MeHg and Fish Oils on CVD Risk, one 6-oz Fish Meal Per Week



## EPA/DHA (mg) Content and Methylmercury ( $\mu\text{g}$ ) Content (3-oz. Seafood)



# Farm Raised vs Wild?

- ◆ Farm-raised salmon receive vaccinations and antibiotics to keep them healthy in their unhealthy living conditions.
- ◆ Farm-raised salmon contain a synthetic pigment to make them pink in color, whereas wild salmon get their pink color from eating pink krill.
- ◆ Farmed salmon have a higher toxic equivalency score than any other food. Farm-raised salmon have significantly higher amounts of dioxin than wild caught salmon.

# Do the Benefits Outweigh the Risk?

	EPA/DHA mg/serving (Serving Size†)	EPA/DHA mg/100 g (3.5 oz)	Selenium µg/g (ppm)	Mercury µg/g (ppm)	PCBs ng/g (ppb)	Dioxins, TEQ pg/g (ppt)‡
<b>Farmed</b>	4504 (6 oz)	2648	0.41	<0.05	21 (2001- 2003)	0.50 (2001- 2003)
<b>Wild</b>	1774 (6 oz)	1043	0.46	<0.05	3 (2002)	0.03 (2002)

Per 100,000 individuals, consumption of farmed vs wild salmon would result in 24 vs 8 excess cancer deaths, respectively, while consumption of either farmed or wild salmon would result in 7125 fewer CHD deaths (Foran JA, et al., *J Nutr.* 2005;135:2639-2643).

# Summary

- ◆ Where nutrients are found naturally is the best place to get them. And one of the places where omega-3 fatty acids, particularly the long chain fatty acids DHA + EPA, are abundant is in oily, cold-water fish
- ◆ Plant sources of omega-3 fatty acids contain the short chain fatty acid ALA, once eaten, the body turns ALA into DHA and EPA, though not very efficiently -- some estimates say the conversion is as low as 5%.
- ◆ Therefore, focus on consuming DHA and EPA fatty acids
- ◆ With the host of functional foods popping up on the market be cautious when purchasing foods with omega-3s. Labels may say 'a good source of omega-3s,' but there really isn't a definition of that.
- ◆ Read labels to determine the amount and type of omega-3 fatty acids in the foods along with the amount of calories you may end up consuming
- ◆ For individuals who do not like or can not eat fish these fortified foods provide a good alternative but for overall health benefits . . .

**It's No Fish Tale – Fish is Best**

