

# **Module 3**

## **Minerals**

## WHAT YOUR MOUTH IS TELLING YOU ABOUT YOUR HEALTH

Ulcer that won't heal: Cancer

B6

Wobbly teeth –  
Vit C, Mn

Cracked and crumbling  
teeth: Acid reflux

Ca, Mg, P, B

Metallic taste –  
pregnancy or leaking  
amalgams

Caries –  
Calcium fluoride

Inflamed gums: Gum disease

Folic acid, CoQ10, Si

Bleeding gums:  
Heart disease or  
type 2 diabetes

B6

Cracked lips: Iron deficiency

B2, EFAs

**THE**  
**Sun**

23/10/18

## **Teeth**

**Cavities – Calcium fluoride**

**Wobbly teeth – Collagen  
(Vitamin C, Mn)**

**Receding gums – Folates, CoQ10  
Silica**

**Bleeding gums – P-5-P, Folates  
Bioflavonoids  
(Rutin),**

**Plaque -**

**Probiotics**

**Bad breath -**

**Probiotics**

**Gingivitis -**

**Vit C, Rutin,  
B Complex**

**Tartar -**

**Magnesium,  
Oils, Vit K2**

**Mouth ulcers -**

**P-5-P**

**Amalgam extraction -**

**Selenium, Bamboo,  
Chlorella, Spirulina**

# Muscles and their meridian relationship.

Meridian	Muscles
Bladder	Tibialis ant, Tibialis post, Peroneus long/brevis, Peroneus tertius
Kidney	Psoas, Iliacus, Upper trap
Gall bladder	Popliteus
Liver	PMS, Rhomoids
Large Intestine	TFL, Hamstrings, QL
Lung	Deltoid, Serratus ant, Coracobrachialis
CV	Supraspinatus, Diaphragm
GV	Teres major
Triple warmer	Teres minor, Infraspinatus
Circulation / sex	Glut max, Glut med/min, Piriformis, Adductors, Sartorius, Gracilis
Stomach	PMC, Neck flexors, Biceps, Brachialis, Pronator teres, Pronator quadratus
Spleen	Lat dorsi, Mid trap, Lower trap, Triceps
Small intestine	Quads, Abdominals
Heart	Subscapularis

# **Nutrition / Muscle relationship.**

**Vitamin A - Latissimus dorsi, Pectoralis major clavicular, Pectoralis minor, Piriformis, Popliteus, Psoas, Quadratus lumborum, Rhomboids, Sacrospinalis, Tibialis anterior.**

**B. Complex - Pectoralis major clavicular, Pectoralis minor, Peroneals, Quadriceps, Subscapularis, Upper trapezius, Supinator.**

**Vitamin B1**

**Vitamin B2 - Neck extensors**

**Vitamin B3 - Gracilis, Neck flexors, Pectoralis minor**

**Vitamin B5 - Sartorius**

**Vitamin B6 - Opponens digiti minimi**

**Folic acid**

**Vitamin B12**

**Biotin**

**Vitamin C - Coracobrachialis, Deltoid, Diaphragm, Quadratus lumborum, Sacrospinalis, Sartorius, Serratus anterior, Middle trapezius, Lower trapezius**

**Vitamin D - Quadriceps, Tensor fascia lata, ICV**

**Vitamin E - Abdominals, Adductors, Gluteus maximus, Gluteus medius, Hamstrings, Quadratus lumborum, Sacrospinalis, Subscapularis**

**Vitamin K**

**Co-enzyme Q10**

**SAMe**

# Muscle / Meridian / Nutrition relationship.

<u>Muscle</u>	<u>Meridian</u>	<u>Nutrition</u>
Abdominals	SI	Vit E
Adductors	Cx	Vit E
Biceps	St	HCl, Chlorophyll
Brachio Radialis	St	HCl
Coracobrachialis	Lung	Vit C
Deltoid	Lung	Vit C, RNA
Diaphragm	CV	Vit C
Gastrocnemius	Cx	Adrenal
Gluteus max	Cx	Vit E
Gluteus med	Cx	Vit E
Gracilis	Cx	Vit B3, Adrenal
Hamstrings	LI	Vit E, HCl, Ca
ICV		Chlorophyll, Ca, Vit D, HCl
Infraspinatus	TW	Thymus
Latissimus dorsi	Sp	Vit A, EFAs, Zn
Neck extensors	St	Vit B2, B3, B6, Iodine
Neck flexors	St	Vit B3, B6
Opponens digiti min	St	Vit B6
Pectoralis major clav	St	Vit B, B12, HCl
Pectoralis major sternal	Liv	Vit A, Bile salts
Pectoralis minor		RNA, Vit A, B, B3, Zn
Peroneals	Bl	Vit B, Ca
Piriformis	Cx	Vit A
Popliteus	Gb	Vit A
Psoas / Iliacus	Kid	Vit A, E
Quadratus lumborum	LI	Vit A, C, E
Rhomboids	Liv	Vit A
Sacrospinalis	Bl	Vit A, C, E, P, Ca
Sartorius	Cx	Vit B5, B6, C, Adrenal, Zn, Ginseng
Serratus anterior	Lung	Vit C
Soleus	Cx	Vit C
SCMastoid	St	Vit B3, B6, Iodine
Subclavius		Mg
Subscapularis	Ht	Vit B, C, E
Supinator	St	Vit B, G, HCl
Supraspinatus	CV	RNA
Tensorfacialata	LI	Vit D, Probiotics, Iron
Teres major	GV	Alkaline minerals, K, P
Teres minor	TW	Iodine
Tibialis anterior	Cx/Bl	Adrenal
Tibialis posterior	Bl	Vit A
Trapezius upper	Kid	Vit A, B, EFAs, Ca
Trapezii mid & lower	Sp	Vit C, Ca
Triceps	Sp	Vit A, HCl

# Minerals covered in Module 3

Boron\*

Calcium\*

Chromium\*

Copper\*

Iodine\*

Iron\*

Magnesium\*

Manganese\*

Molybdenum\*

Phosphorus

Potassium\*

Selenium\*

Silica\*

Silver\*

Sodium

Sulfur

Zinc\*

5

B

Boron

# Boron spectroscopy

absorption



emission



**Boron\*** is a chemical element with symbol B and atomic number 5. Because boron is produced entirely by cosmic ray spallation and not by stellar nucleosynthesis, it is a low-abundance element in both the Solar system and the Earth's crust.

*\*"Q & A: Where does the element Boron come from?". [physics.illinois.edu](http://physics.illinois.edu).*

*Retrieved 2011-12-04.*

**Boron** is concentrated on Earth by the water-solubility of its more common naturally occurring compounds, the borate minerals. These are mined industrially as evaporites, such as borax and kernite. The largest proven boron deposits are **in Turkey**, which is the also the largest producer of boron minerals.

**Chemically un-combined boron, which is classed as a metalloid, is found in small amounts in meteoroids, but is not found naturally on Earth.**

**According to conventional medicine it is not known if **boron** is essential for humans but research shows that we do need it\*.**

*\* "Boron". PDRhealth. Archived from the original on 11 October 2007. Retrieved 2008-09-18.*

**The reason why it was difficult to answer this question is the presence of boron in all plants and unprocessed foods.**

**Diets with a fair amount of fruit and vegetables provide about 2 to 5 mg of boron per day, but this also depends on the region where the food was grown and how it was grown.**

**Boron. IN: Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, ~~Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Copper~~**

**National Academy Press. 2001, PP. 510–521.**

In reality the average intake in developed countries is **1-2 mg** of boron per day. Chemical fertilizers inhibit the uptake of boron from the soil: an organic apple grown in good soil may have 20 mg boron, but if grown with fertilizer it may have only 1 mg of boron.

Boron. IN: Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Copper.

National Academy Press. 2001, PP. 510–521.

**The cooking water of vegetables may be discarded during home cooking or commercial processing; phytic acid in baked goods, cereals and cooked legumes may greatly reduce availability, while gluten sensitivity and Candida overgrowth inhibit the absorption of minerals.**

## **Health Effects of Boron**

### **1. Protects from Fluorides.**

**Boron protects against the accumulation of fluorides in the body; is effective as an antidote in fluoride toxicity; and can remove fluorides from the body.\***

\*Pizzorno, L (Aug 2015). "Nothing boring about boron". *Integrative Medicine*. 14 (4): 35&ndash

**2. Anti-microbial. Boron is toxic to insects, parasites, protozoa and bacteria.\***

**3. Fungicide. Effective against moulds and fungi, internally and externally.\***

**4. Anti-viral\*\***

*Klotz, J. H.; Moss, J. I.; Zhao, R.; Davis Jr., L. R.; Patterson, R. S. (1994). "Oral toxicity of boric acid and other boron compounds to immature cat fleas (Siphonaptera: Pulicidae)". J. Econ. Entomol. 87 (6): 1534–1536*

**\*\*Pizzorno, L (Aug 2015). "Nothing boring about boron". *Integrative Medicine*. 14 (4): 35&ndash**

## **5. Hormone normalizer.\***

**Stimulates the production of hormones, stabilizes estrogen, assists with insulin use and blood glucose control, triglyceride use and production of reactive oxygen. With boron sufficiency, blood serum triglyceride levels are significantly lower.**

\*Pizzorno, L (Aug 2015). "Nothing boring about boron". *Integrative Medicine*. 14 (4): 35&ndash

**In one study\*, following just one week of Boron supplementation (10mg daily), male subjects reported an average increase in free testosterone levels of 28.3%, which is significant by all standards. Another study using a dose of 10mg/daily for 4 weeks also reported an upward trend in overall testosterone levels at 11.4%.**

**\*Naghii, Mohammad Reza, Mahmoud Mofid, Ali Reza Asgari, Mehdi Hedayati, and Maryam-Saddat Daneshpour. "Comparative effects of daily and weekly boron supplementation on plasma steroid hormones and proinflammatory cytokines" *Journal of Trace Elements in Medicine and Biology* 25, no. 1 (2011): 54-58.**

**6. Immune system enhancer.**

**Promotes healing of wounds.**

**7. Reduction and control of inflammation.**

**8. Aphrodisiac for men and women. Boron stimulates the production of testosterone and normalizes estrogen.**

**9. Toxin removal. Powerful chelator of heavy metals.**

\*Pizzorno, L (Aug 2015). "Nothing boring about boron". *Integrative Medicine*. 14 (4): 35&ndash

