

Krill Oil- the New Marine Lipid

- shrimp-like crustaceans
- known to turn the Antarctic red due to the astaxanthin they contain
- world's largest food biomass
- food for the blue whale
- excellent source of DHA and EPA

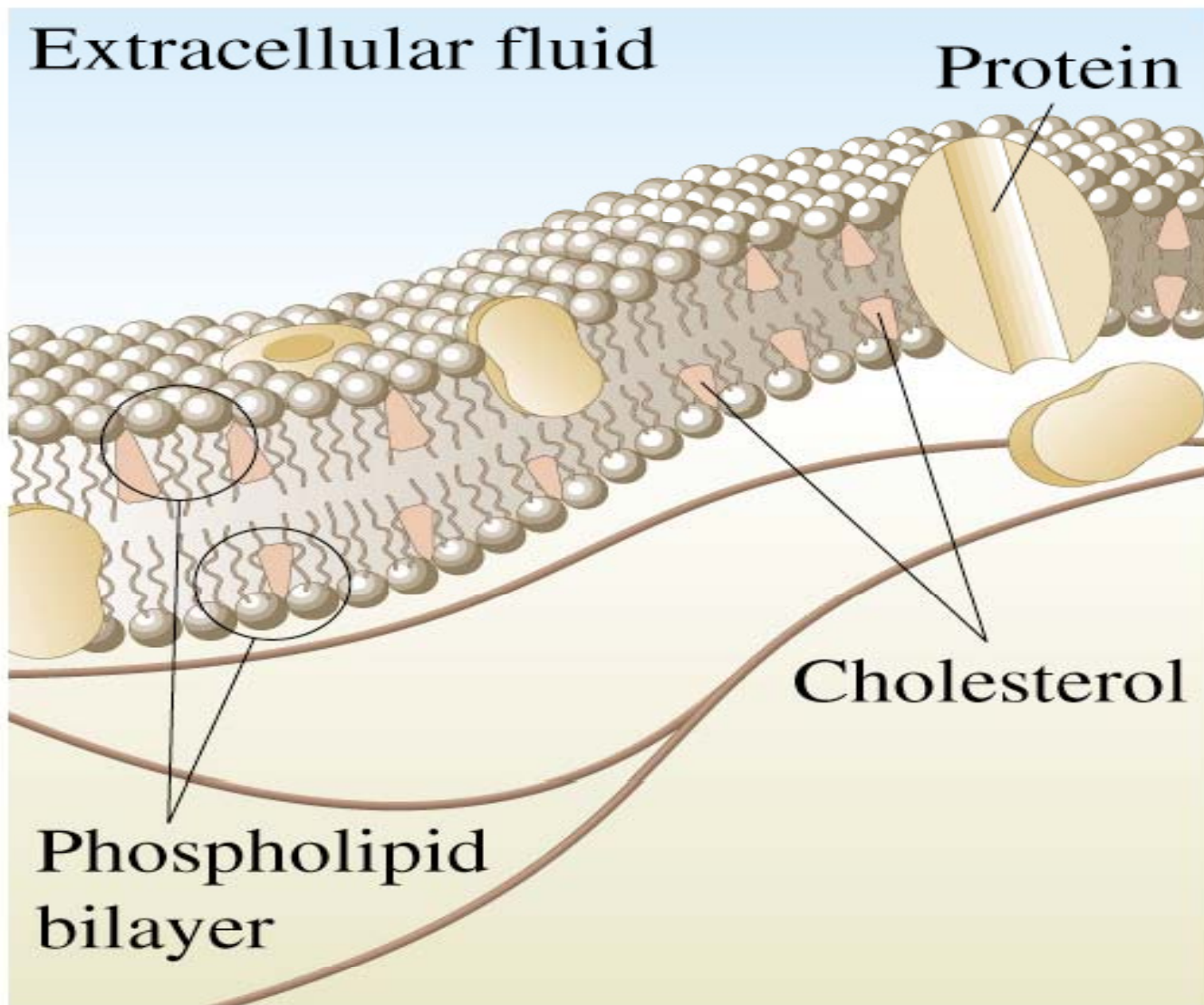


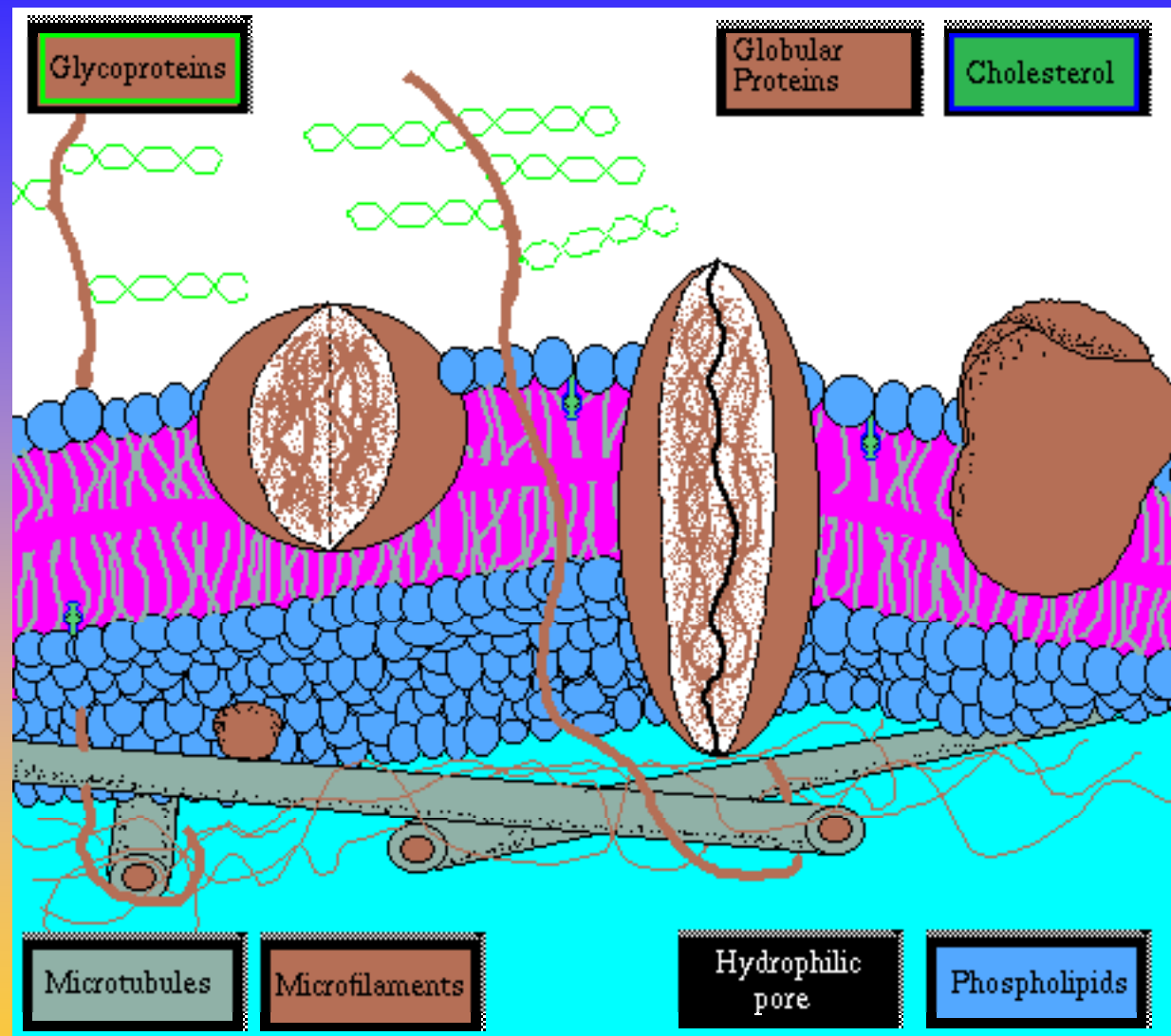
Unique source of many nutrients

Krill oil contains:

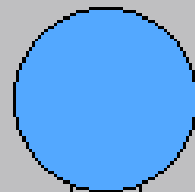
- Phosphatidylcholine
- Phosphatidylinositol
- Phosphatidylethanolamine
- DHA and EPA
- Antioxidants: A, E, beta-carotene, astaxanthin, canthaxanthin







Hydrophilic Head

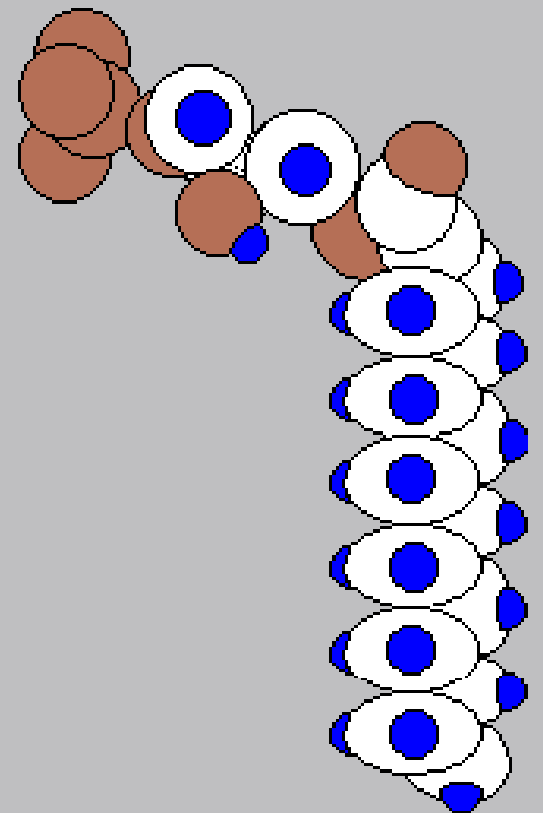
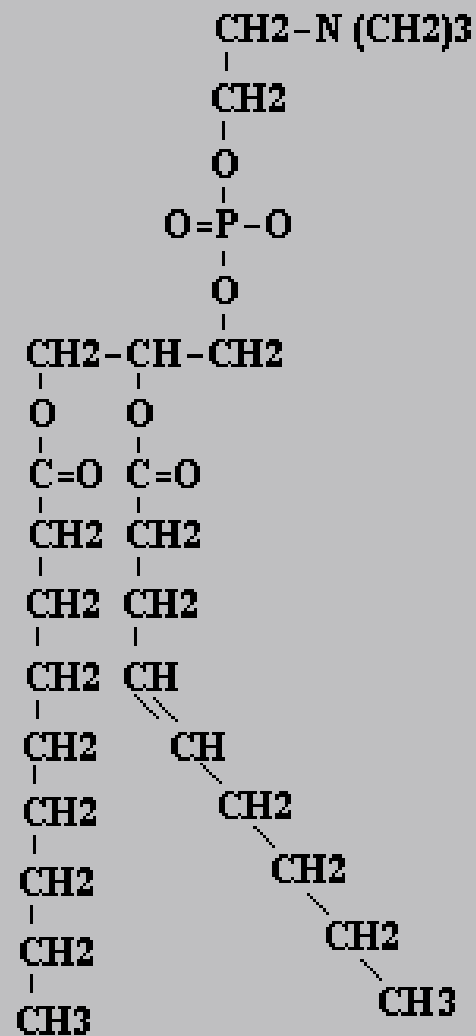
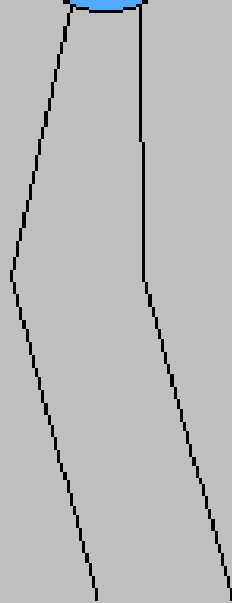


Special region

Phosphate

Fatty acid tail

Hydrophobic Tail



Supplement Facts- Krill Oil

- Serving size: 2 softgels
- 90 mg EPA
- 150 mg DHA
- 73 mg choline
- 1.5 mg astaxanthin
- 100 IU Vit A

Glycerophospholipids

- PE = cephalin
- PC = lecithin
- PI – Inositol esterified to phosphate – this is a source of inositol trisphosphate and diacylglycerol – act as “second messengers” involved in the action of some hormones

Krill - Brain food?

