The Facts About
Vitamin A

Presented by
Warren Maginn
BHsc (Nutr. Med.), GradCert (Hum. Nutr.)

What is Vitamin A?

History

- **1912**: Hopkins found **unknown factors** present in milk, that were not fats, proteins or carbohydrates, but were required to aid growth in rats.
- **1917**: McCollum, Mendel, etc. identified one of these substances as fat-soluble while researching the role of dietary fats (butter).
- **1920**: These essential 'accessory factors' were referred to as "**Vitamin A**". (demonstrating they must be obtained through diet)

WarrenMaginn.com

3

What is Vitamin A?

The pre-formed '**active**' forms of **Vitamin A** found naturally in the body = (i.e. animal foods)

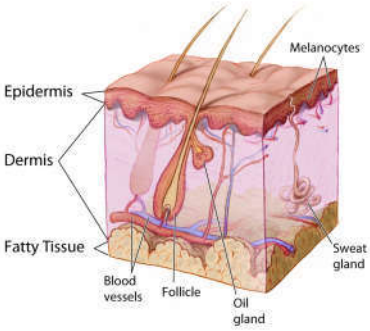
- **Retinol** (often as Retinyl Esters)
- **Retinal** (Retin-Aldehyde)
- **Retinoic Acid** (all-trans-Retinoic Acid = 'Tretinoin')

- Collectively referred to as '**Retinoids**' (fat-soluble)

WarrenMaginn.com

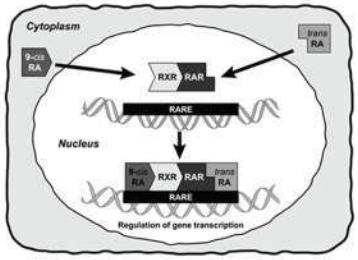
4

Vitamin A Functions



- Stored predominantly in Liver
- Regulation of all Cells **Differentiation**, **Proliferation** & **Function**
- Epithelial Integrity (Membranes – Keratin, Collagen, etc.)
- Reproduction (i.e. Embryonic Development)
- RBC Production
- Immune Function (e.g. T Cells)
- Vision (*11-cis-retinal* oxidation to *all-trans-retinal* = light sensitivity)
- and Hearing?, etc....

- Mostly mediated via DNA binding by Receptors (**RAR** and **RXR**)
  (Retinoic Acid Receptors, Retinoid X Receptors)

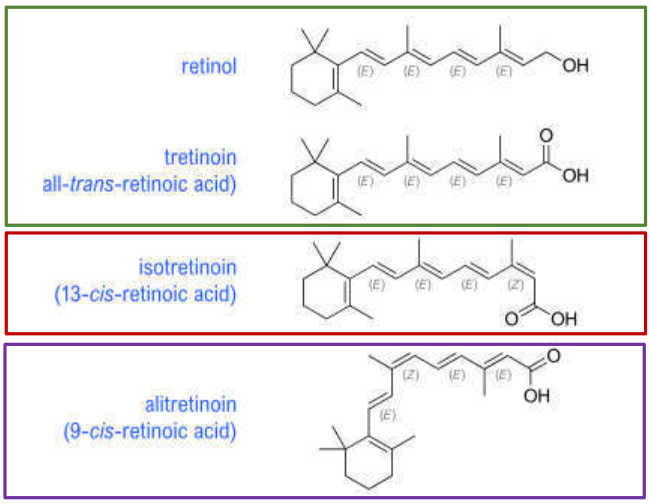


WarrenMaginn.com

Natural Vs Artificial

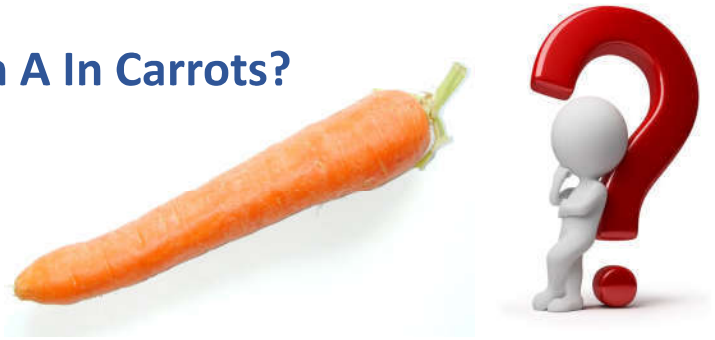
Pharmaceutical Synthetic Forms:

- **Isotretinoin** (Roaccutane): *Acne…*
- **Alitretinoin**: *Skin Cancers…*



WarrenMaginn.com

Is There Vitamin A In Carrots?

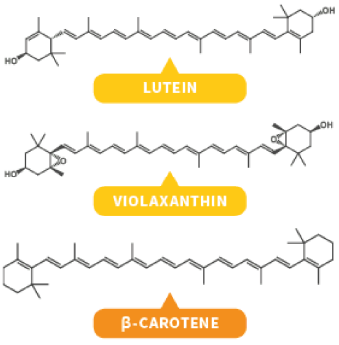


WarrenMaginn.com

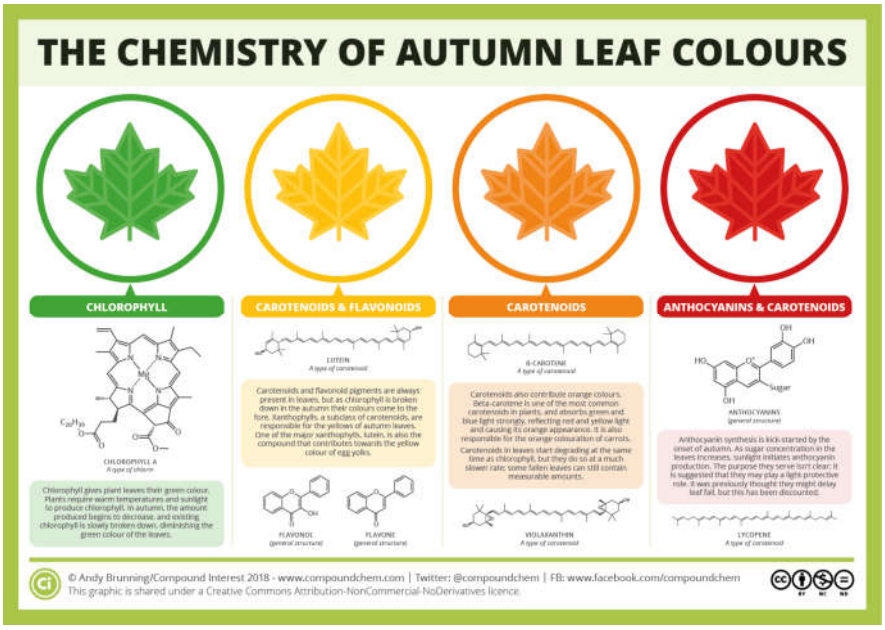
History of Carotenoids

- **1800s**: 'yellow oil of the carrot' isolated seeking a worming Rx
- **1907**: '**β-Carotene**' structure identified
- **1900s**: Other plant pigments found - e.g. **Lycopene**, **Lutein**, **Zeaxanthin**
- Collectively referred to as '**Carotenoids**' (1100+)
- Found to give the colors to Carrots, Sweet Potatoes, Daffodils, etc…

- α,γ,β-Carotene found to convert to Retinol
- Thus defined as '**Provitamin A**'
  (but often referred to as 'Vitamin A')
- However, Lycopene, Lutein, Zeaxanthin, etc. cannot!