**10. Stabilizer of calcium, copper and magnesium levels, inhibits calcification. Boron sufficiency normalizes calcium levels, preventing both abnormal calcium deposition and bone weakness. Boron sufficiency inhibits the concentration of copper in the bones and prevents loss of bone.\***

**\*Pizzorno, L (Aug 2015). "Nothing boring about boron". *Integrative Medicine*. 14 (4): 35&ndash**

**11. Mental enhancement. Improves attention, both short and long term memory, perception, hand-eye coordination, and manual dexterity. Boron is distributed throughout the body with the highest concentration in the parathyroid glands, followed by bones and dental enamel.**

**\*Pizzorno, L (Aug 2015). "Nothing boring about boron". *Integrative Medicine*. 14 (4): 35&ndash**

**It is essential for healthy bone\* and joint function, regulating the absorption and metabolism of calcium, magnesium and phosphorus through its influence on the parathyroid glands. With this boron is for the parathyroids what iodine is for the thyroid.**

**\*Pizzorno, L (Aug 2015). "Nothing boring about boron". *Integrative Medicine*. 14 (4): 35&ndash**

**Boron deficiency causes the parathyroids to become overactive, releasing too much parathyroid hormone which raises the blood level of calcium by releasing calcium from bones and teeth. This then leads to osteoarthritis and other forms of arthritis, osteoporosis and tooth decay.**

**\*Pizzorno, L (Aug 2015). "Nothing boring about boron". *Integrative Medicine*. 14 (4): 35&ndash**

**With advancing age high blood levels of calcium lead to calcification of soft tissues causing muscle contractions and stiffness; calcification of endocrine glands, especially the pineal gland and the ovaries; arteriosclerosis, kidney stones, and calcification of the kidneys ultimately leading to kidney failure.**

**Boron deficiency** combined with magnesium deficiency is especially damaging to the bones and teeth. Boron affects the metabolism of steroid hormones, and especially of sex hormones. It increases low testosterone levels in men and oestrogen levels in menopausal women.

\*Pizzorno, L (Aug 2015). "Nothing boring about boron". *Integrative Medicine*. 14 (4): 35&ndash

**It also has a role in converting vitamin D to its active form, thus increasing calcium uptake and deposition into bone and teeth rather than causing soft tissue to calcify. Also other beneficial effects have been reported such as improvement of heart problems, vision, psoriasis, balance, memory and cognition.**

\*Pizzorno, L (Aug 2015). "Nothing boring about boron". *Integrative Medicine*. 14 (4): 35&ndash

**Areas in the world with highest boron levels have lowest incidence of osteoarthritis. Areas with lowest levels of boron have the highest incidence. Synovial fluid in osteoarthritic joints is low in boron.**

**With additional boron bone fractures heal in about half the normal time in both man and animal.**

**Boron is also effective with other forms of arthritis, such as Rheumatoid Arthritis, Juvenile Arthritis, and Lupus (Systemic Lupus Erythematosus).**

**Boron inhibits the formation of biofilms and also the transformation of harmless yeast cells into invasive hyphal form.**

\*Pizzorno, L (Aug 2015). "Nothing boring about boron". *Integrative Medicine*. 14 (4): 35&ndash

## **Supplement Products**

**Boric acid**

**Sodium borate**

## **Plant sources**

**Valerianella locusta  
(Corn salad)**

**Prunus domestica  
(Plum)**

**Cydonia oblonga  
(Quince)**

**Fragaria spp  
(Strawberry)**

**Prunus persica  
(Peach)**

**Brassica oleracea  
(Cabbage)**

## **Sources**

**Hazelnuts, Raisins, Brazil nuts, Almonds, Walnuts, Avocadoes Prunes, Dried apricots, Broccoli, Potatoes, Pears, Prunes, Honey and Oranges.**

<https://www.livestrong.com/article/242015-foods-high-in-boron-vitamins/>

## **FDA Daily Value (RDA)**

**Not allocated but thought to be  
around 1mg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

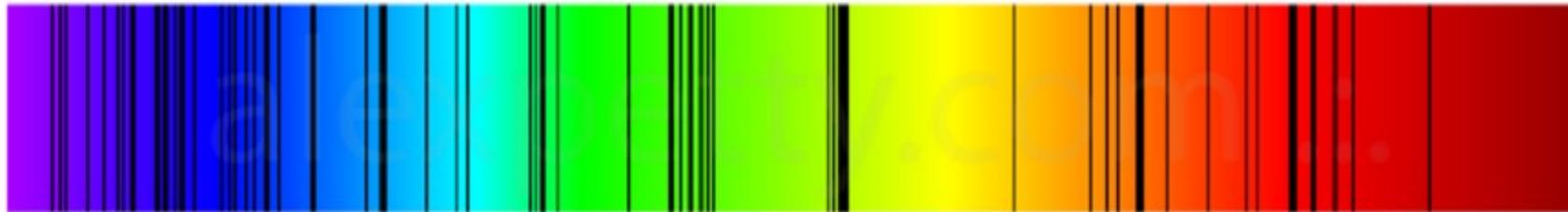
20

Ca

Calcium

# Calcium spectroscopy

absorption



emission



**Biomarker for muscle and nerve  
function**

**Immune system**

**Bone density**

**98% in bone rest in soft tissue,  
body fluids and all cells.**

**Generally extra-cellular.**

**Calcium concentration 10mg/dl.**

**50% is ionised. 50% bound to  
albumin.**

**Calcium hydroxapatite in bone  
along with phosphate, carbonate,  
fluoride, hydroxide and citrate.\***

\*Role of Nutrition in Health and Disease by W.E. Cornatzer, Pub Thomas. Page 154

# **Calcium – Physical complaints**

- **Cancer**
- **Paralysis**
- **Swollen glands, thyroid – hypo**
- **Heart complaints, hypertrophy**
- **Myoma**
- **Anaemia**
- **Stomach problems**

Homeopathy and the Elements by Jan Scholten p324

# Calcium – Physical complaints

- **Diabetes**
- **Kidney problems**

## **Calcium – Biochemical activity**

- **Bones and teeth strong, supporting skeletal structure and function, osteoporosis**
- **Plays a key role in cell signalling and nerve function**
- **Cells use Ca to activate certain enzymes, transport ions across the cellular membrane**

Homeopathy and the Elements by Jan Scholten p324

## **Calcium – Biochemical activity**

- **And send and receive neurotransmitters during communication with other cells**
- **Role in muscle contraction**
- **As an electrolyte (conducts electricity in the body) Ca is one of the key players in maintaining a regular heart beat**

## **Calcium – Biochemical activity**

- **Ca may decrease the risk for colorectal cancer. Because it is involved in cell signalling in cells of the immune system, participates in the regulation of cell differentiation and gene transcription**

## **Calcium – Biochemical activity**

- **Ca readily binds to proteins, changing the charge on the protein chain, causing the protein structure to change**
- **Eg in several of the clotting factors in the blood plasma**

## **Calcium – Biochemical activity**

- **The voltage gated sodium ion channels in the cell membranes of the nerves and muscles are sensitive to concentrations of Ca in the plasma**
- **A relatively small decrease in Ca causes these channels to leak sodium into the nerve cells or axons,**

Homeopathy and the Elements by Jan Scholten p324

## **Calcium – Biochemical activity**

- **making them hyper-excitabile, causing spontaneous muscle spasms (tetany) and paraesthesia (pins and needles)**
- **The kidney filters & reabsorbs Ca**

# **Calcium – Biochemical activity**

## **Wound healing**

**Univ. Bristol School of Biochemistry**

**Studied the cellular process underlying the body's response to healing, have revealed how a flash of calcium is the first step in repairing damaged tissue, attracting the first white blood cells to the wound, these are needed to kill off invading microbes.**

**Wound induced Ca flash – earliest signal following the wound and orchestrates the rapid recruitment of immune cells**

## **Factors influencing blood calcium**

- 1. Parathyroid PTH ↑ blood Ca.**
- 2. Calcitonin ↓ blood calcium**
- 3. 1,25(OH)D3 ↑ blood Ca, ↑  
Intestinal absorption and ↓  
kidney excretion.**
- 4. ↓Albumin causes ↓ Ca.**
- 5. ↑Phosphate causes ↓Ca.**
- 6. Alkalosis causes ↓ Ca > tetany**
- 7. ↓ Estrogen causes ↓ Ca.**

## **Supplement products**

**Calcium bisglycinate**

**Calcium citrate**

**Calcium fluoride**

**Calcium phosphate**

**Calcium sulphate**

## **Plant sources**

**Lycopersion**

**esculentum (Tomato)**

**Brassica botrytis**

**(Cauliflower)**

**Valeriana officinalis**

**(Valarian)**

**Urtica dioica**

**(Stinging nettle)**

**Prunus serotina**

**(Black cherry)**

**Tabebuia heptaphylla**

**(Pau d'arco)**

## Sources

- Almond, rice, coconut, and hemp milks
- Canned seafood with bones (e.g., salmon and sardines)
- Dairy products
- Fortified cereals and juices
- Fortified soy beverages (soymilk)
- Green vegetables (e.g., spinach, kale, broccoli, turnip greens)
- Tofu (made with calcium sulfate)

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**1000mg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

