The ABCs of Omega-3s for Dry Eye and More

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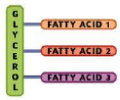
Lipids

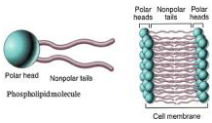
- **Fatty Acids**
- **Triglycerides**
- **Phospholipids**
- **Steroids**
  - Cholesterol
  - Bile salts
  - Vitamin D
  - Adrenocortical hormones
  - Sex hormones
- **Eicosanoids**
  - Prostaglandins
  - Leukotrienes
- **Other lipids**
  - Carotenes
  - Vitamin E
  - Vitamin K
  - Lipoproteins

Fatty Acids

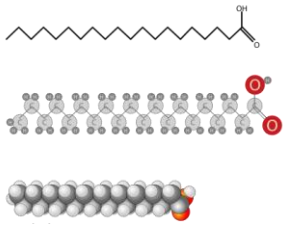
- Triglycerides



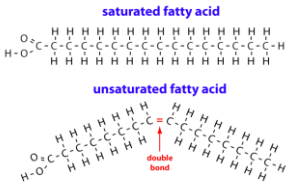
- Phospholipids



Fatty Acids



Fatty Acids



Hydrogenation

INGREDIENTS: MADE FROM ROASTED PEANUTS AND SUGAR, CONTAINS 2% OR LESS OF: MOLASSES, FULLY HYDROGENATED VEGETABLE OILS (RAPESEED AND SOYBEAN), MONO AND DIGLYCERIDES, SALT.
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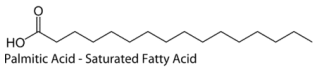
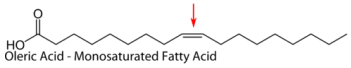
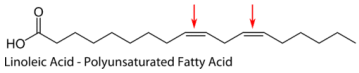
Fatty Acids

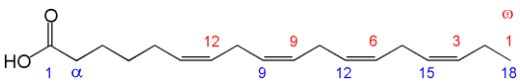

Palmitic Acid - Saturated Fatty Acid


Oleric Acid - Monosaturated Fatty Acid

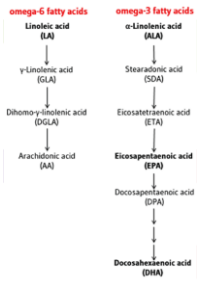

Linoleic Acid - Polyunsaturated Fatty Acid

http://www.ck12.org/book/CK-12-Chemistry-Concepts-Intermediate/section/26.8/

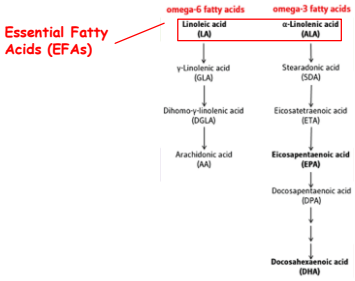
Omega Fatty Acids



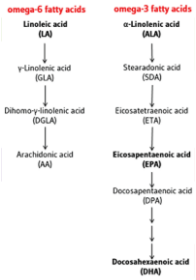
Omega-6 and Omega-3 Polyunsaturated Fatty Acids



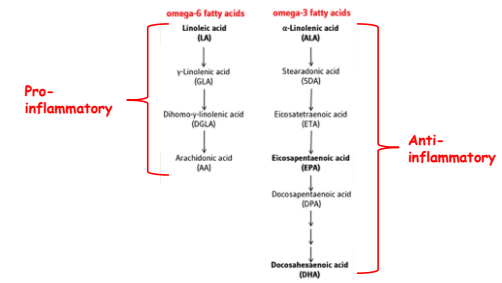
Omega-6 and Omega-3 Polyunsaturated Fatty Acids



Omega-6 and Omega-3 Polyunsaturated Fatty Acids



Omega-6 and Omega-3 Polyunsaturated Fatty Acids



Omega-3,6 in the Diet

- Ideal Ratio of omega-6 to omega-3 is **4:1 or less**
- Typical western diet contains a ratio of **20:1** or more

Dietary Sources of Omega-6 and Omega-3 Fatty Acids

- Omega-6
  - Vegetable oils (soy, corn, sunflower, etc.)
  - Peanut oil
  - Salad dressing, mayo
  - Processed foods (cereals, bread, white rice)
  - Eggs
  - Baked goods
- Omega-3
  - Oily fish (herring, salmon, trout, tuna)
  - Flaxseed
  - Dark green, leafy vegetables
  - Walnuts
  - Grass-fed beef