WarrenMaginn.com



WarrenMaginn.com

Conversion of Vitamin A Forms

- **Plant-Based** Foods
- Ester Vitamin A Supps
- **Animal-Based** Foods
- **In The Body**

β-carotene

retinyl palmitate

all-*trans*-retinol

B3

all-*trans*-retinal

11-*cis*-retinal

all-*trans*-retinoic acid

9-*cis*-retinoic acid

13-*cis*-retinoic acid

Supporting:

- Reproduction
- Vision
- Growth Regulation (Skin, Gut, Organs, Bone)

WarrenMaginn.com

How Efficient Is Conversion?

WarrenMaginn.com

A Question of Equivalency

- Vitamin A potential can be measured as '**Retinol Activity Equivalents**' (RAE)
- "Recent studies indicate the **conversion efficiency** of dietary β-Carotene is in the range of **10 to 28:1**"
- "These data indicated that the bioconversion of β-Carotene to vitamin A was not as efficient as expected"
- "…as a result, the Food and Nutrition Board recently revised the estimated efficiency factor"

Table 1. Retinol activity equivalents (RAE) Ratios for Preformed Vitamin A and Provitamin A Carotenoids

Quantity Consumed	Quantity Bioconverted to Retinol	RAE Ratio
1 µg of dietary or supplemental vitamin A	1 µg of retinol*	1:1
*1 IU is equivalent to 0.3 microgram (µg) of retinol, and 1 µg of retinol is equivalent to 3.33 IU of retinol.		
12 µg of dietary β-carotene	1 µg of retinol	12:1
24 µg of dietary α-carotene	1 µg of retinol	24:1

- **Note:** 1,000 **IU** = 300mcg Retinol

WarrenMaginn.com

2010, Tang. Bioconversion of dietary provitamin A carotenoids to vitamin A in humans. 12

Difficulties Utilising Carotenes

- "**Preformed Vitamin A** from animal origins… can be absorbed and stored in the human body **very effectively**."

However,

- "The bioavailability of Provitamin A carotenoids in fruit and vegetables is **lower than once believed**."
- May need over 20x more carotenes (by weight, than direct vitamin A) to meet needs (**a lot of veggies!**)
- "It is difficult for children to fulfil their daily requirements through plant foods alone."
- Vitamin A deficiency common in regions where **plant sources >70%**
- Conversion of Carotenes occurs predominantly in the **intestines**
- Numerous **digestive factors** required for effective conversion to take place

WarrenMaginn.com

1995, Pee. Lack of improvement in vitamin A status with increased consumption of dark-green leafy vegetables.
2010, Tang. Bioconversion of dietary provitamin A carotenoids to vitamin A in humans. 13

Factors Affecting Utilisation of Carotenes

- **Food Matrix Structure** – (e.g. Spinach 21:1, Carrot 15:1)
- **Amount** – (6mg β-carotene = 4:1, 125mg β-carotene Supp = 55:1)
- **Fat in Meal** – (~1 tsp minimum required)
- **Genetics** – β-carotene 15,15'-monoxygenase (**BCMO1**) SNPs = ~60-70% reduction!
- **Body Fat** – (higher BMI = lower conversion)
- **Nutrition Status** – esp. Vitamin B3, Zinc

- **Healthy Liver & Gallbladder** – (**Bile Salts** required for assimilation)
- **Healthy Pancreas** – (Lipase enzyme production)
- **Healthy Intestines** – (BCMO1 metabolism, Absorption capacity of membranes, etc.)
- **Medications** – (Substances altering HCL, motility, etc. can affect assimilation)

WarrenMaginn.com

1980, Goodwin. The biochemistry of the carotenoids
2000, Tang. Vitamin A equivalence of beta-carotene in a woman
2007, Mercado. Carotene-rich plant foods ingested with minimal dietary fat enhance the total-body vitamin A pool 14

Problems with
Synthetic β-Carotene Supplements

- Synthetic β-carotene does not appear to behave the same way as natural β-carotene found in foods.
- "The results of several human intervention studies indicate that high-dose **supplementation with β-carotene**… does not decrease the risk of cancer or cardiovascular disease, and might even be **harmful to smokers** …

  Thus, it may be that β-carotene and other carotenoids promote health when taken at physiologic amounts in foods, but have adverse properties when given **in high doses** and under **highly oxidative conditions**."

2010, Tang. Bioconversion of dietary provitamin A carotenoids to vitamin A in humans. 15

So How Much Vitamin A Do We Need?

16

The RDA for Retinol
(Minimums)

Life Stage	Age	Males (µg/day)	Females (µg/day)	
Infants	0-6 months	400 (AI)	400 (AI)	1,333 IU
Infants	7-12 months	500 (AI)	500 (AI)	1,666 IU
Children	1-3 years	300	300	
Children	4-8 years	400	400	
Children	9-13 years	600	600	2,000 IU
Adolescents	14-18 years	900	700	
Adults	19 years and older	900	700	2,333 – 3,000 IU
Pregnancy	18 years and younger	-	750	2,500 IU
Pregnancy	19 years and older	-	770	
Breast-feeding	18 years and younger	-	1,200	4,000 IU
Breast-feeding	19 years and older	-	1,300	4,330 IU

WarrenMaginn.com

Upper Limits?
The **Tolerable Upper Limit** for Adults (inc. pregnancy) = 3,000 mcg Retinol (**10,000 IU**) p/d
(In Children: **remain < double the applicable RDA** when persistent dosing)

17

Safe vitamin A dosage during pregnancy and lactation

World Health Organization
The Micronutrient Initiative

Recommendations and report of a consultation

Recommendations on doses and timing

1. Maternal supplementation during pregnancy

(Either during the first 60 days following conception when there is a teratogenic risk or after the first 60 days following conception, for women whose habitual intakes are above the RDA or below the RDA)

For fertile women, independent of their vitamin A status, 10 000 IU (3000 µg RE) is the maximum daily supplement to be recommended at any time during pregnancy.