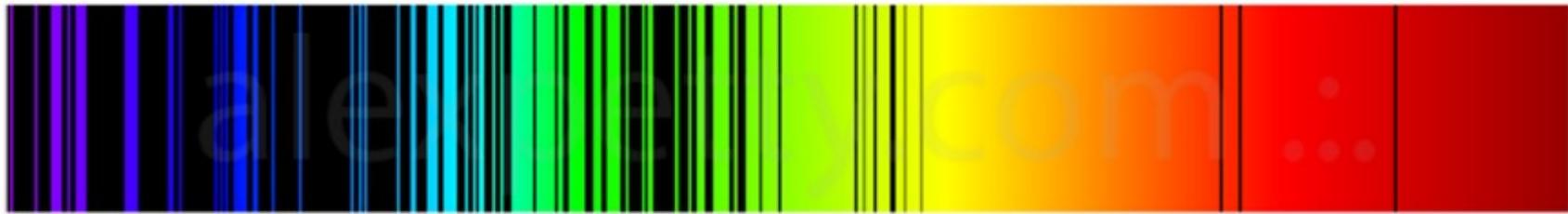
24

Cr

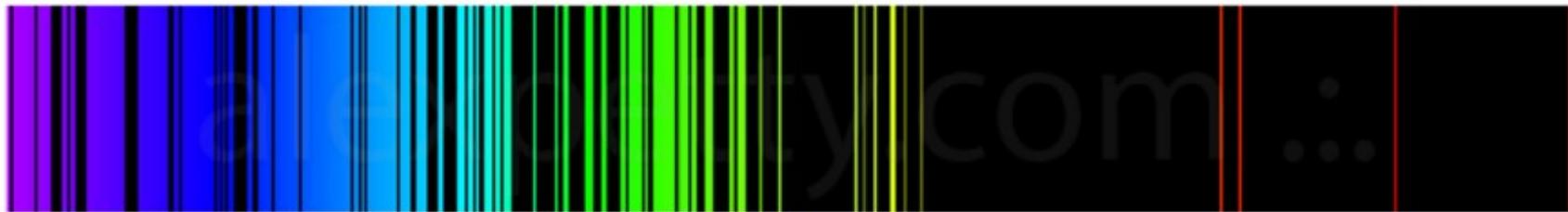
Chromium

# Chromium spectroscopy

absorption



emission



**Biomarker for Glucose tolerance.**

**In the United States, trivalent chromium (Cr(III)) ion is considered an essential nutrient in humans for insulin, sugar and lipid metabolism.\***

*\*"Chromium". Office of Dietary Supplements, US National Institutes of Health. 2016. Retrieved 26 June 2016.*

**However, in 2014, the European Food Safety Authority, acting for the European Union, concluded that there was not sufficient evidence for chromium to be recognized as essential.\***

**\*"Scientific Opinion on Dietary Reference Values for chromium". European Food Safety Authority. September 18, 2014. Retrieved March 20, 2018.**

**Trivalent chromium (Cr(III)) ion is possibly required in trace amounts in human metabolism for sugar and lipid metabolism. While chromium metal and Cr(III) ions are not considered toxic, hexavalent chromium (Cr(VI)) is toxic and carcinogenic.**

**In the form trivalent chromium, chromium was tentatively identified as an essential nutrient in the late 1950s and later accepted as a trace element for its roles in the action of insulin, a hormone critical to the metabolism and storage of carbohydrate, fat and protein.\***

*\*"Chromium". Office of Dietary Supplements, US National Institutes of Health. 2016. Retrieved 26 June 2016.*

**Chromium deficiency, involving a lack of Cr(III) in the body, or perhaps some complex of it, such as glucose tolerance factor is controversial.\***

*\*"Chromium". Office of Dietary Supplements, US National Institutes of Health. 2016. Retrieved 26 June 2016.*

**Some studies suggest that the biologically active form of chromium (III) is transported in the body via an oligopeptide called low-molecular-weight chromium-binding substance (LMWCr), which might play a role in the insulin signaling pathway.<sup>1</sup>**

Vincent, JB (2015). "Is the Pharmacological Mode of Action of Chromium(III) as a Second Messenger?". *Biological Trace Element Research*. 166 (1): 7–12

## **Supplement products**

## **Plant sources**

**Taraxacum officinalis  
(Dandelion)**

**Avena sativa (Oats)**

**Cymbopogon citratus  
(Lemon grass)**

**Juniperus communis  
(Juniper berry)**

**Trifolium pratense (Red  
clover)**

**Hordeum vulgare  
(Barley)**

**Elettaria cardamomum  
(Cardamon)**

## **Sources**

**Broccoli • Fruits (e.g., apple and banana) • Grape and orange juice • Meats • Spices (e.g., garlic and basil) • Turkey • Whole grains**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**120mcg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

29

Cu

Copper

# Copper spectroscopy

absorption



emission



- **Copper** is classified as an essential mineral because deficiencies can produce various symptoms. The total body copper content is 75-150 mg.
- Highest **copper concentrations** are found in the liver, brain, heart and kidneys.\*

\*Johnson, MD PhD, Larry E., ed. (2008). "Copper". *Merck Manual Home Health Handbook*. Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc. Retrieved 7 April 2013.

It is absorbed in the stomach and duodenum and transported to the liver loosely bound to albumin. The absorption is about 30% effective. It is then incorporated into **ceruloplasmin**, a glycoprotein synthesised in the liver, which transports copper to the tissues where it can be used for the synthesis of other **copper-containing enzymes**.

Adelstein, S. J.; Vallee, B. L. (1961). "Copper metabolism in man". *New England Journal of Medicine*. 265 (18): 892–897.

- If the body does not acquire a sufficient amount of copper, absorption of iron is also impaired because of the lack of ceruloplasmin, and the **deficiency anaemia** can result. Insufficient amounts can lead to the decreased activity of various enzymes with relevant clinical sequelae:

Adelstein, S. J.; Vallee, B. L. (1961). "Copper metabolism in man". *New England Journal of Medicine*. 265 (18): 892–897.

**Lysyl oxidase (weak walled blood vessels, intervertebral discs);  
Tyrosinase (depigmentation);\*  
Dopamine hydroxylase  
(neurological defects);  
Cytochrome C oxidase  
(decreased energy production);  
Superoxide dismutase (oxidative damage to tissues).**

**\*Bonham, Maxine; O'Connor, Jacqueline M.; Hannigan, Bernadette M.; Strain, J. J. (2002). "The immune system as a physiological indicator of marginal copper status?". *British Journal of Nutrition*. 87 (5): 393–403**

- **Copper** is usually found in foods containing iron.

## **Supplement products**

**Copper chloride**

**Copper citrate**

**Copper picolinate**

## **Plant source**

**Prunus serotina**

**(Black cherry)**

**Lycopersicon escul**

**(Tomato)**

**Brassica capitata**

**(Red cabbage)**

**Corylus avellana**

**(Hazelnut)**

**Sesamum indicum**

**(Sesame)**

**Brassica botrytis**

**(Cauliflower)**

## Sources

- Chocolate and cocoa • Crustaceans and shellfish • Lentils
- Nuts and seeds • Organ meats (e.g., liver) • Whole grains

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**2mg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

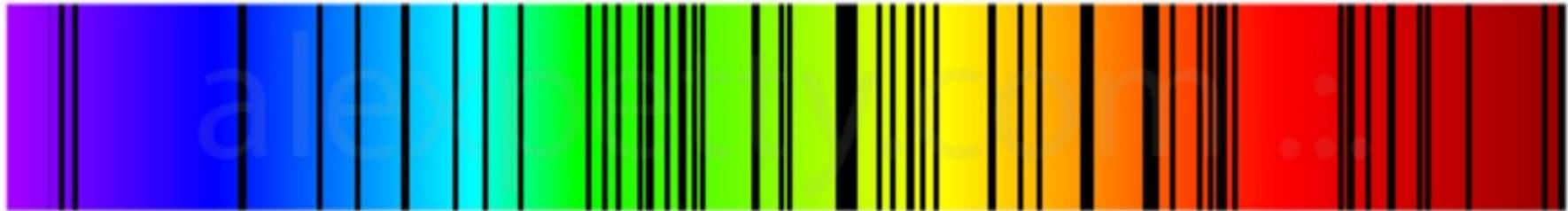
53



Iodine

# Iodine spectroscopy

absorption



emission



**An estimated total body iodine amount is 28mg – 60% is concentrated in the thyroid.**

**Iodide is used in 3 body systems**

- 1. Thyroid\***
- 2. Estradiol / Estrone metabolism**
- 3. Immune system\*\***
- 4. Synthesis of acetylcholine**

**\*"Iodine". Micronutrient Information Center, Linus Pauling Institute, Oregon State University, Corvallis, OR. 2015. Retrieved 20 November 2017.**

**\*\*Patwardhan, Narendra; Kelkar, Uday (2011). "Disinfection, sterilization and operation theater guidelines for dermatosurgical practitioners in India". *Dermatosurgery Specials*. 77 (1): 83–93.**

**Iodine** deficiency affects about two billion people and is the leading preventable cause of intellectual disabilities.

**15 to 20 mg of iodine is concentrated in thyroid tissue and hormones, but 70% of all iodine in the body is found in other tissues, including mammary glands, eyes, gastric mucosa, fetal thymus, cerebro-spinal fluid and choroid plexus, arterial walls, the cervix, and salivary glands.\***

*\*Patrick, L. (2008). "Iodine: deficiency and therapeutic considerations"(PDF). Altern Med Rev. 13 (2): 116–27.*

