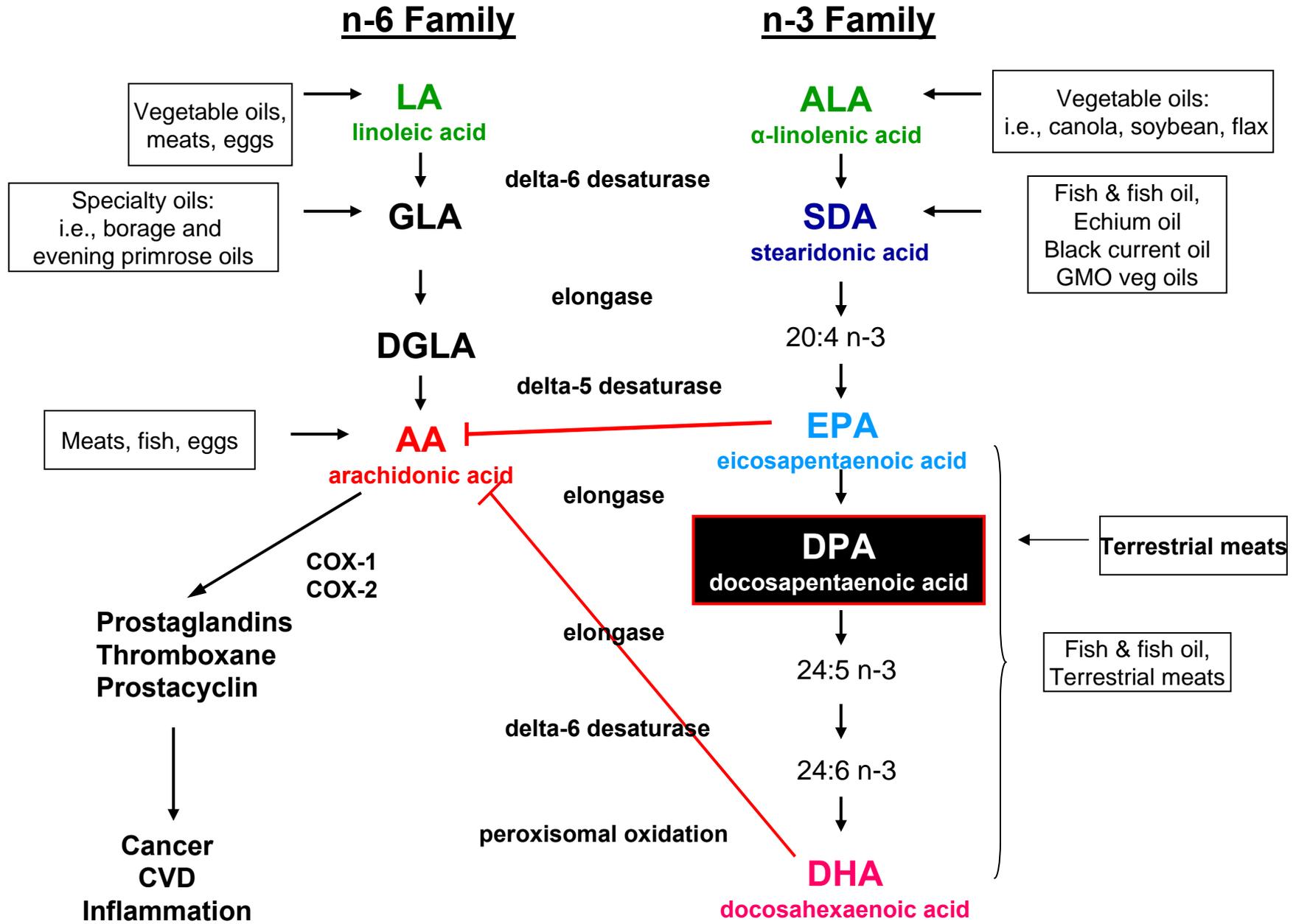


**Innovative Dietary Sources of Omega-3 Fatty Acids
or
“The challenges of monitoring intake of LC N-3 PUFAs”**

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