Where VAD is endemic among children under school age and maternal diets are low in vitamin A, health benefits are expected for the mother and her developing fetus, with little risk of detriment to either, from:

- either a **daily supplement** not exceeding 10 000 IU vitamin A (3000 µg RE) at any time during pregnancy;
- or a **weekly supplement** not exceeding 25 000 IU vitamin A (8500 µg RE). In this

2. Supplementation for mothers in the first six months postpartum

(Single high-dose supplement above 25 000 IU, and usually at a level of 200 000 IU, during the safe period of postpartum infertility for mothers in vitamin-A-deficient areas)

At the population level

Mothers who are not breast-feeding will benefit from a high-dose supplement given safely during the first 28 days (4 weeks or 1 month) postpartum. Although the risk of conception beyond this point is poorly documented, normal fertility does not usually return for 5–10 weeks. Beyond 6 weeks, therefore, non-lactating mothers should be given no more than 10 000 IU daily. Direct supplementation of the non-breast-fed infant < 6 months of age, who is not given a fortified breast-milk substitute, with as much as 50 000 IU (15 000 µg RE) is the recommended safe intervention to meet the infant's need for vitamin A.

WarrenMaginn.com

1998, World Health Organization. The Micronutrient Initiative. 18

When To Use Vitamin A?

- **Pregnancy & Childhood** – Vit A key roles in embryonic and childhood growth/development
  (Low maternal **retinol** associated with **anemia** and low birth weight)
- **Vision** – Vit A deficiency major cause of preventable blindness worldwide
  (Low Light Blindness, Corneal Inflammation, Dry Eyes, …)
- **Recurrent Infections** – Vit A maintains normal T-Cell/Immune functions
  (e.g. Childhood Infections, Recurrent Flus, Chest Infections, Urinary Infections, Cold Sores, …)
- **Skin & Gut Issues** – Vit A regulates cell growth and differentiation (RA → Collagen via RXR)
  (e.g. Acne, Wound Healing, Membrane Healing (Celiac), Anti-Ageing, Dry/Rough, etc.)
- **Thyroid** – Vit A supports HPT Axis, utilisation of Iodine, and function of Thyroid Receptors
  (Note: Vit A deficiency or excess may be inhibitory of metabolism)
- **Obesity** – Vit A needs higher when higher fat mass
  (Greater fat volume = reduced concentration, lower Retinol Binding Protein)
- **General Wellbeing** – Vit A has numerous nutrient-gene interdependencies
  (General nourishment – possibly physical performance/recovery)

When Is It Toxic?

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE FREE PREVIEW ARCHIVE

Vitamin A Transport in Human Vitamin A Toxicity

Frank Rees Smith, M.D., and DeWitt S. Goodman, M.D.

- "High intake of synthetic vitamin A over a prolonged period can lead to toxicity, but toxicity from **food sources** is rare."
- "Periodic supplementation should not cause serious adverse effects."

- "The plasma retinol transport system was studied in three patients with chronic hypervitaminosis A. The toxic state in each was associated with increased plasma concentrations of total vitamin A, and particularly of **retinyl esters**."
- "detailed studies… suggest that vitamin A toxicity occurs when excessive amounts of vitamin A are presented to cell membranes in association with plasma lipoproteins, rather than specifically bound to retinol-binding protein."

1976, Smith. Vitamin A transport in human vitamin A toxicity.
2011, Mayo-Wilson. Vitamin A supplements for preventing mortality, illness, and blindness in children aged under 5: systematic review and meta-analysis.

What Are Some Effects of Excess?

Original Contribution FREE

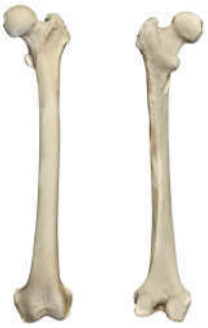
January 2, 2002

Vitamin A Intake and Hip Fractures Among Postmenopausal Women

Diane Feskanich, ScD; Vishwa Singh, PhD; Walter C. Willett, MD, DrPH; et al

JAMA. 2002;287(1):47-54. doi:10.1001/jama.287.1.47

- Report showed a group of women with **higher long-term dietary Retinol intake** (>1,000 mcg / 3,333 IU per day), than those with <400mcg (1,333 IU) intake, were associated with a 1.69x **increased risk of hip fracture**.
- However, interestingly
  "The association of high retinol intake with hip fracture was attenuated among women using postmenopausal estrogens"
- **What's going on here?**



WarrenMaginn.com

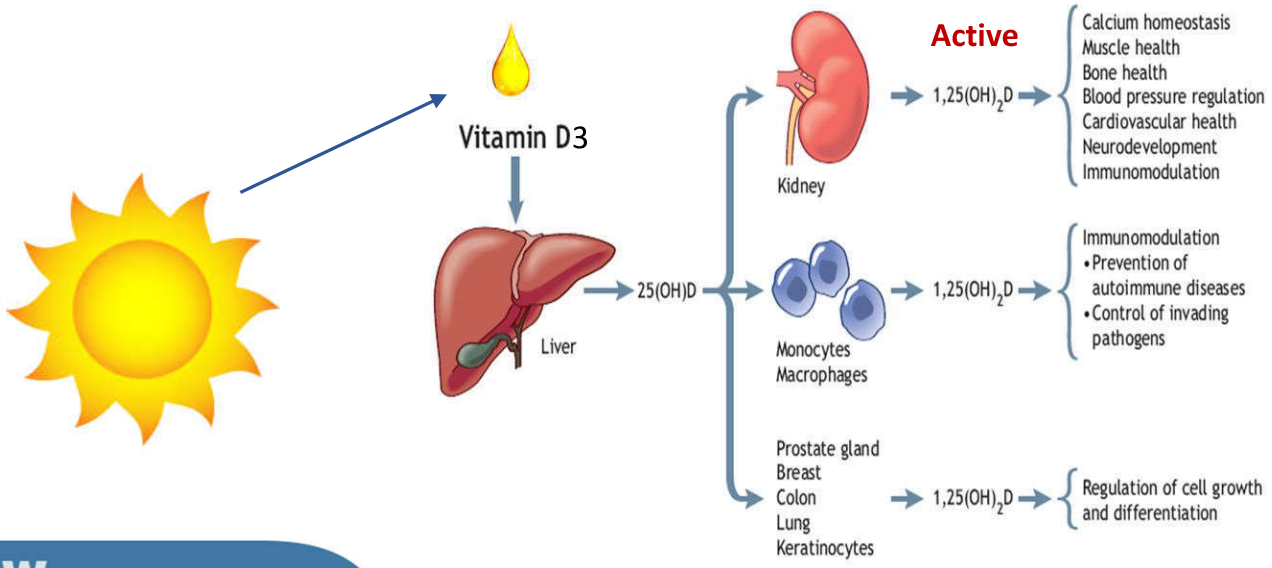
2002, Feskanich. Vitamin A intake and hip fractures among postmenopausal women. 21