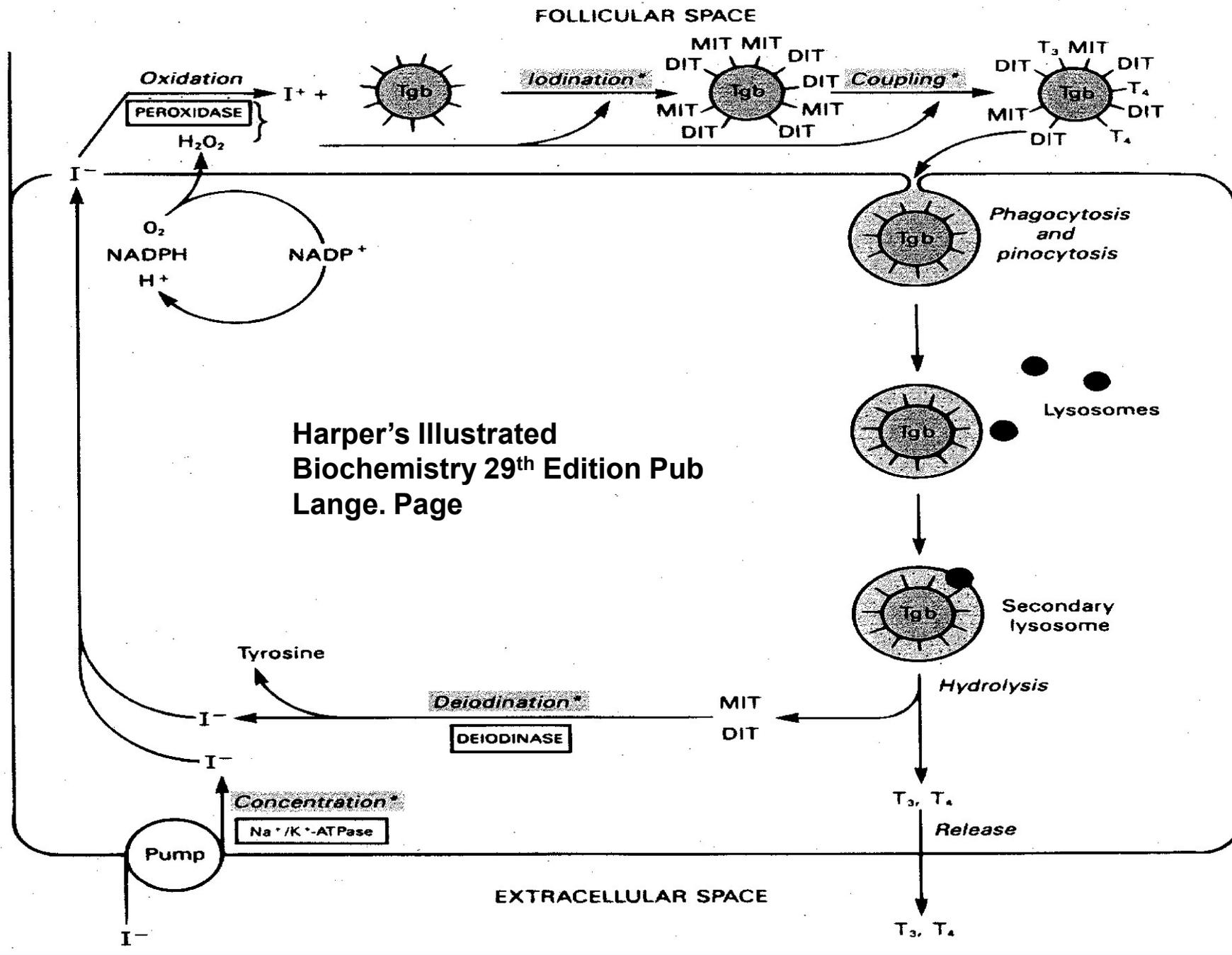
**The thyroid gland needs no more than 70 µg/day to synthesise the requisite daily amounts of T4 and T3. \***

**\*"Iodine". Micronutrient Information Center, Linus Pauling Institute, Oregon State University, Corvallis, OR. 2015. Retrieved 20 November 2017.**

**The higher recommended daily allowance levels of iodine seem necessary for optimal function of a number of body systems, including lactating breast, gastric mucosa, salivary glands, brain cells, choroid plexus, thymus, and arterial walls.\***

**\*"Iodine". Micronutrient Information Center, Linus Pauling Institute, Oregon State University, Corvallis, OR. 2015. Retrieved 20 November 2017.**

# Thyroid hormones



Harper's Illustrated  
 Biochemistry 29<sup>th</sup> Edition Pub  
 Lange. Page

**Tyrosine**

**Diodotyrosine  
(DIT)**

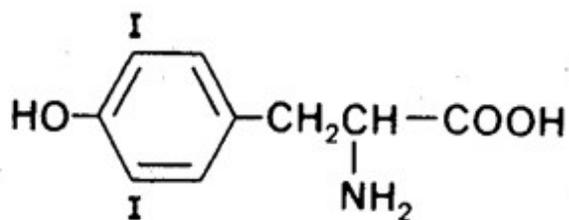
**Monoiodotyrosine  
(MIT)**

**Tetraiodothyronine  
THYROXIN (T4)**

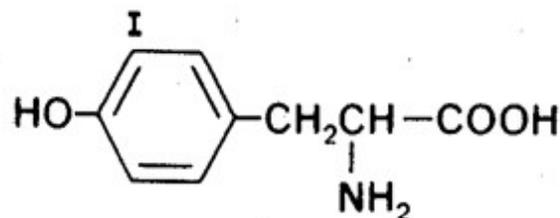
**Triiodothyronine  
(T3)  
or Reverse T3**



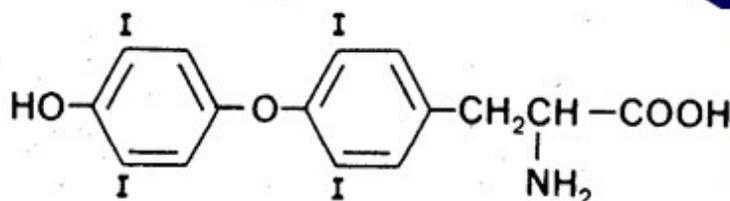
# Tyrosine



**Diodotyrosine  
(DIT)**

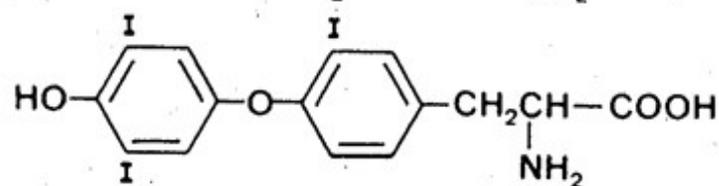
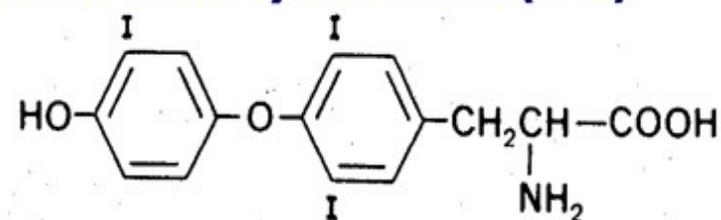


**Monoiodotyrosine  
(MIT)**

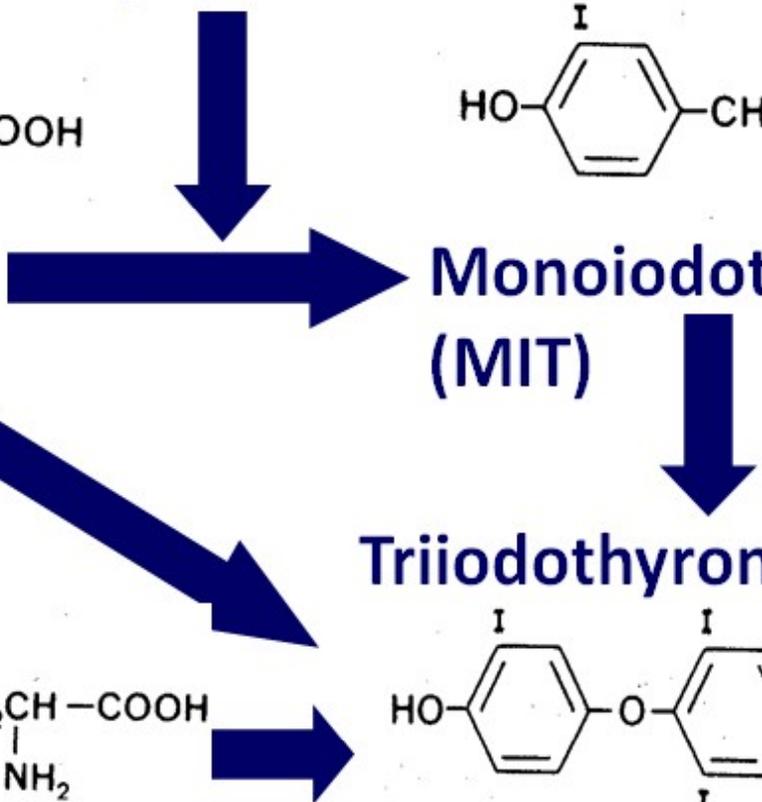


**Tetraiodothyronine  
THYROXIN (T4)**

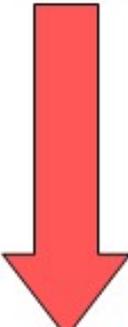
**Triiodothyronine (T3)**



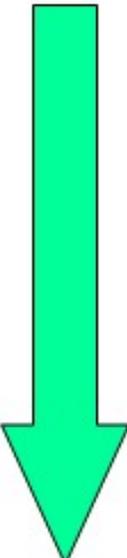
**or Reverse T3**



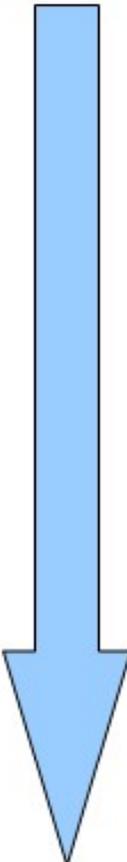
## Thyroxin (T4)



**35% deiodination  
to T3**



**45% deiodination  
to reverse T3**



**20% conjugation mainly with  
glucuronate in the liver**

**T3 is 10x more** metabolically active than thyroxin. It targets receptors on the nucleus thus stimulating general protein synthesis and a positive nitrogen balance via increasing or decreasing gene transcription.

It stimulates the conversion of **riboflavin** to **FMN and FAD**.