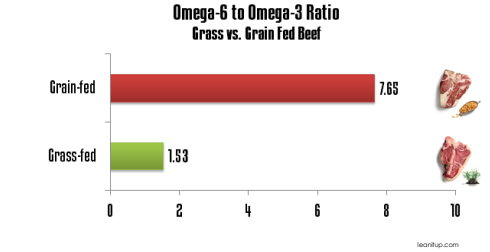
NUTRITION JOURNAL

REVIEW Open Access

A review of fatty acid profiles and antioxidant content in grass-fed and grain-fed beef

Table 2 Comparison of mean polyunsatured fatty acid composition (expressed as mg/g of fatty acid or as a % of total lipid) between grass-fed and grain-fed cattle

Author, publication year, breed, treatment	Fatty Acid											
	C18:1 t11 Vaccenic Acid	C18:2 n-6 Linoleic	Total CLA	C18:3 n-3 Linolenic	C20:5n-3 EPA	C22:5n-3 DPA	C22:6n-3 DHA	Total PUFA	Total MUFA	Total n-6	Total n-3	n-6/n-3 ratio
Alfaia, et al., 2009, Crossbred steers	g/100 g lipid											
Grass	1.35	12.55	5.14*	5.53*	2.13*	2.56*	0.20*	28.99*	24.69*	17.97*	10.41*	1.77*
Grain	0.92	11.95	2.65*	0.48*	0.47*	0.91*	0.11*	19.06*	34.99*	17.08	1.97*	8.99*
Leheska, et al., 2008, Mixed cattle	g/100 g lipid											
Grass	2.95*	2.01	0.85*	0.71*	0.31	0.24*	na	3.41	42.5*	2.30	1.07*	2.78*
Grain	0.51*	2.38	0.48*	0.13*	0.19	0.06*	na	2.77	46.2*	2.58	0.19*	13.6*
Garcia, et al., 2008, Angus steers	% of total FAs											
Grass	3.22*	3.41	0.72*	1.30*	0.52*	0.70*	0.43*	7.95	37.7*	5.00*	2.95*	1.72*
Grain	2.25*	3.93	0.58*	0.74*	0.12*	0.30*	0.14*	9.31	40.8*	8.05*	0.86*	10.38*
Ponnampalam, et al., 2006, Angus steers	mg/100 g muscle tissue											
Grass	na	108.8*	14.3	32.4*	24.5*	36.5*	4.2	na	930*	191.6	97.6*	1.96*
Grain	na	167.4*	16.1	14.9*	13.1*	31.6*	3.7	na	1729*	253.8	63.3*	3.57*
Nuernberg, et al., 2005, Simmental bulls	% of total fatty acids											
Grass	na	6.56	0.87*	2.22*	0.94*	1.32*	0.17*	14.29*	56.09	9.80	4.70*	2.04*
Grain	na	5.22	0.72*	0.46*	0.08*	0.29*	0.05*	9.07*	55.51	7.73	0.90*	8.34*
Descalzo, et al., 2005, Crossbred steers	% of total FAs											
Grass	4.2*	5.4	na	1.4*	tr	0.6	tr	10.31*	34.17*	7.4	2.0	3.72*
Grain	2.8*	4.7	na	0.7*	tr	0.4	tr	7.29*	37.83*	6.3	1.1	5.73*
Realini, et al., 2004, Hereford steers	% fatty acid within intramuscular fat											
Grass	na	3.29*	0.53*	1.34*	0.69*	1.04*	0.09	9.96*	40.96*	na	na	1.44*
Grain	na	2.84*	0.25*	0.35*	0.30*	0.56*	0.09	6.02*	46.36*	na	na	3.00*



Omega-3 and Dry Eye

- Increased clarity of Meibomian gland secretions
- Decrease in lacrimal gland cell apoptosis
- Increased TBUT
- Increased Shirmer
- Decreased OSDI

Other Eye Conditions

- Macular Degeneration
- Retinitis Pigmentosa
- Glaucoma
- Cataract
- Uveitis

Summerton S. Omega-3s: What They Can Do For You. Review of Optometry. 2015 Jul;152(7):32-38.

Macular Degeneration

- "Studies have suggested eating fish more than twice a week may cut risk of developing macular degeneration in half. Additionally, a diet low in trans- and unsaturated fat and rich in omega-3 fatty acids and olive oil may reduce the risk of age-related macular degeneration."

Summerton S. Omega-3s: What They Can Do For You. Review of Optometry. 2015 Jul;152(7):32-38.

Retinitis Pigmentosa

- "Patients with X-linked retinitis pigmentosa have low levels of DHA in red blood cells compared with normal sighted control subjects. DHA supplementation may correct a fatty acid deficiency and rod ERG functional loss in X-linked retinitis pigmentosa."

Summerton S. Omega-3s: What They Can Do For You. Review of Optometry. 2015 Jul;152(7):32-38.