The Vitamin D Connection

WarrenMaginn.com

22

Functions of Vitamin D

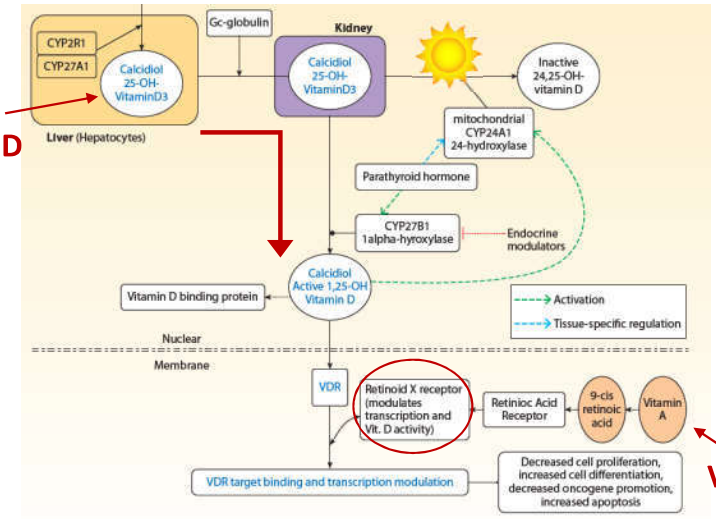


WarrenMaginn.com

23

Vitamin A & D Work Together

Vitamin D



Vitamin A

*** Gene Transcription Modulation ***

WarrenMaginn.com

Vitamin A & D Need to be Balanced!

(Balancing Competition vs Complementation)

Note:

- Typical 'Minimum Erythemal Dose' = **10,000 – 25,000 IU** Vitamin D3
  (Your lowest **sun exposure** to get 'rosy glow' (e.g. 30min) - to most exposed parts)
- Without any sun exposure, mounting evidence suggests at least 800-1,000 IU Vit D_3 p/d required to prevent frank vitamin D deficiency (>50 nmol/L) – (more if looking for double as optimum)
- Acquire each as nature intended? (Sunlight and wholefood sources)

WarrenMaginn.com

2002, Holick. Vitamin D: the underappreciated D-lightful hormone that is important for skeletal and cellular health
1999, Harris. Plasma 25-hydroxyvitamin D responses of younger and older men to three weeks of supplementation

25

When To Have Caution?

(i.e. To Avoid High Vit A Doses)

- Unresolved Vitamin D Deficiency! (May make it worse)
- Osteoporosis (Postmenopause)
- Severe Liver Disease (Metabolism may be impaired)
- Medications / High Toxicity (Interations & Burden)

Note:

- Sometimes poor conversion from 25-OH-Vit D to active 1,25-OH-Vit D
  (May appear normal on typical blood tests)
  (but issue/deficiency needs to be addressed before any high-dose A)
- Implications for Autoimmunity

WarrenMaginn.com

26

A 'Catch-22'?

Importance of Liver & Kidney Health
(Vitamin A Storage & Metabolism Organs)

- "In the patients with **Liver** Disease, the levels of vitamin A, RBP [Retinol Binding Protein], and PA [Pre-Albumin] were all markedly decreased"
- "Patients with chronic **Renal** Disease had marked abnormalities in the plasma concentrations of RBP and vitamin A and in the molar ratios examined. "

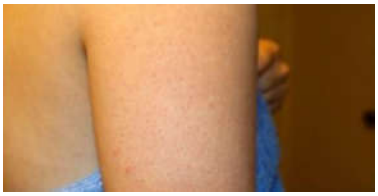
So:

- **Support Liver Metabolism** (e.g. Lipotropics, Glucuronidation)
- **Support Kidney Function** (e.g. Blood Sugar, Pressure, Oxidation, Allergy, Infection)
- Before then addressing likely Vitamin A deficiency (Dose Low and Slow)

WarrenMaginn.com

1971. The effects of diseases of the liver, thyroid, and kidneys on the transport of vitamin A in human plasma. 27

Limitations Determining Deficiency



- Overt signs often involve aberrant Keratinisation
  (thickening, mottling, ulcerations, Hyperkeratosis)
  (e.g. Tongue, Gut, Urinary, Lungs, Back of Arms?, …)
- If no improvement on UL supplementation, consider other factors
  (more is not always better)
- Overt signs not always apparent!

- **Serum Retinol** = homeostasis – (not always conclusive)
  (suggested optimum range: 1.0-2.5 umol/L (28-70 ug/dL)
- **Serum RBP** may be needed to rule out transport issues
- **Serum Retinyl Esters** may be more appropriate test for determining toxicity
- **Other Tests:** Gene testing for BCMO1, FBC (Anemia, imbalanced WBCs), Inflam. (CRP)

WarrenMaginn.com

2002, Pee. Biochemical Indicators of Vitamin A Deficiency 28

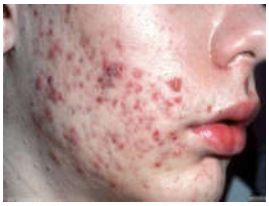
So How To Supplement Vitamin A?

WarrenMaginn.com

29

High-Dose Synthetic Retinyl Esters?

- Rarely. (not necessarily better)



?

e.g. for Acne:

- Vitamin A provides the DNA regulation
- But consider all the substrate cofactors (Zinc, Vitamin C, Proline/Lysine (Protein)
- If going to high-dose anything try Vitamin B5 (water-soluble!)

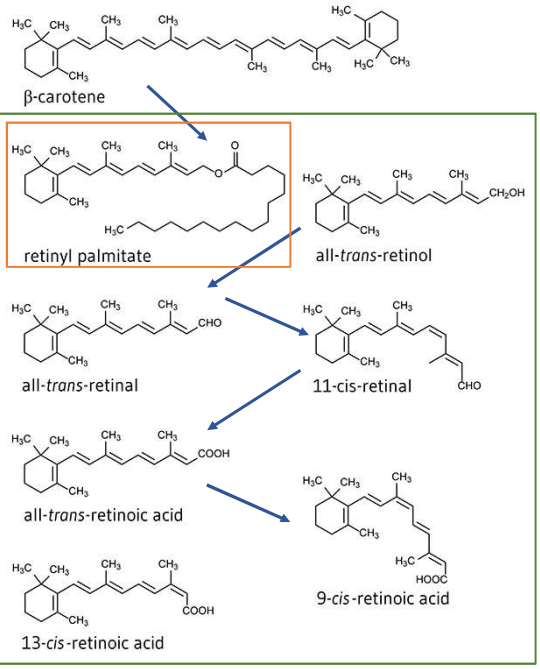
✓

WarrenMaginn.com

30

Ester vs Natural Mixture?