# Functional tests for thyroid

## Weak muscle

1. Strengthen to TSH
2. Strengthen to MIT
3. Strengthen to DIT
4. Strengthen to Thyroxin
5. Strengthen to T3

# **Strong muscle weakens to**

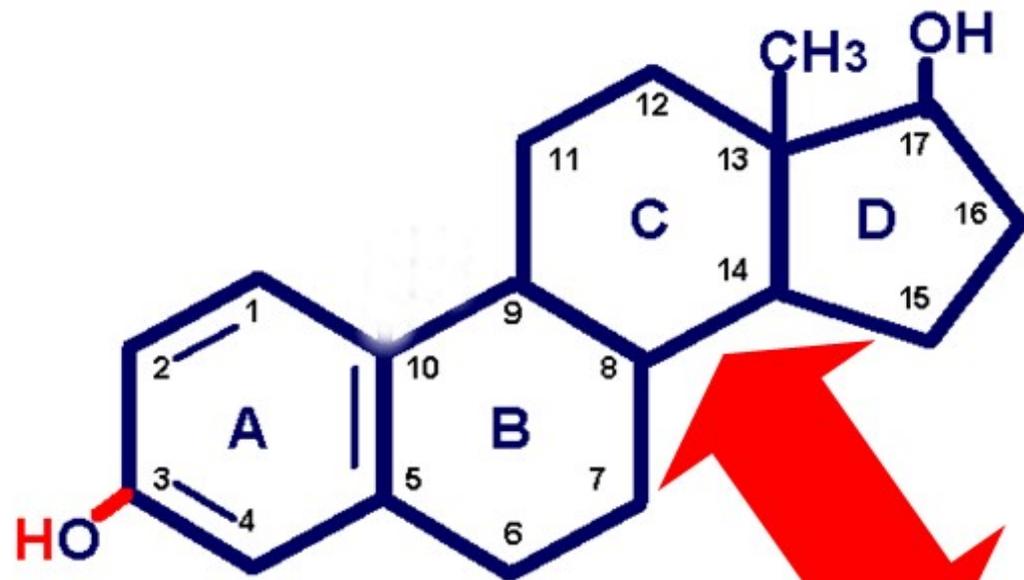
**1. TSH**

**2. Thyroxin**

**3. Reverse T3      - Acetyl CoA  
Cholesterol**

# The Estrogens

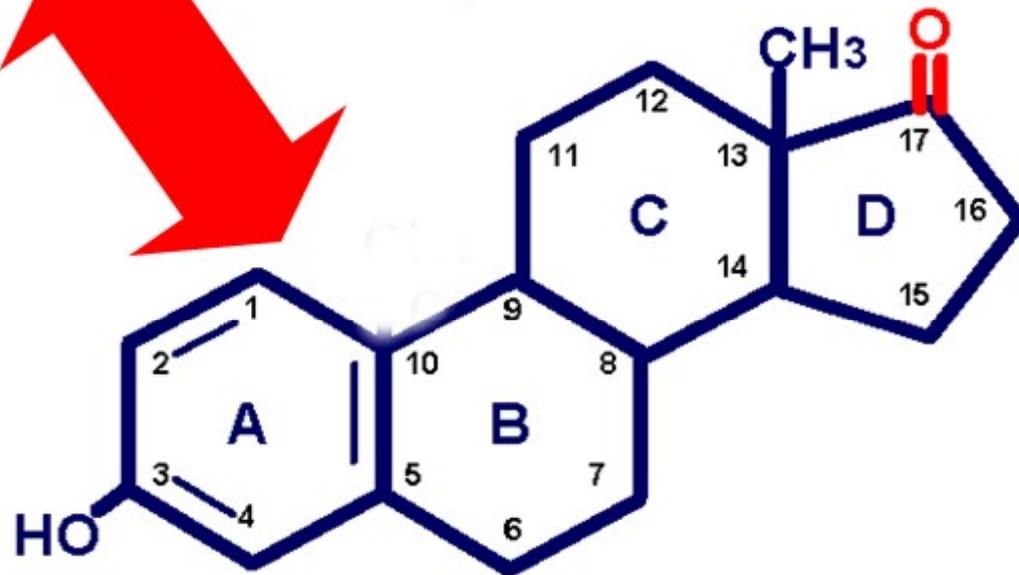
# 17 $\beta$ -Estradiol (E2)



*17 $\beta$ -hydroxysteroid  
dehydrogenase*

NAD(P)  
Fe<sup>+++</sup>

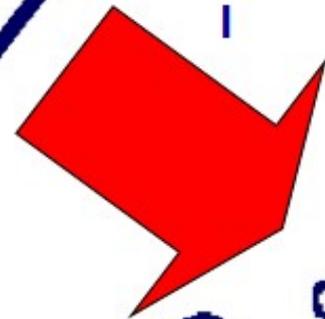
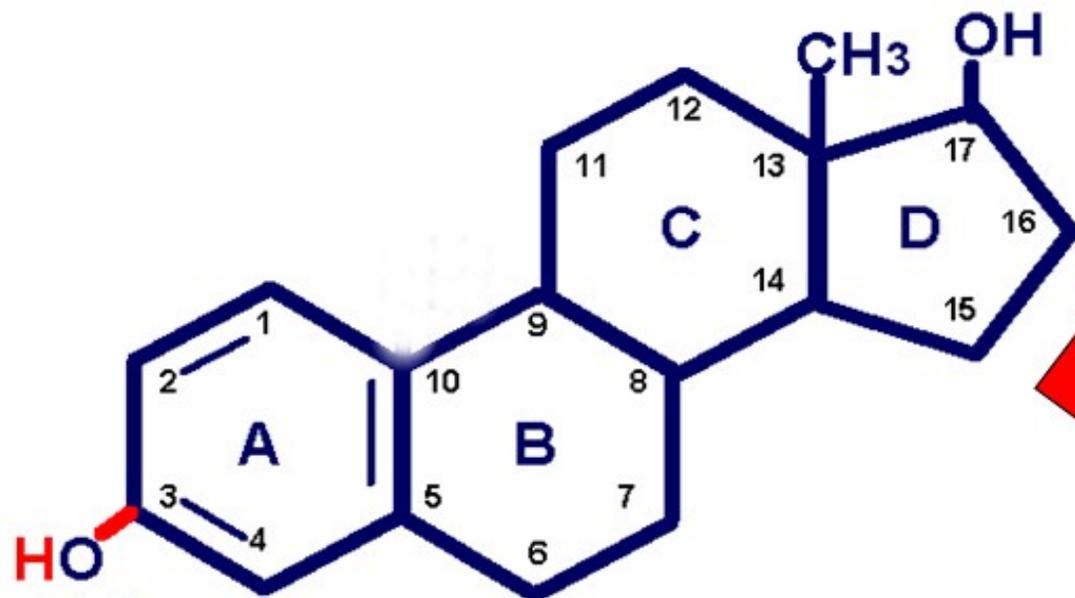
# Estrone (E1)



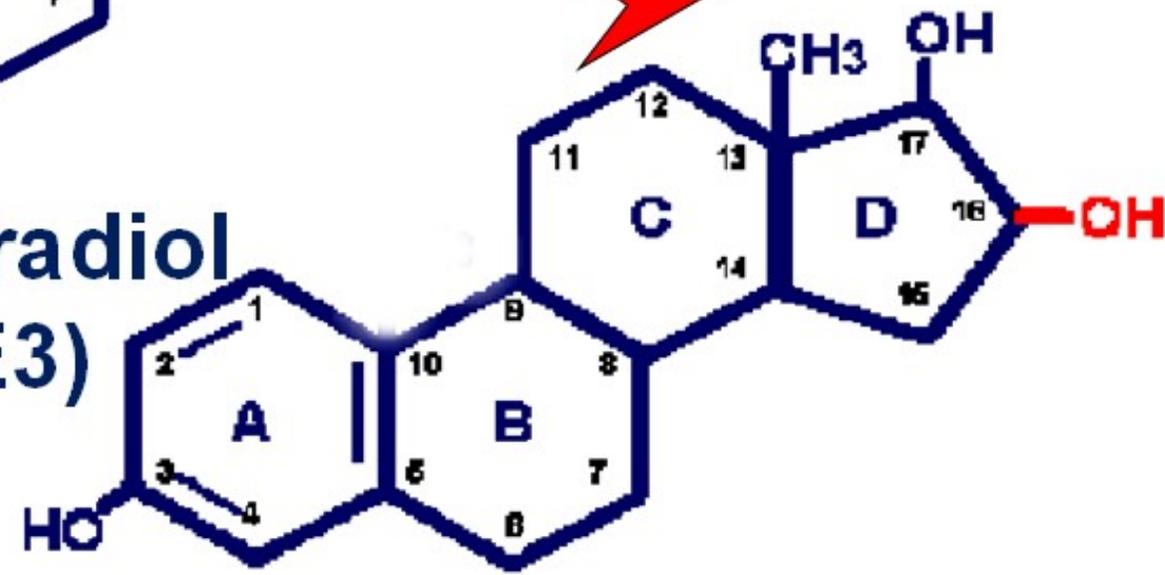
# 17 $\beta$ -Estradiol (E2)

*cytochrome p450*  
*CYP 1A2*

NADPH  
Fe<sup>++</sup>  
O<sub>2</sub>  
|



16 $\alpha$ -  
Hydroxyestradiol  
(Estrinol or E3)



## **Functional test for Estrogen excess –**

- 1. Strong muscle weakens when challenged against Estradiol + Estrone**
- 2. Weakness negated with Iodide or other nutrients**