Glaucoma

- "A small study found that primary open-angle glaucoma patients have reduced blood levels of DHA and EPA compared with normal controls. EPA and DHA appear to modulate impaired systemic microcirculation, ocular blood flow and optic neuropathy associated with glaucoma."

Summerton S. Omega-3s: What They Can Do For You. Review of Optometry. 2015 Jul;152(7):32-38.

Cataract

- "The Nurses' Health Study showed women with the highest EPA/DHA intake had 12% lower risk for cataract extraction. Those who had more than three servings of fish per week had a 19% lower risk."

Summerton S. Omega-3s: What They Can Do For You. Review of Optometry. 2015 Jul;152(7):32-38.

Uveitis

- "In vivo EPA inhibits multiple inflammatory molecules. In animal models, oral EPA showed a decrease in leukocyte adhesion to retinal vessels, a decrease in leukocyte infiltration into the vitreous cavity along with a decrease in pro-inflammatory cytokines."

Summerton S. Omega-3s: What They Can Do For You. Review of Optometry. 2015 Jul;152(7):32-38.

Coronary Heart Disease

- In the largest randomized controlled trial of supplemental omega-3 fatty acids to date, the GISSI-Prevenzione Trial, CHD patients who received supplements providing 850 mg/day of EPA + DHA for 3.5 years had a risk of sudden death that was 45% lower than those who did not take supplements; supplement users also experienced a 20% lower risk of death from all causes compared to non-supplement users.
- The American Heart Association recommends that individuals with documented CHD consume approximately 1 g/day of EPA + DHA, preferably by consumption of oily fish

Diabetes Mellitus

- Increasing EPA and DHA intakes may be beneficial to diabetic individuals, especially those with elevated serum triglycerides or with a history of MI.
- There is no compelling evidence that daily EPA + DHA intakes of less than 3 g/day adversely affect long-term glycemic control in diabetics.
- The American Diabetes Association recommends that diabetic individuals increase omega-3 fatty acid consumption by consuming two to three 3-oz servings of fish weekly.

http://lpi.oregonstate.edu/mic/other-nutrients/essential-fatty-acids#supplements

Rheumatoid Arthritis

- A 2012 meta-analysis concluded omega-3 consumption of ≥2.7 g/day for a minimum of three months reduced nonsteroidal anti-inflammatory drug (NSAID) use but had no significant effect on tender joint count, swollen joint count, morning stiffness, or physical function compared to placebo.
- A 2012 systematic review concluded that there appears to be a consistent, though modest, benefit of marine-derived omega-3 PUFA (average intake ~3g/day) on some clinical symptoms of RA.
- Thus, high-dose supplementation of long-chain omega-3 PUFA spares the need for anti-inflammatory medications and may reduce joint pain and swelling in some RA patients.

http://lpi.oregonstate.edu/mic/other-nutrients/essential-fatty-acids#supplements

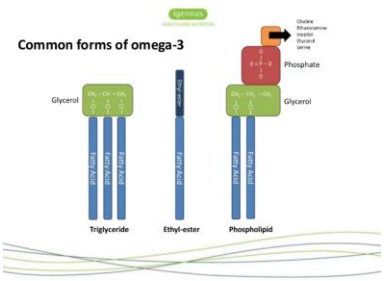
Omega-3 Dry Eye Supplements

	Manufacturer	Dose	Count	Cost	$/month	EPA	DHA	Total	Form
BioTears®	Biosyntrx®	2	120	$37	$19	21	24	45	EE
EZ Tears™	ZeaVision	2	60	$36	$36	590	440	1030	EE
Fortifeye® Super Omega™	Fortifeye®	2	60	$30	$30	860	580	1440	rTG
HydroEye®	ScienceBased Health®	4	120	$39	$39	100	70	170	EE
LipoTriad Dry Eye	LipoTriad LLC	2	60	$23	$23	504	378	882	EE
MaxiTears®	MedOp Health, Inc.	4	120	$29	$29	600	400	1000	EE
Omega-3 Dry Eye Formula™	Eye Love	3	90	$26	$26	500	400	900	EE
PRN Dry Eye Omega	PRN	4	240	$100	$50	1680	560	2240	rTG
retaine FLAX™	OCuSOFT®	4	120	$38	$38	0	0	*150	EE
retaine OM3™	OCuSOFT®	2	60	$30	$30	800	400	1200	EE
TheraTears Eye Nutrition	Akorn	3	90	$13	$13	450	300	750	EE
Ultra Dry Eye TG™	OcuSci™	3	60	$95	$143	1515	630	2145	rTG
VisiVite® Dry Eye Relief®	Vitamin Science, Inc.	4	120	$47	$47	600	400	1000	rTG