- **Plant-Based** Foods
- **Ester** Vitamin A Supps
- **Animal-Based** Foods



The Power of **Cod Liver Oil**

WarrenMaginn.com

31

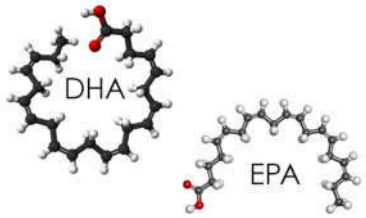
Quick Reminder Why Omega FAs & Fish Oil Are Important

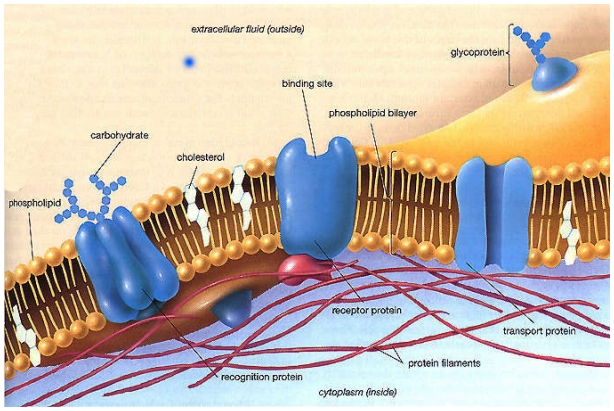
WarrenMaginn.com

32

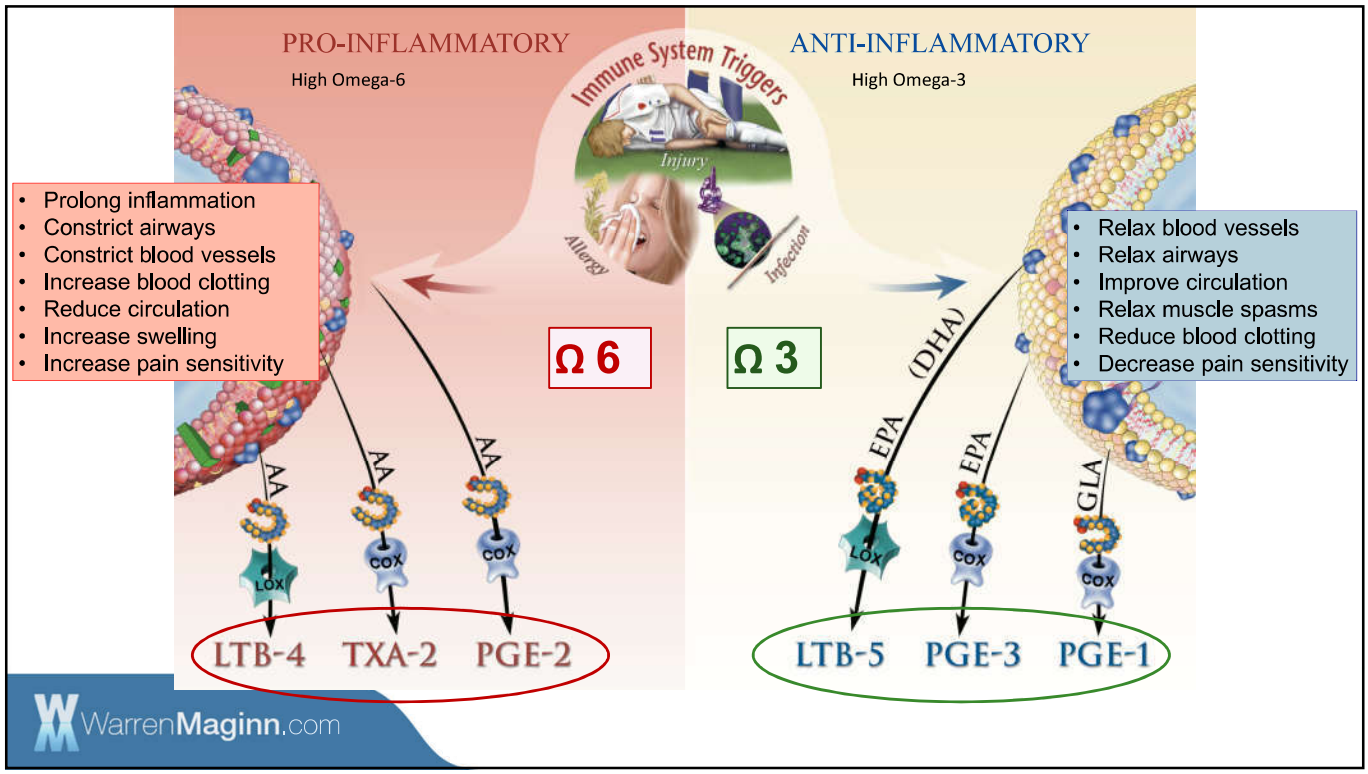
EPA & DHA in The Lipid Bilayer

1. Cell structure / **fluidity** and function
2. Regulate Inflammation via **hormone compounds**
3. Regulate **genetic expression**