# **The Immune System**

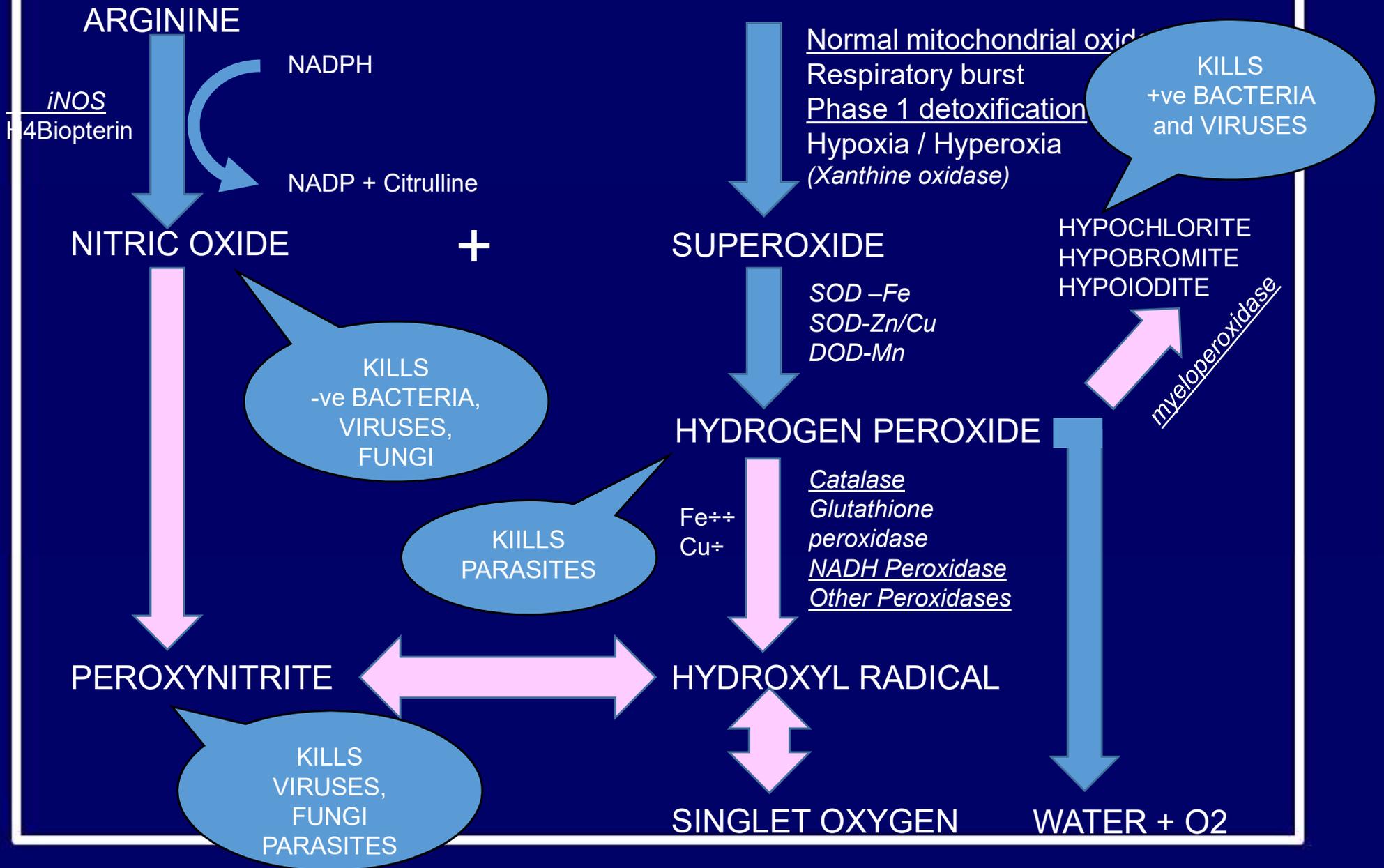
The body kills **gram positive bacteria** and certain viruses by stimulating myeloperoxidase to convert H<sub>2</sub>O<sub>2</sub> to the halogen anions -

1. Hypoiodide

2. Hypobromide

3. Hypochloride

# Reactive Oxygen Species



**Functional challenge** for an overactive immune system producing excess ROS

1. Strong muscle weakens to NF Kappa B or Malondialdehyde
2. Weakness negated with Iodide.

**Dr Goodheart**  
**says** give  
iodine in cases  
of thick and  
heavy  
secretions in  
the sinuses or  
vagina.



## **Functional test for iodide –**

**Paint 1 drop organic iodine (I<sub>2</sub>) onto the back of the hand.**

**The faster the colour disappears the more the person needs iodine.**

<b>&lt; 15 minutes</b>	<b>5+ drops</b>
<b>15 minutes – 1 hour</b>	<b>4 drops</b>
<b>1 – 2 hours</b>	<b>3 drops</b>
<b>2 – 4 hours</b>	<b>2 drops</b>
<b>4 hours +</b>	<b>1 drop</b>

**Organic iodine is a mixture of potassium, magnesium and ammonium iodides from kelp.**

## **Popular Products**

**Black walnut tincture**

**Kelp (Bladderwrack)**

**Rosemary tincture**

**White deadnettle**

**Yarrow tincture**

## **Supplement products**

**Magnesium iodide**

**Potassium iodide**

## **Plant sources**

**Fucus vesiculosus**  
**(Bladderwrack, Kelp)**

**Pistacia vera**  
**(Pistacchio)**

**Glycine max**  
**(Soybean)**

**Cinnamomum verum**  
**(Cinnamon)**

**Juglans nigra**  
**(Walnut)**

**Ananas comosus**  
**(Pineapple)**

## **Sources**

**Breads and cereals • Dairy products • Iodized salt • Potatoes • Seafood • Seaweed • Turkey**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**150mcg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# Dairy Council issues booklet on iodine in dairy

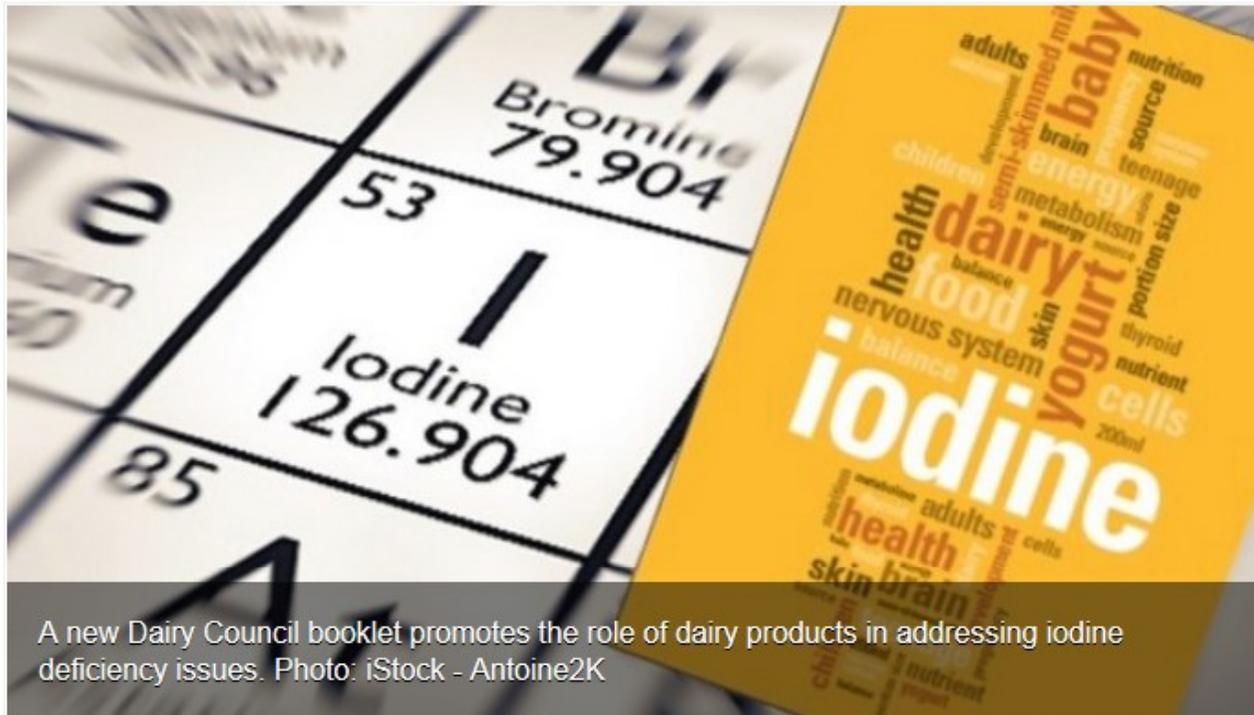


By Jim Cornall+

26-Apr-2016

Last updated on 26-Apr-2016 at 12:20 GMT

Post a comment



A new Dairy Council booklet promotes the role of dairy products in addressing iodine deficiency issues. Photo: iStock - Antoine2K

Related tags: National diet and Nutrition Survey, Iodine, Dairy Council, Thyroid

Certain groups of the UK population are classified as mildly iodine deficient, however, according to The Dairy Council, consuming milk, yogurt and cheese can help ensure that

Mendeleev Periodic Table

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

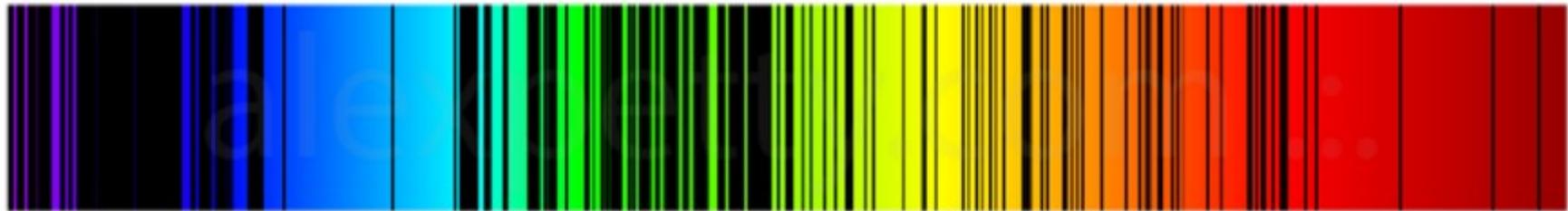
26

Fe

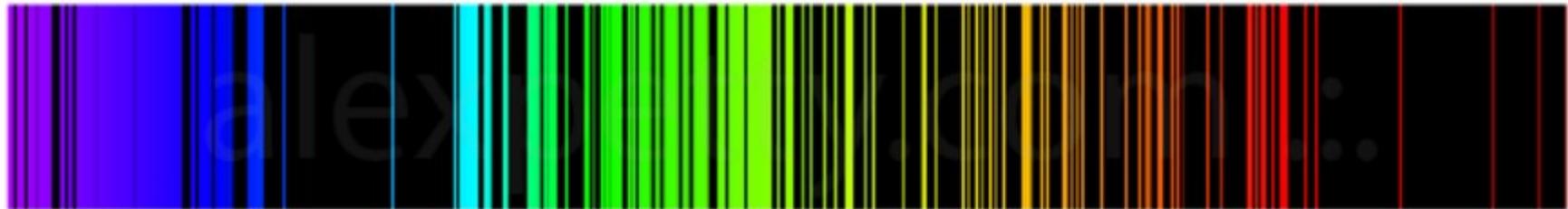
Iron

# Iron spectroscopy

absorption



emission



- Iron deficiency is one of the **most common** deficiency diseases in the world amongst men as well as women.

- The daily loss of iron is **0.5-1.0 mg** and is due to:  
gastrointestinal tract turnover,  
desquamation of intestinal  
mucosal cells and biliary  
excretion, sweat and  
desquamation of skin cells  
and urinary losses.

- They are counterbalanced by the absorption of dietary iron in the duodenum.
- The demand for iron increases during growth, pregnancy, and **menstruation** (1 ml of blood loss is equal to 0.5 mg of iron).