- The phospholipids in krill oil are bound to astaxanthin, known to cross the blood-brain barrier
- Phosphatidylcholine converts into Acetylcholine which improves memory
- Contains sphingomyelin – a component of myelin sheath that protects the nerve cells

Carotenoids vs. xanthophylls as oxygen scavengers

- **Singlet oxygen quenching by dietary carotenoids in a model membrane environment.**

Arch Biochem Biophys. 2003 Apr 1;412(1):47-54

Cantrell A, McGarvey DJ, Truscott TG, Rancan F, Bohm F.

- Study results:

Ability to quench singlet oxygen radicals in the lipid membrane from greatest to least ability:

- Lycopene
- Beta-carotene
- Astaxanthin
- Canthaxanthin
- Zeaxanthin

Similar study

Carotenoids, tocopherols and thiols as biological singlet molecular oxygen quenchers.

Biochem Soc Trans. 1990 Dec;18(6):1054-6.

Di Mascio P, Devasagayam TP, Kaiser S, Sies H.

- Singlet molecular oxygen has been shown to be generated in biological systems and is capable of damaging proteins, lipids and DNA.
Results from greatest to least effective:
- lycopene, gamma-carotene, astaxanthin, canthaxanthin, alpha-carotene, beta-carotene, bixin, zeaxanthin, lutein, bilirubin, tocopherols and thiols.

Astaxanthin inhibits lipid peroxidation

- **Astaxanthin and canthaxanthin are potent antioxidants in a membrane model.**

Palozza P, Krinsky NI. Arch Biochem Biophys. 1992

Sep;297(2):291-5.

Department of Biochemistry, Tufts University School of Medicine, Boston, Massachusetts 02111-1837.

A research study performed at Tufts University in Boston found that when astaxanthin or canthaxanthin are added to rat liver microsomes, these antioxidants greatly inhibited radical-initiated lipid peroxidation, equal to that of alpha-tocopherol and to a greater extent than beta-carotene.

Astaxanthin protects LDL from oxidation.

Inhibition of low-density lipoprotein oxidation by astaxanthin.

Iwamoto T, Hosoda K, Hirano R, Kurata H, Matsumoto A, Miki W, Kamiyama M, Itakura H, Yamamoto S, Kondo K.
National Institute of Health and Nutrition, Tokyo, Japan.

- Marine animals produce astaxanthin which is a carotenoid and antioxidant
 - This study determined the in vitro and ex vivo effects of astaxanthin on LDL oxidation.

Astaxanthin protects LDL from oxidation.

- LDL was measured in a 1 ml reaction system consisting of increasing concentrations of astaxanthin (12.5, 25.0, 50.0 microg/ml)
- Astaxanthin dose, dependently significantly prolonged the oxidation lag time (31.5, 45.4, 65.0 min) compared with the control (19.9 min).
- For the ex vivo study 24 volunteers (mean age 28.2 [SD 7.8] years) consumed astaxanthin at doses of 1.8, 3.6, 14.4 and 21.6 mg per day for 14 days.
- No other changes were made in the diet.

Astaxanthin protects LDL from oxidation.

- Fasting venous blood samples were taken at days 0, +14. LDL lag time was longer (5.0, 26.2, 42.3 and 30.7% respectively) compared with day 0 after consuming astaxanthin at doses of 1.8, 3.6, 14.4 and 21.6 mg for 14 days
- No difference in control group
- Our results provide evidence that consumption of marine animals producing astaxanthin inhibits LDL oxidation and possibly therefore contributes to the prevention of atherosclerosis.