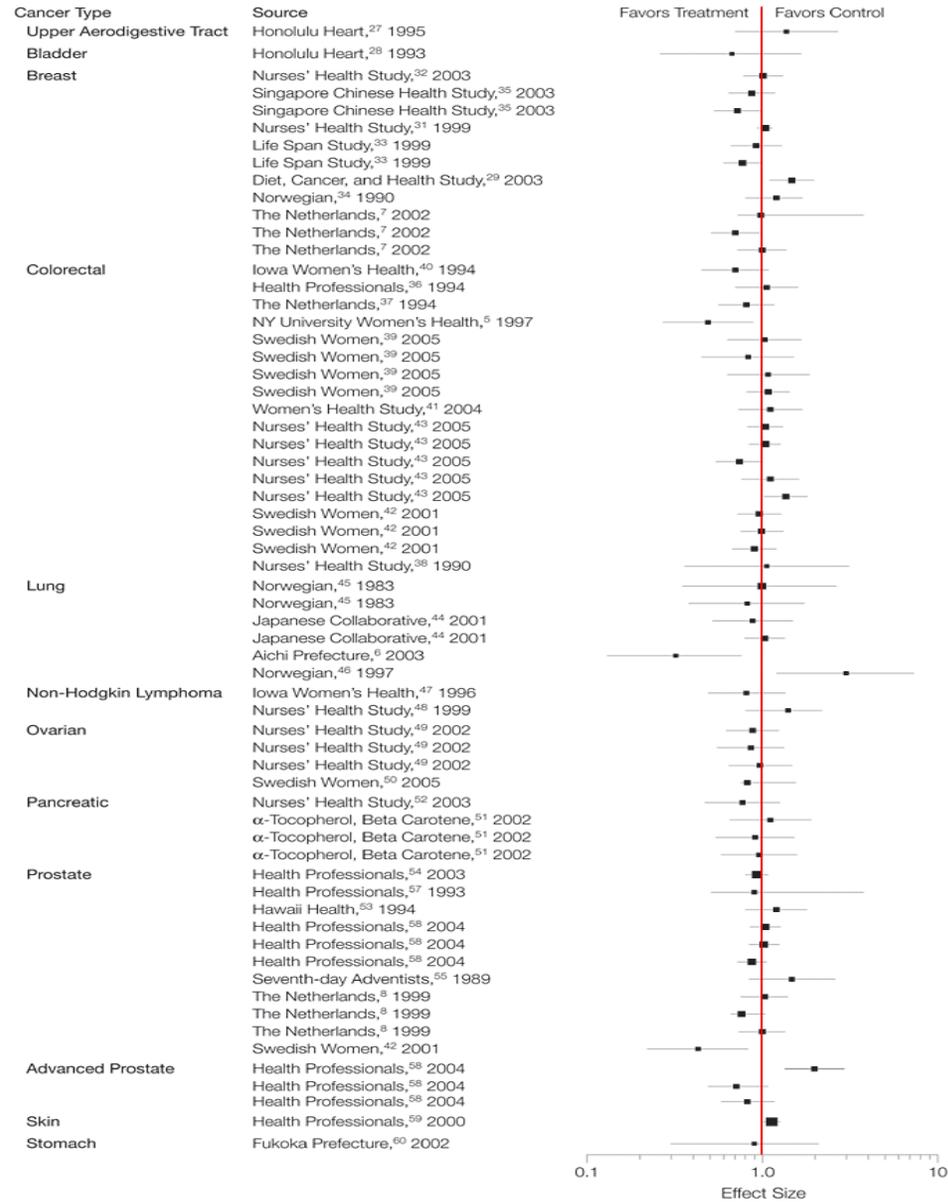
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The Effect of EPA/DHA (fish & fish oil) Consumption on CVD Mortality