## **Supplement products**

**Iron chloride**

**Iron citrate**

**Iron picolinate**

**Iron sulfate**

## **Plant sources**

**Tacaxacum officinalis  
(Dandelion)**

**Echinacea spp  
(Echinacea)**

**Artemesia vulgaris  
(Mugwort)**

**Trifolium pratense  
(Red clover)**

**Thymus vulgaris  
(Thyme)**

**Camellia sinensis  
(Tea)**

## **Sources**

**• Beans and peas • Dark green vegetables • Meats • Poultry • Prunes and prune juice • Raisins • Seafood • Whole grain, enriched, and fortified cereals and breads**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**18mg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

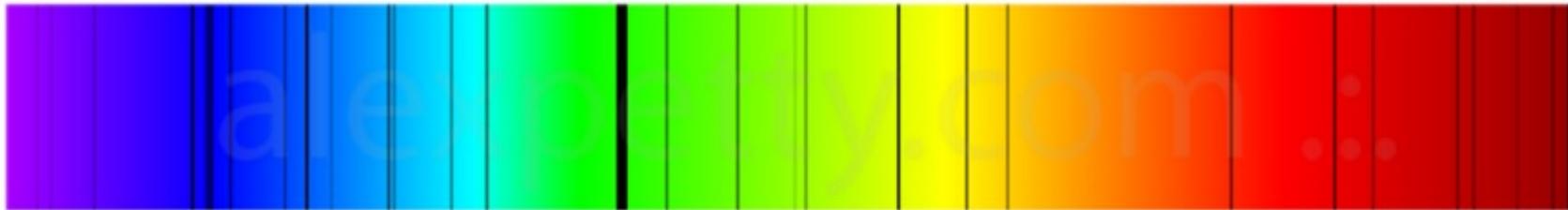
12

Mg

Magnesium

# Magnesium spectroscopy

absorption



emission



**Magnesium** is the second major intracellular cation.

Its intracellular concentration is 10x that of the serum.

Normal dietary absorption is 44%.

## **Major signs of deficiency**

**Confusion**

**Hallucinations**

**Muscle twitching and tremor**

**Tetany**

**Convulsions**

**Rigidity**

**Delirium**

**Coma**

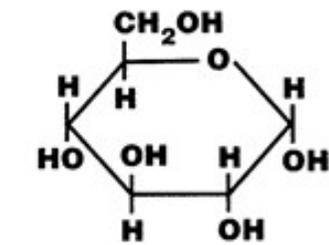
**Abnormal heart conduction and arrhythmia may occur.**

**Neuromuscular irritability is equated by**

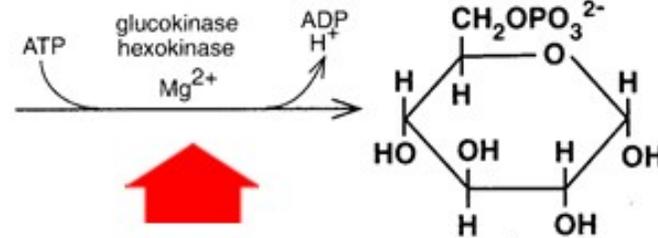
**Neuromuscular irritability =  $\frac{K^+ + Na^+}{Ca^{++} + Mg^{++} + H^+}$**

## **Functions of magnesium include**

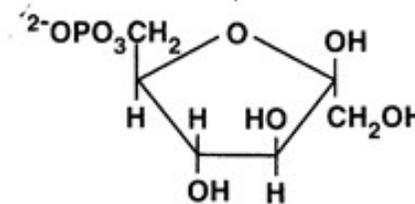
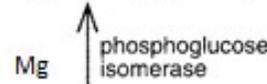
**Many enzymes in carbohydrate metabolism and energy synthesis.**



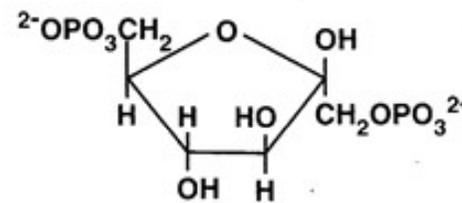
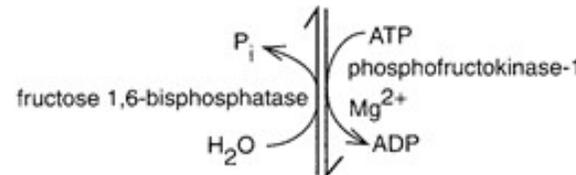
glucose



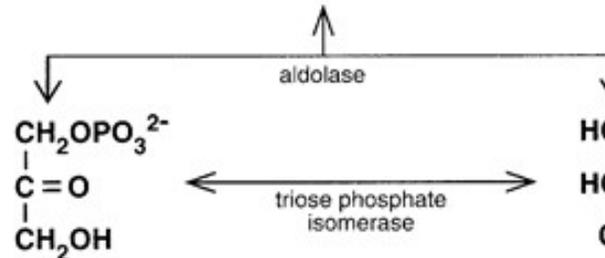
glucose 6-phosphate



fructose 6-phosphate



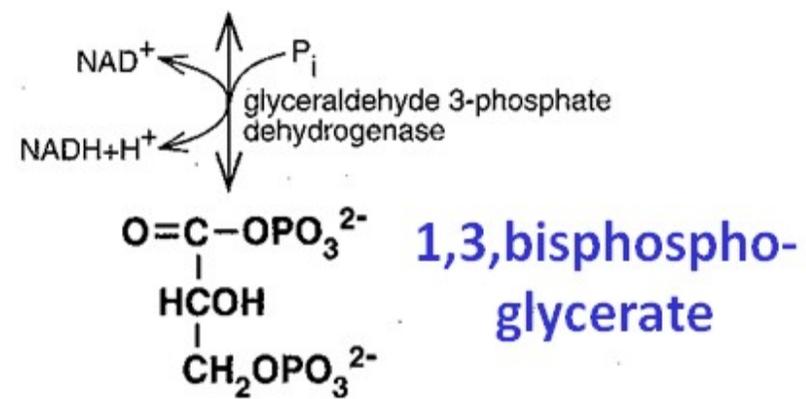
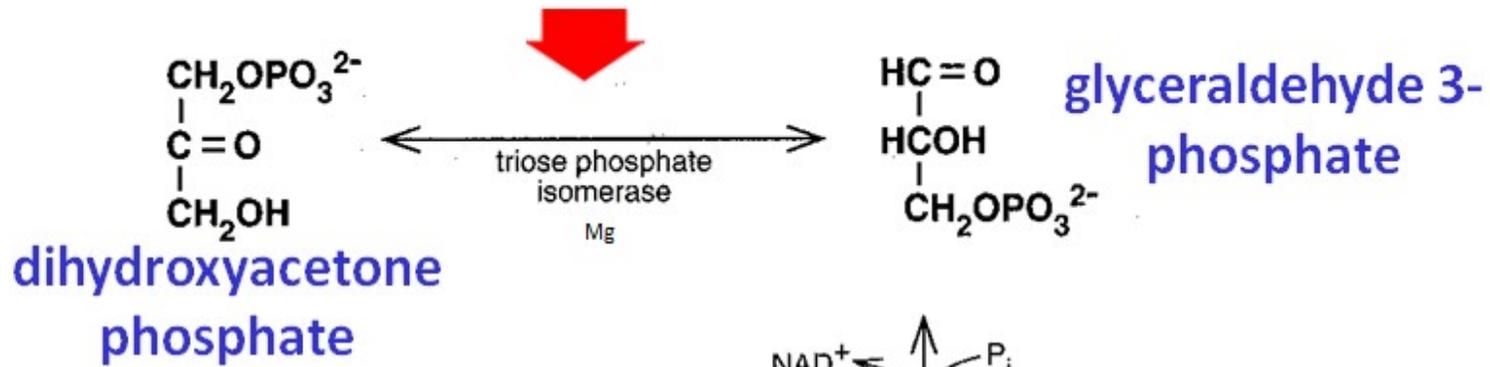
fructose 1,6-bisphosphate