Safety of Krill Oil

- US FDA – 3 g EPA and DHA daily is GRAS
- Studies show 3-8 g omega-3 fatty acid consumption daily has no adverse effects
- Mice given large doses of krill oil – human equivalent of 9 g EPA/DHA daily
- 7-11 times the recommended dose for 6 months– no adverse effects

Safety of Krill Oil

- 25 adult human volunteers given 2 gelcaps of krill oil 3 times daily
- 1 gelcap = 1 gram omega 3's (6 grams)
- No side effects
- No negative changes in blood chemistry of these volunteer subjects

Human safety study – 6 grams of krill oil daily

Subjects reported:

- increased ability to concentrate,
- decreased seasonal allergy symptoms
- increased skin hydration
- improved hair texture
- decreased joint discomfort
- improved emotional and physical PMS symptoms

PMS Study on Krill Oil

Evaluation of the Effects of Neptune Krill Oil™ on the Management of Premenstrual Syndrome and Dysmenorrhea.

Altern Med Rev 2003;8(2)171-179. Sampalis, F., M.D, PhD. et al.

- 2 Krill oil gel caps taken daily for 90 days.
- Symptom questionnaires were given at 45 days and 90 days.
- Compared to an equivalent dose of fish oil
- The fish oil group after 90 days only had statistically significant improvement in weight gain, swelling and abdominal pain.

Krill Oil improves PMS

- After 45 and 90 days the NKO™ Krill Oil group on 2 g per day, had statistically significant differences in both emotional and physical symptoms including breast tenderness, joint pain and dysmenorrhea.

PMS Study – Krill vs Fish Oil

by Tina Simpalas, PhD, MD

- Feeling overwhelmed, anxiety, stress, irritability, and depression.
- These emotional symptoms were significantly improved on 2 grams of krill oil daily and did not improve significantly in the fish oil group

Krill Oil Hyperlipidemia study

- A recent study on 120 human subjects (results to be published) compared the effects of Fish oil vs. Krill oil on hyperlipidemia.
- Krill oil at a dose of 1.5 grams per day was more effective than fish oil at reducing glucose levels, total cholesterol, LDL, Chol:HDL ratio and at raising HDL levels.
- A 3 g dose of Krill oil daily lowered triglyceride levels as well.

Skin Cancer Study

- A mice study showed that Krill Oil can significantly prevent the incidence of skin cancer caused by chronic exposure to Ultraviolet radiation (results to be published)

Is Krill Oil stable?

- DFH Krill Oil uses a cold extraction process
- Protects the lipids from alteration and avoids peroxidation
- Zero heavy metals
- No organohalide pollutants
- Peroxide value 0.00
- P-anisidine 0.1

Krill Oil

- Oil stability index is 16
- ORAC test shows it to have 300 times the antioxidant capacity of Vitamins A or E alone!

Brunswick Laboratories 6 Thatcher Lane Wareham
MA 02571

The ORAC analysis, which utilizes Fluorescein as the fluorescent probe, provides a measure of the scavenging capacity of antioxidants against the peroxyl radical, which is one of the most common reactive oxygen species (ROS) found in the body.

Vitamin A	1.25
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Vitamin E	1.25
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Lutein	8
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Fish Oil	8
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Coenzyme Q-10	11
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Astaxanthin	51
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Lycopene	58
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NKO Krill	378
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Oxygen Radical Absorption Capacity

Beta-Carotene + Alpha-Tocopherol= stronger

Beta-Carotene and alpha-tocopherol are synergistic antioxidants.

Arch Biochem Biophys. 1992 Aug 15;297(1):184-7.
Palozza P, Krinsky NI.

- Tufts University study says:
- together they inhibit lipid peroxidation better than either alone.

How to Dose Krill Oil

- PMS: 2 capsules daily for 60 days – then reduce to 1 capsule per day (500 mg)
- Cardiovascular/Hyperlipidemia: 3 capsules daily – maintenance of 1-2 capsules daily.
- For more aggressive treatment 6 capsules daily would be recommended.
- Maintenance dose for most conditions is 1 daily.