Study	N-3 PUFA g/day	Effect on CVD Mortality (RR)
Ascherio (1995)	70 mg/d vs 580 mg/d	NS (n=44,895)
Singh (1997)	+1.08 g/d (EPA)	↓ (n=122)
Albert (1998) (Physicians Health Study)	10 mg/d vs ≥247 mg/d	NS (n=20,551)
Marchioli (2002) (GISSI Prev. Trial)	+1 g/d (EPA+DHA)	↓ (n=11,323)
Hu (2002)	67 mg/d vs 533 mg/d	↓ (n=84,688)
Hu (2003) (Nurses Health Study)	40 mg/d vs ≥250 mg/d	↓ (n=5,103)
Mozaffarian (2005)	<250 mg/d vs ≥250mg/d	↓ (n=45,722)
Yzebe (2004)	Meta-Analysis	↓ (n=13,780)

Risk of Developing Cancer: Highest Group vs Lowest Group of Omega-3 Fatty Acid



MacLean, C. H. et al. JAMA
2006;295:403-415.



“Based on analysis of a single 24 hour recall in NHANES III, only 25% of the US population reported any amount of daily EPA or DHA intake.”

Translation: 75% of the US population is VEGANS

<http://www.ahrq.gov/clinic/tp/o3cardtp.htm>

USDA Database

Can it be related to reported levels of long chain highly unsaturated fatty acid compositions, i.e., AA, EPA, DPA, DHA?

Why is this important?

- The USDA database is the gold standard database for nutrient composition
- The USDA database is the primary source for most of the food analysis **software** used in research
- It is used in setting public policy with regards to recommendations

Beef, rib eye, small end (ribs 10-12), separable lean and fat, trimmed to 0" fat, all grades, cooked, broiled

Refuse: 8% (Bone and connective tissue)

NDB No: 13952 (Nutrient values and weights are for edible portion) *(as of April 22, 2007)*

Nutrient	Units	Value per 100 grams	Number of Data Points	Std. Error
<u>Proximates</u>				
Water	g	57.52	20	0.591
Protein	g	27.27	20	0.378
Total lipid (fat)	g	14.74	20	0.788
Ash	g	1.10	20	0.02
<u>Fatty acids, total polyunsaturated</u>				
18:2 undifferentiated	g	0.547	0	
18:3 undifferentiated	g	0.402	0	
18:4	g	0.093	0	
18:4	g	0.000	0	
20:4 undifferentiated	g	0.000	0	
20:4 undifferentiated	g	0.053	0	
20:5 n-3 (EPA)	g	0.000	0	
22:5 n-3 (DPA)	g	0.000	0	
22:6 n-3 (DHA)	g	0.000	0	

However, 8 oz of Rib Eye contains 67 mg EPA/DPA/DHA!

And ~70% of that is DPA, not EPA or DHA!

Taber et al., Lipids 33:1151, 1998

DPA: the forgotten n-3 PUFA?

- DPA (22:5 n-3) is a major LC n-3 PUFA in terrestrial meats and maybe of particular importance in assessing risk for chronic diseases.
- For example, **Howe et al.** estimates
 - that **43%** of the LC n-3 PUFA in the Australian diet is derived from land-based meats
 - **DPA is the major** LC n-3 PUFA in those food sources



Current estimates for the amounts of EPA+DHA in the diets of various countries:

USA	~100-200 mg/d	(Kris-Etherton 2003)
Canada	143 mg/d (pregnant women)	(Holub 2005)
Australia	246 mg/d	(Howe 2004)
Germany	215/315 mg/d (women/men)	(Linseisen 2000)
France	400/500 mg/d (women/men)	(Astorg 2004)

Problems with modifying foods with LC n-3 PUFA:

- Our food supply is rapidly changing with regards to n-3 PUFA content and this complicates our **inability** to accurately assess n-3 PUFA intake because
 1. We lack appropriate tools to do this **now**
 2. Enriching/fortifying non-traditional foods will provide a continually moving target

Non-Traditional Dietary Sources of N-3 PUFA

Food	Serving	ALA (mg)	EPA+DHA (mg)
Breads and Pasta	100 g	113-1600	8-80
Cereals (and granola bars)	1 cup (55 g)	1000-4900	--
Milk	250 ml	--	10-190
Eggs	1 egg (50 g)	100-600	86-150
Processed Meats	100 g	490	88-190
Salad Dressing	14-31 g	2000-4000	700
Margarine spreads	10-100 g	300-1000	60-150
Pizza	1 slice	--	32
Nutrition Bars	50 g	70-2200	3-115
Juices	6 oz	--	100