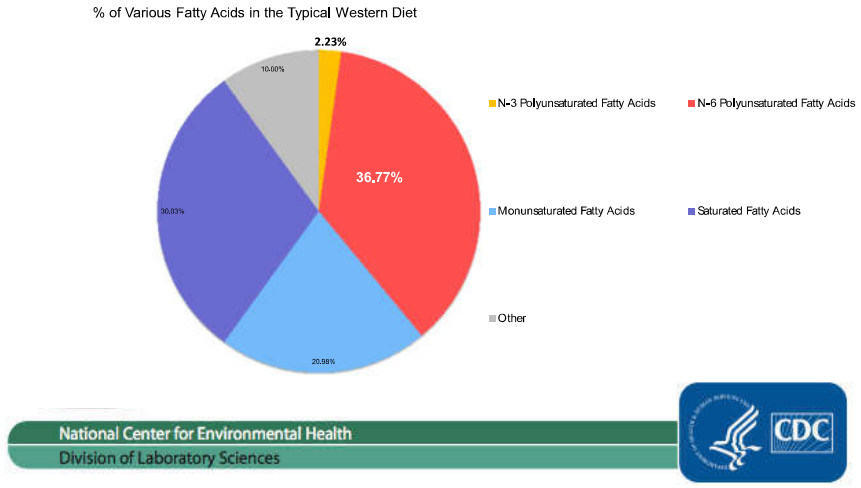


WarrenMaginn.com



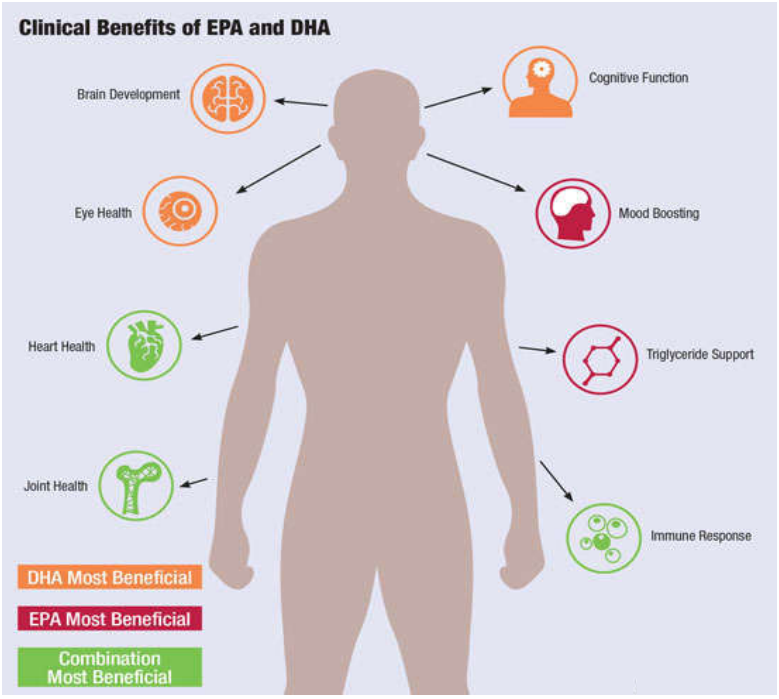
WarrenMaginn.com

Modern Omega-3 Deficiency



WarrenMaginn.com

- **Impacts ALL Body Systems!**
- **DHA** Key to Brain & Eyes
- **DHA** + EPA for Heart, Bones & Immune System

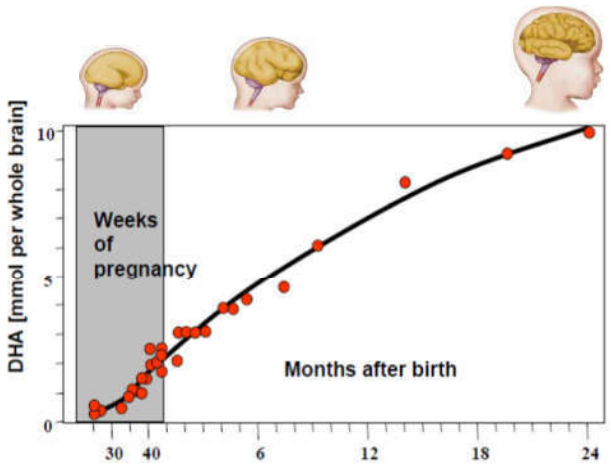


WarrenMaginn.com

36

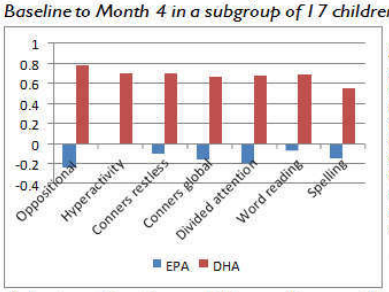
Integration & Brain DHA

Prenatal



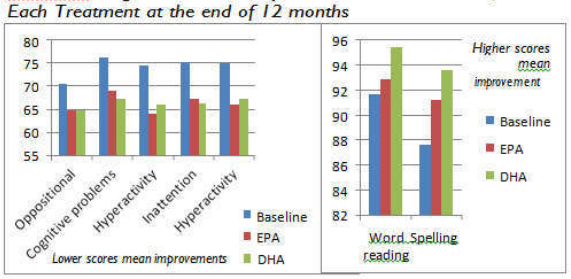
Post Natal

Correlations between RBC Fatty Acid Status and Outcomes from Baseline to Month 4 in a subgroup of 17 children



After 4 months treatment, increased RBC DHA was associated with a number of outcome improvements that were more evident in a subgroup of 17 children with learning difficulties. There was no similar association with RBC EPA content and the same outcome measures.

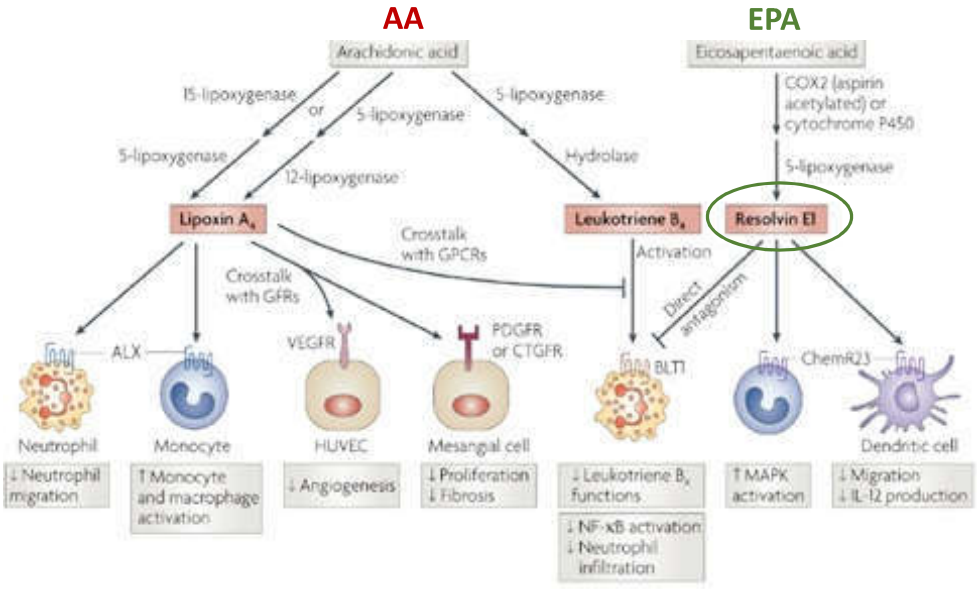
Behaviour, Cognition and Literacy Scores at Baseline and After Each Treatment at the end of 12 months



WarrenMaginn.com

37

EPA & Inflammation Regulation



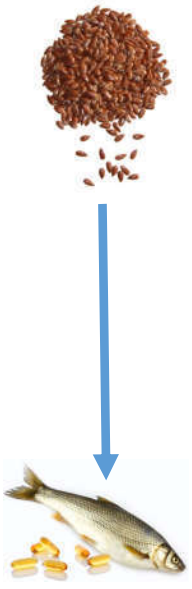
WarrenMaginn.com

38

What About Plant Sources?