Krill Oil should be considered for

- Delayed speech development
- Dyslexia and autism
- Pregnancy and lactation
- PMS and menopause
- Hyperlipidemia
- Cancer prevention
- Retinitis Pigmentosa
- Skin cancer prevention
- Osteo and rheumatoid arthritis
- Depression
- Manic Depression
- SAD
- Inflammation
- Metal Toxicity

Depression Protocol

- Krill Oil: 1 breakfast, 1 dinner (1000 mg)
- 5 HTP: 2-3 breakfast, lunch and dinner (300-450 mg) plus 3 bedtime if needed for insomnia
- SAMe: 1 breakfast (200 mg)
- Ultra B12 –Folate: 1 breakfast
- Inositol: 2 caps breakfast and 2 bedtime (helps insomnia and anxiety)
- Wheat-free and dairy-free diet

What is PMS?

- A Cyclic pattern of severe emotional and behavioral symptoms occurring typically during the last week of the luteal phase and remitting within a few days after the onset of follicular phase
- DSM-III –R diagnostic criteria are confusing
- At least 5 of the following symptoms have been present for most of the time during each symptomatic late luteal phase, at least one being either 1, 2, 3 or 4:

PMS Diagnostic Symptoms

1. Feeling suddenly sad, tearful, irritable, or angry (marked affective lability)
2. Persistent and marked anger or irritability
3. Marked anxiety, tension, feelings of being “keyed up”, or “on edge”
4. Decreased interest in usual activities
5. Easy fatigability or marked lack of energy
6. Subjective sense of difficulty in concentrating
7. Marked change in appetite, or specific food cravings

PMS Symptoms continued

8. Hypersomnia or insomnia
9. Other physical symptoms, such as breast tenderness or swelling, headaches, joint or muscle pain, a sensation of “bloating”, weight gain
 - These symptoms can be experienced even by hysterectomized women who retain ovarian function
 - 30 – 40 yr olds usually report the worst symptoms

Possible Causes of PMS

- High estrogen, low progesterone
- Hypoglycemia
- Mercury Toxicity
- Hypothyroid
- Candidiasis
- Food allergies/sensitivities
- Inadequate protein intake – liver enzymes that convert female hormones depend on protein
- Poor Liver Function- the liver metabolizes estrone into estriol (may protect from cancer)
- Poor Adrenal Function

PMS Protocol

GLA (borage oil)	240 mg, 4 daily
Magnesium	800 mg. at night
B6 (DFH Water Ease)	100 mg-200 mg daily
Inositol	½ tsp. am and pm
Krill Oil	2 gelcaps daily
B complex (B Supreme)	100 mg., 2 daily
CraveArrest	2-3 per meal

B6 and Tryptophan Metabolism

- Tryptophan

—————→ Kynurenine

Kynurenine hydroxylase (inhibited by estrogen)



3-hydroxylkynurenine



2-amino-3-carboxymuconic semialdehyde



Quinolinate

decarboxylation



Nicotinate mononucleotide
(contains niacin)

Pellagra

- A disease caused by niacin deficiency
- Italian word for “rough skin” – black tongue in dogs
- Women on BCP’s, HRT or who have estrogen dominance (susceptible to PMS) are susceptible to pellagra
- Because kynurenine hydroxylase is inhibited by estrogen
- And these hormone prescriptions deplete B vitamins

Vitamin B₃



An inability to absorb niacin (vitamin B₃) or the amino acid tryptophan may cause pellagra, a disease characterized by scaly sores, mucosal changes and mental symptoms

Fetal biotin deficiency

- **Marginal biotin deficiency is teratogenic in ICR mice.**

Mock DM, Mock NI, Stewart CW, LaBorde JB, Hansen DK.
Department of Biochemistry and Molecular Biology, University of
Arkansas for Medical Sciences, Little Rock, AR 72205, USA.

- The incidence of marginal biotin deficiency in normal human gestation is approximately one in three

Biotin deficiency in mice

- This study utilized validated indices of biotin status to investigate the relationships among maternal biotin status, fetal biotin status and the rate of fetal malformations in ICR mice.

Biotin deficiency causes birth defects

- In ICR mice, maternal biotin deficiency results in:
 - cleft palate
 - micrognathia – abnormally small jaw
 - microglossia – small tongue
 - limb hypoplasia – underdeveloped limbs