Omega-3 Dry Eye Supplements

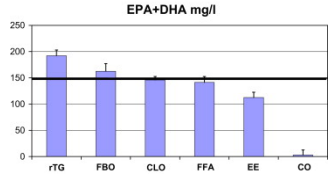
Supplement	Manufacturer	Dose	Count	Cost	$/month	EPA	DHA	Total	Form
EZ Tears™	ZeaVision	2	60	$36	$36	590	440	1030	EE
Fortifeye® Super Omega™	Fortifeye®	2	60	$30	$30	860	580	1440	rTG
MaxiTears®	MedOp Health, Inc.	4	120	$29	$29	600	400	1000	EE
PRN Dry Eye Omega	PRN	4	240	$100	$50	1680	560	2240	rTG
retaine OM3™	OCuSOFT®	2	60	$30	$30	800	400	1200	EE
Ultra Dry Eye TG™	OcuSci™	3	60	$95	$143	1515	630	2145	rTG
VisiVite® Dry Eye Relief®	Vitamin Science, Inc.	4	120	$47	$47	600	400	1000	rTG

Omega-3 Forms



Omega-3 Forms

Bioavailability



J. Dyerberg et al. / Prostaglandins, Leukotrienes and Essential Fatty Acids 83 (2010) 137–141

Bioavailability

- Taking the mean of the increase in EPA plus DHA in all three plasma lipid classes (grand total) for the two natural fish oils (fish body oil and CLO) as unity (100%), the mean relative bioavailability, unadjusted for dosage, of EPA plus DHA from EE was 73%, from FFA 91% and from rTG 124%. Adjusted for dosage, the results were 76%, 86% and 134%, respectively.

J. Dyerberg et al. / Prostaglandins, Leukotrienes and Essential Fatty Acids 83 (2010) 137–141

Omega-3 Dry Eye Supplements

Supplement	Manufacturer	Dose	Count	Cost	$/month	EPA	DHA	Total	Form
Fortifeye® Super Omega™	Fortifeye®	2	60	$30	$30	860	580	1440	rTG
PRN Dry Eye Omega	PRN	4	240	$100	$50	1680	560	2240	rTG
Ultra Dry Eye TG™	OcuSci™	3	60	$95	$143	1515	630	2145	rTG
VisiVite® Dry Eye Relief®	Vitamin Science, Inc.	4	120	$47	$47	600	400	1000	rTG

Omega-3 Dry Eye Supplements

Supplement	Manufacturer	Dose	Count	Cost	$/month	EPA	DHA	Total	Form
Fortifeye® Super Omega™	Fortifeye®	2	60	$30	$30	860	580	1440	rTG
PRN Dry Eye Omega	PRN	4	240	$100	$50	1680	560	2240	rTG
Ultra Dry Eye TG™	OcuSci™	3	60	$95	$143	1515	630	2145	rTG
VisiVite® Dry Eye Relief®	Vitamin Science, Inc.	4	120	$47	$47	600	400	1000	rTG
Ultimate Omega®	Nordic Naturals®	2	180	$60	$20	650	450	1100	rTG

Nordic Naturals Ultimate Omega

Supplement Facts

Serving Size: **2 Soft Gels**

Amount Per Serving		% Daily Value*
Calories	18	
Calories from fat	18	
Total Fat	2.0 g	3%
Saturated Fat	0.1 g	1%
Trans Fat	0 g	†
Total Omega-3s	1280 mg	†
EPA (Eicosapentaenoic Acid)	650 mg	†
DHA (Docosahexaenoic Acid)	450 mg	†
Other Omega-3s	180 mg	†

* Percent Daily Values are based on a 2,000 calorie diet.
† Daily Value not established.
Less than 5 mg of Cholesterol per serving.

Ingredients: purified deep sea fish oil (from anchovies and sardines), soft gel capsule (gelatin, water, glycerin, natural lemon flavor), natural lemon flavor, dalpha tocopherol, rosemary extract (a natural preservative).
No gluten, milk derivatives, or artificial colors or flavors.

Dosing

- Recommended minimum of 1000 mg/day of EPA + DHA
- FDA GRAS (generally regarded as safe) level of 3000 mg EPA and DHA combined per day

Contraindications

- EPA and DHA doses greater than 3000 mg/day may increase prothrombin time and risk of bleeding
- Omega-3s may lower thromboxane A2 supplies within platelets, and decrease clotting factor VII
- Not recommended for patients on warfarin or heparin

Summary

- 1000-3000 mg/day of EPA + DHA
- Consult PCP if on blood thinners

Omega-3 for Dry Eye

"For every thousand hacking at the leaves of evil, there is one striking at the root."

Henry David Thoreau

Thank You