Wegman's n-3 Breads
 • microencapsulated powder
 (80 mg LC n-3)



Omega 3 Super Eggs
 Flax fed chickens
 • Texas

per egg
 - OMEGA 3 DHA 150 mg

Tip-Top Bakeries
 • Australia



Parmalat
 Omega 3 Milk
 • Europe/S.A



per 200 ml
 - OMEGA 3 120 mg
 - OMEGA 3 EPA 60 mg
 - OMEGA 3 DHA 60 mg

Pasta with Omega 3 eggs
 • France



per slice
 - OMEGA 3 121 mg
 - OMEGA 3 ALA 84 mg
 - OMEGA 3 EPA 6 mg
 - OMEGA 3 DHA 27 mg

**Microencapsulated
Tuna oil (*Nu Mega*)**



per slice

- OMEGA 3 32 mg

Cheeses



per
serving

- OMEGA 3 50 mg

Orange Juice
with MEG-3* (fish oil and fish gelatin)
•Ocean Nutrition Canada

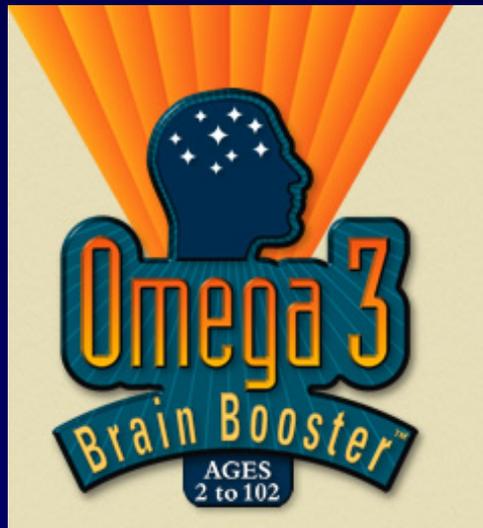


The primary ways that these products are being enriched/fortified with n-3 PUFA:

- Bio-delivery: feeding an animal the n-3 PUFA precursor (i.e., ALA) and enriching their tissues with LC n-3 PUFA (i.e., EPA, DPA in meats, and DHA in eggs)
- Adding the n-3 PUFA rich/enriched oils directly to foods (post-harvest modification of the foods)
- Post harvest modification of the oils: Micro-encapsulation of the oil to maintain stability and mask flavors

- **BASF, Roche, Clover, Nu-Mega, Wudel, Inc and Ocean Nutrition Canada (ONC), have created microencapsulated fish oil powders for use in food products.**
- **These companies used spray dried emulsion technology or a process involving complex coacervation to form powders to create the shell of the microcapsule.**

**A powder you add to foods
to supplement the diet**



Wudel, Inc

**Omega-3 Fish Oil Powder you can add to
juice or food**

- 500mg Omega-3 (DHA + EPA) per serving
- No fish taste or smell
- No large fish oil capsule
- No unpleasant fish burps
- Convenient delivery system for adults and children

**Ubisol-Aqua™ using nanotechnology has
generated a water soluble fish oil/ n-3 PUFA
•by Zymes LLC**



Ideal for fish oil / omega 3-fortified fruit juices,
i.e., grape juice or in apple juice

Development of plant sources LC n-3 PUFA

- **DHA generated from algae, i.e., Martek's DHASCO oil (40% DHA)**
- **Genetically modified plant oils, (i.e., Monsanto's SDA-enriched canola oil, and genetically-modified soybean by a number of companies)**

SUMMARY

- **These changes further exacerbate our inability to maintain accurate, up-to-date food composition databases for n-3 PUFA, and further challenge the ability of scientists to ascertain true health risks associated with their consumption.**
- **With the ability to provide cheaper and safer sources of LC n-3 PUFA (compared to fish), along with the technological advances that improve palatability and stability, commercial development of non-traditional foods that are enriched/fortified with n-3 PUFA will only increase.**
- **The Result: Quantifying LC n-3 PUFA intakes in the US will become even more daunting.**

Thank You

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