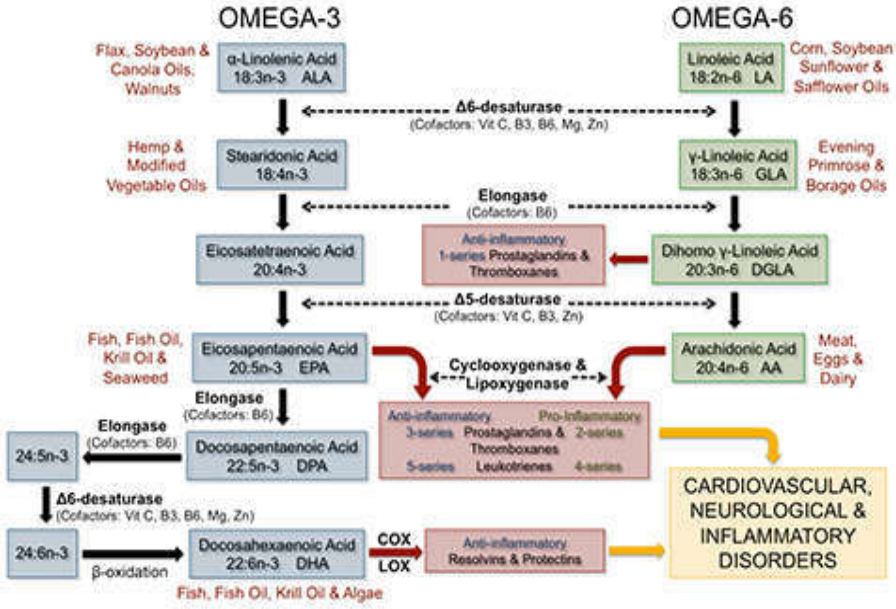
WarrenMaginn.com

39



8%?

1%?



WarrenMaginn.com

40

What About Bleeding Risk?

WarrenMaginn.com

Australian Government
Department of Health
Therapeutic Goods Administration

Home | Safety information | Consumers | Health professionals | Industry | About the TGA

Safety of fish oil and omega-3 fatty acids

Dr Mary Boyd Turner, Office of Medicines Safety Monitoring

DHA has the potential to influence platelet aggregation by competing with ARA for membrane incorporation in platelets and thereby reducing available ARA for thromboxane A_2 generation. Other mechanisms such as decreasing platelet growth and clotting factors are also postulated to play a role.[3,4]

There is some evidence for other benefits of fish oil. These include use for infant eye/brain development, inflammation, nutrition (in gastrointestinal disorders), mental health disorders, Alzheimer's disease and rheumatoid arthritis. While fish oil products are widely used, this suggests the potential for more extensive applications.[5]

Regulation

Health Canada permits a number of health claims for fish oil including the maintenance of good health, cardioprotection, assistance in reduction of serum triglycerides, and promotion of healthy mood balance. A June 2009 fish oil monograph indicates that no statements are required in relation to cautions, warnings, contraindications, and known adverse reactions.[19]

In 2004, the US Food and Drug Administration endorsed a qualified health claim indicating that, 'Supportive but not conclusive research shows that consumption of EPA and DHA omega-3 fatty acids may reduce the risk of coronary heart disease'. It states that, 'Dietary supplements should not recommend or suggest in their labelling a daily intake exceeding 2 grams of EPA and DHA'.[20]

The NHF review did not consider fish oils to have a significant effect on haemostasis and did not include a cautionary statement.[2]

- Regulatory agencies consider that fish oil and omega-3 fatty acid containing products are safe with some requiring warnings about the theoretical possibility of bleeding events and drug interactions in their product information.
- Evidence in relation to the safety concern about possible bleeding indicates that the theoretical possibility of increased bleeding tendency is not reflected functionally in results of human studies.

Leaf *et al* (1994) undertook a randomised controlled trial in 551 candidates for percutaneous intraluminal coronary angioplasty to investigate whether omega-3 fatty acids prevented restenosis. Subjects were randomised to receive high doses of EPA and DHA or placebo for 14 days before, and six months after, angioplasty. All patients also received 325 mg of aspirin for six months post angioplasty. While the intervention did not prevent restenosis, there was no statistically significant difference in bleeding time between groups.[9]

The safety of postoperative fish oil was evaluated by Heller *et al* (2002) in a randomised, double-blind, placebo-controlled trial of 44 patients administered high doses of omega-3 fatty acids in parenteral nutrition after major abdominal surgery. No significant between-group difference was seen in bleeding events.[10]

Commentary by Lichtenstein (2005) on clinical data concerning dietary supplements affecting antithrombotic therapy included the conclusion on safety from an evidence-based review on the effects of omega-3 fatty acids on cardiovascular disease, prepared for the US Agency for Healthcare Research and Quality in 2004. It was noted that while clinical bleeding was a theoretical concern, in the studies reviewed there was no difference in the overall number of bleeding events between supplement and control groups. It was concluded that adverse events related to consumption of fish oil appeared to be minor.[11]

Harris (2007) reviewed 19 clinical trials of candidates for vascular surgery or femoral artery puncture who were administered omega-3 fatty acids in addition to anticoagulant medications. In 14 of these trials, the fatty acids were administered one and 42 days prior to surgery, and in 5 studies, postoperatively, at doses varying from 1.4 to 21 g/day. It was concluded that clinically significant bleeding events were 'virtually non-existent'.[12]

The effects of prescription omega-3 acids (POM) and aspirin, alone and in combination, on platelet function in 10 healthy subjects were investigated by Larson *et al* (2008). This was an open-label four-week sequential therapy trial with each subject their own control. It was found that while platelet aggregation was not affected by POM alone, it was affected by aspirin and by aspirin with POM.[13]

Tavazzi *et al* (2008) published the results of a randomised, double-blind, placebo-controlled trial looking at the effect of n-3 polyunsaturated fatty acids (PUFA) in patients with chronic heart failure (New York Heart Association class II-IV). Participants were assigned to n-3 PUFA 1 g/day (n=3494) or placebo (n=3481). Analysis of those discontinuing the study due to adverse events was undertaken, and showed no significant difference between the treatment and placebo groups.[14]

Watson *et al* (2009) undertook a retrospective record review of 182 subjects treated with high-dose fish oil, aspirin and clopidogrel and 182 controls on aspirin and clopidogrel alone, with a mean follow-up period of 33 months. One major bleed was seen in the treatment group (a patient with rectal cancer requiring transfusion) and none in the control group (p=1.0). There were more minor bleeds in the control group compared to the treatment group but the difference was not statistically significant. It was concluded that high-dose fish oil is safe in combination with aspirin and clopidogrel, and does not increase the risk of bleeding compared with that seen with aspirin and clopidogrel alone.[15]

An analysis of data by Elmer *et al*, collected as part of the Cardiovascular Health Study cohort study of risk factors for coronary heart disease (CHD) and stroke in adults 65 years and older, aimed to determine the prevalence of CM use concurrent with prescription and over-the-counter (OTC) medications and assess the risk for adverse interactions.[17] Fish or cod liver oil was the fourth most common CM, with 2.28% of study participants using it over the four periods. Its use was categorised as a possible or theoretical risk for bleeding adverse events, rather than a significant risk.

So how is Cod Liver Oil different to Fish Oil?

WarrenMaginn.com

43

It Is Fish Oil!

with High-DHA Active Omega 3

AND Natural Active Vitamin A & D

The 'Fat-Soluble Multi-Vitamin'

WarrenMaginn.com

What Makes a Quality Cod Liver Oil?

WarrenMaginn.com

'Cod Liver Oil'
What's in a Name?

- TGA Allows ALL **Gadidae family spp.** to be used for 'Cod Liver Oil'

But

- Not all Gadidae spp. are called Cod
- Not all species called 'Cod' are Gadidae spp.

WarrenMaginn.com

28 'Cod' Species

'Arctic' Cod
Vs
Everything Else

Scientific Name	English Name	Distribution	Max. Length (cm)
Arctogadus glacialis	Arctic cod	Arctic and Northeast Atla	32.5 TL
Boreogadus saida	Polar cod	Circumpolar in the Arctic	40 TL
Eleginus gracilis	Saffron cod	North Pacific	55 TL
Eleginus nawaga	Navaga	Arctic	42 TL
Gadiculus argenteus	Silvery pout	Northeast Atlantic	15 TL
Gadiculus thori		Northeast Atlantic	15 TL
Gadus chalcogrammus	Alaska pollock	North Pacific	91 TL
Gadus macrocephalus	Pacific cod	*Gadus ogac* is repo	119 TL
Gadus morhua	Atlantic cod	North Atlantic and Arctic	200 TL
Melanogrammus aeglefinus	Haddock	Northeast Atlantic	112 TL
Merlangius merlangus	Whiting	Northeast Atlantic	70 TL
Microgadus proximus	Pacific tomcod	Eastern Pacific	30.5 SL
Microgadus tomcod	Atlantic tomcod	Northwest Atlantic	38.1 TL
Micromesistius australis	Southern blue whiting	There are 2 disjunct popu	90 TL
Micromesistius poutassou	Blue whiting	Northeast Atlantic	50 TL
Pollachius pollachius	Pollack	Northeast Atlantic	130 TL
Pollachius virens	Saithe	Eastern Atlantic	130 TL
Raniceps raninus	Tadpole fish	Northeast Atlantic	30 TL
Theragra finnmarchica	Norwegian pollock	Northeast Atlantic	50 TL
Trisopterus capelanus		Mediterranean. [Country	32 TL
Trisopterus esmarkii	Norway pout	Northeast Atlantic	35 TL
Trisopterus luscus	Pouting	Northeastern Atlantic	46 TL
Trisopterus minutus	Poor cod	Northeastern Atlantic	40 TL

High in:
DHA
Vitamin A
Vitamin D

WarrenMaginn.com

47

Lofoten Islands

WarrenMaginn.com

48

- Under **natural conditions** Vitamin A and D levels vary
- General hallmark of a natural forms is (lower) VARIABLE amounts on bottle (amounts often around 500-2,500IU per tsp (not 5,000 IU)

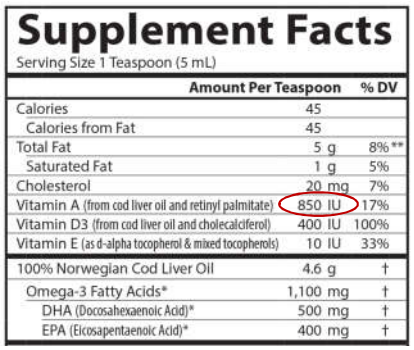
Fortified

Supplement Facts

Serving Size 1 Teaspoonful (5 ml)
Servings Per Container 60

Amount Per Serving	% Daily Value
Calories (energy) 40	
Calories from Fat 40	
Total Fat 4.5 g	7%*
Saturated Fat 1g	5%*
Cholesterol 25 mg	8%*
Vitamin A (naturally occurring in CLO and added as vitamin A palmitate) 5000 IU	100%
Vitamin D (naturally occurring in CLO and added as cholecalciferol) 800 IU	200%
Alaskan Cod Liver Oil 4.4 g	†
Total Omega-3 Fatty Acids 1 g	†
EPA (Eicosapentaenoic Acid) 440 mg	†
DHA (Docosahexaenoic Acid) 400 mg	†

Fortified



Supplement Facts

Serving Size 1 Teaspoon (5 mL)

	Amount Per Teaspoon	% DV
Calories	45	
Calories from Fat	45	
Total Fat	5 g	8%**
Saturated Fat	1 g	5%
Cholesterol	20 mg	7%
Vitamin A (from cod liver oil and retinyl palmitate)	850 IU	17%
Vitamin D3 (from cod liver oil and cholecalciferol)	400 IU	100%
Vitamin E (as d-alpha tocopherol & mixed tocopherols)	10 IU	33%
100% Norwegian Cod Liver Oil	4.6 g	†
Omega-3 Fatty Acids*	1,100 mg	†
DHA (Docosahexaenoic Acid)*	500 mg	†
EPA (Eicosapentaenoic Acid)*	400 mg	†

Natural

Supplement Facts

Serving Size: 1 Teaspoon (5 mL)

Amount Per Serving		% DV[1]	% DV[2]*
Calories	45		
Calories from fat	45		
Total Fat	5.0 g	†	8%
Saturated Fat	1.0 g	†	5%
Trans Fat	0 g	†	†
Cholesterol	20 mg	†	7%
Vitamin A	230–920 I.U.	9–37%	5–18%
Vitamin D	0–201 I.U.	0–5%	0–5%
Total Omega-3s	1060 mg	†	†
EPA (Eicosapentaenoic Acid)	340 mg	†	†
DHA (Docosahexaenoic Acid)	510 mg	†	†
Other Omega-3s	210 mg	†	†

WarrenMaginn.com

49

Summary

WarrenMaginn.com

50

- **Carotenes** = Precursors to Vitamin A (not Vitamin A itself)
- Active (Fully Formed) Vitamin A = **Retinoids**
- Both are **fat-soluble** and subjective to numerous digestive and dietary factors
- **Conversion to Retinoids limited** and may often require direct Retinoid consumption
- Retinoids fulfill **many essential roles** in the body (esp. DNA expression)
- Concern for deficiency should be as great as excess
- Key **synergy with Vitamin D** (determined by sunlight and organ function)
- Partners very well with other essential fatty substances (e.g. **EFAs**)
- **Cod Liver Oil** can provide all key **fat-sol** components in highly available, **natural forms**
- and **SAFE doses** (staying below 3,000 IU p/d unless extra Vitamin D or status confirmed)
- A quality Cod Liver Oil may be indispensable for maintaining optimum health for many