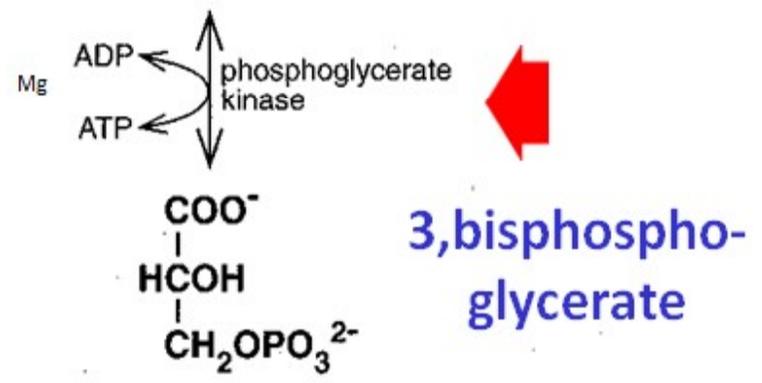
dihydroxyacetone phosphate

glyceraldehyde 3-phosphate

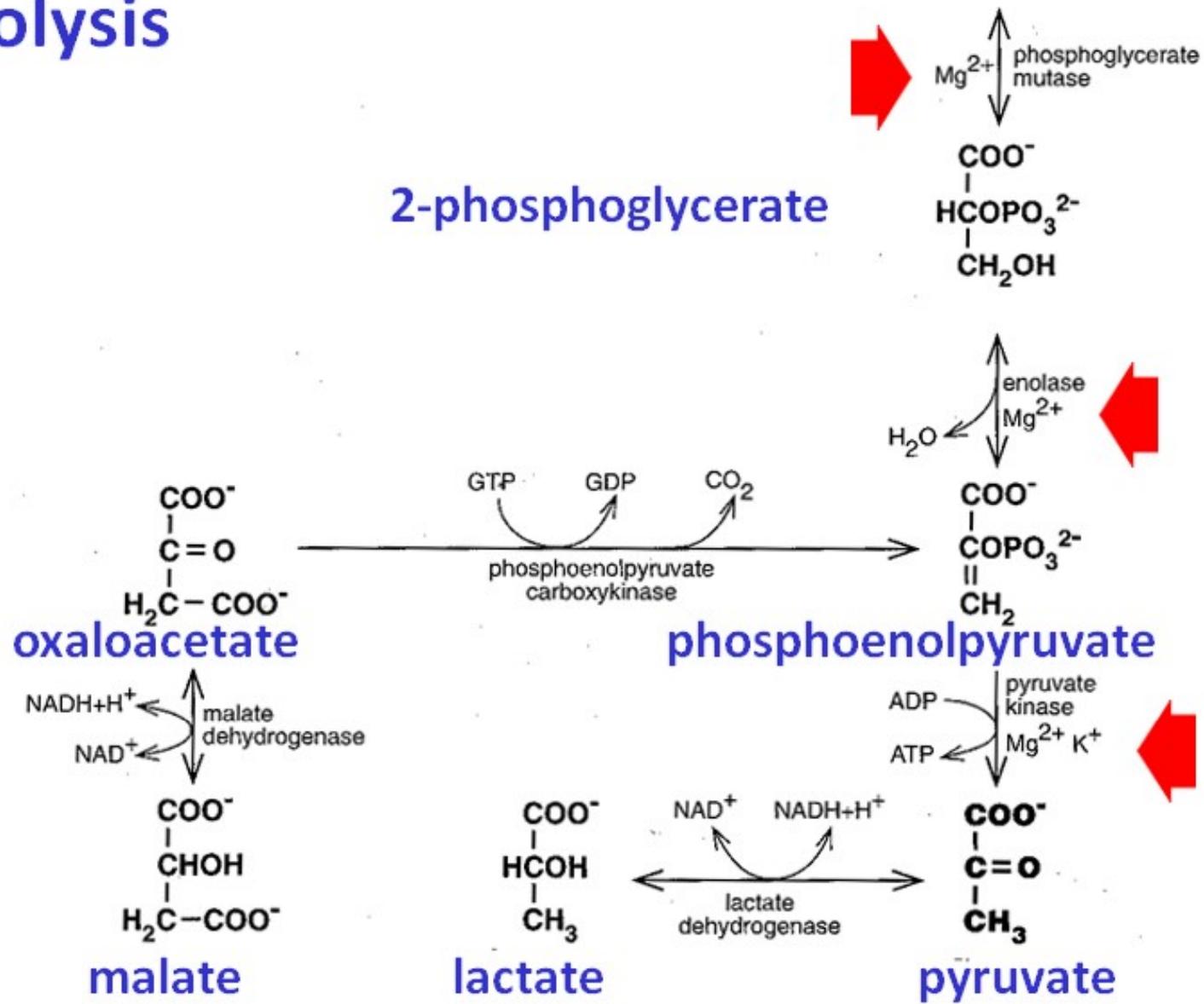
# Glycolysis



# Glycolysis



# Glycolysis



## **Synthesis of heme in hemoglobin**

*Delta-aminolevulinate synthase* requires magnesium, glycine, succinyl CoA and P5P. It is involved with the first step in the synthesis of porphobilinogen, a precursor of heme in hemoglobin.

## **Functions of magnesium include**

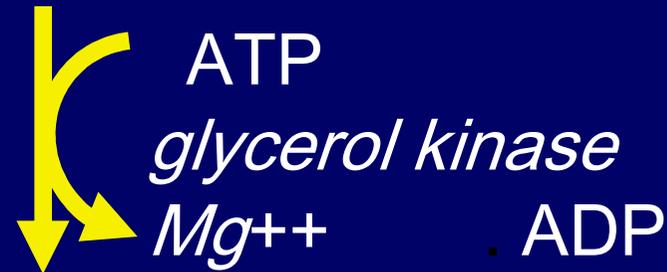
**Synthesis of purine and pyrimidine bases in RNA and DNA.**

**Synthesis of flavin nucleotides.**

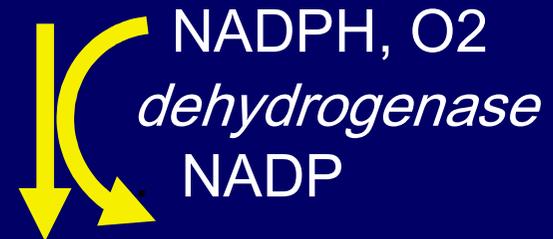
**Synthesis of nicotinamide adenine dinucleotides.**

# **Synthesis of phospholipids**

**Glycerol**

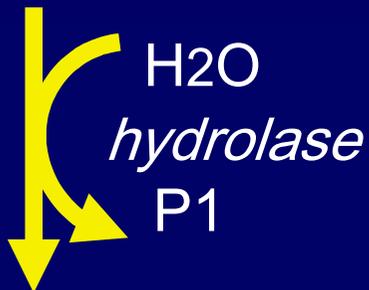


**Glycerol-3-phosphate**



**Phosphatidate**

**Dihydroxyacetone  
phosphate**

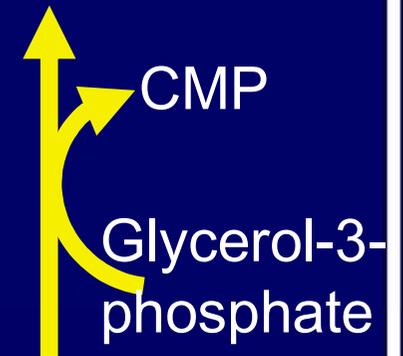
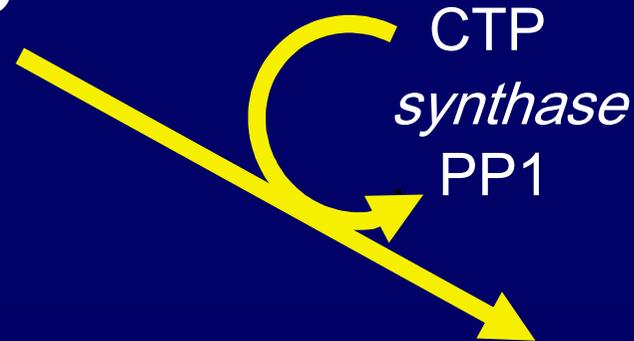


**Diacylglycerol**

**Plasmalogens**

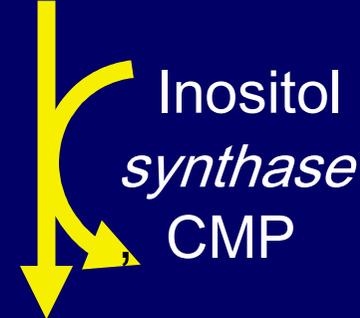
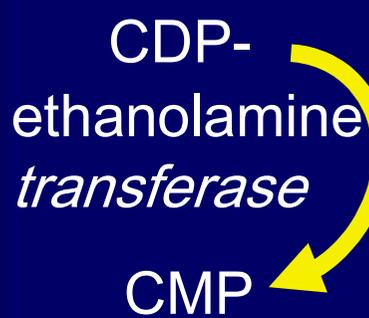
Cardiolipin

**Phosphatidate**



**Diacylglycerol**

**CDP-Diacylglycerol**



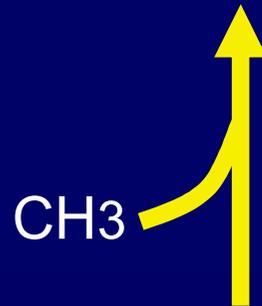
**Phosphatidylinositol**

**Phosphatidylcholine**

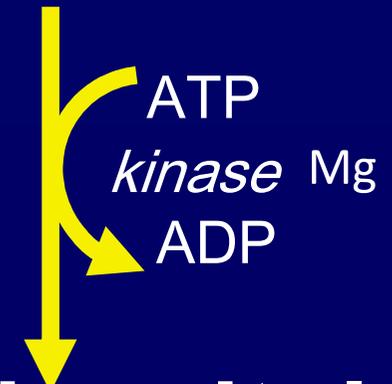
**Phosphatidylethanolamine**

**Phosphatidylcholine**

Phosphatidylinositol



**Phosphatidylethanolamine**



**Phosphatidylinositol  
-4-phosphate**



**Phosphatidylserine**

**Phosphatidylinositol-4,5-  
bisphosphate**

**Synthesis of CoA and of Acyl-CoA derivatives of fatty acids.**

**Synthesis of active sulfur (PAPs).**

**Catecholamine metabolism.**

**Muscle contraction.**

**Gene protein synthesis.  
Synthesis of glutathione.  
Synthesis of glutamine and  
asparagine and P5P.**

**Magnesium deficiency may lead to excessive **body odour** and excessive **body sweat** production.**

Here's a handy chart of specific foods that contain abundant amounts of magnesium for every 100 grams (just over 3 ounces) you consume...

**Dr Mercola 24<sup>th</sup> Feb 2018**

<b>Food (100 grams)</b>	<b>Magnesium Content (mg)</b>
Seaweed, agar, dried	770 mg
Coriander leaf (spice), dried	694 mg
Pumpkin seeds, dried	535 mg
Cocoa, dry powder, unsweetened	499 mg
Basil, dried	422 mg
Flaxseed	392 mg
Cumin seed (spice)	366 mg
Brazil nuts, dried	376 mg
Parsley, freeze dried	372 mg
Almond butter	303 mg
Cashew nuts, roasted	273 mg
Whey, sweet, dried	176 mg
Leeks, freeze dried	156 mg
Kale, scotch, raw	88 mg
Spinach	79 mg

## **Supplement Products**

**Magnesium chloride**

**Magnesium citrate**

**Magnesium malate**

**Magnesium**

**phosphate**

**Magnesium sulfate**

## **Plant sources**

**Cvesiculosahondrus  
crispus (Irish moss)**

**Phaseolus vulgaris  
(beans)**

**Avena sativa (Oats)**

**Spinacia oleracea  
(Spinach)**

**Glycyrrhiza glabra  
(Licorice)**

**Lactuca sativa  
(Lettuce)**

**Fucus vesiculosus  
(Bladderwrack)**

## **Sources**

**• Avocados • Bananas • Beans and peas • Dairy products • Green leafy vegetables (e.g., spinach) • Nuts and pumpkin seeds • Potatoes • Raisins • Wheat bran • Whole grains**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

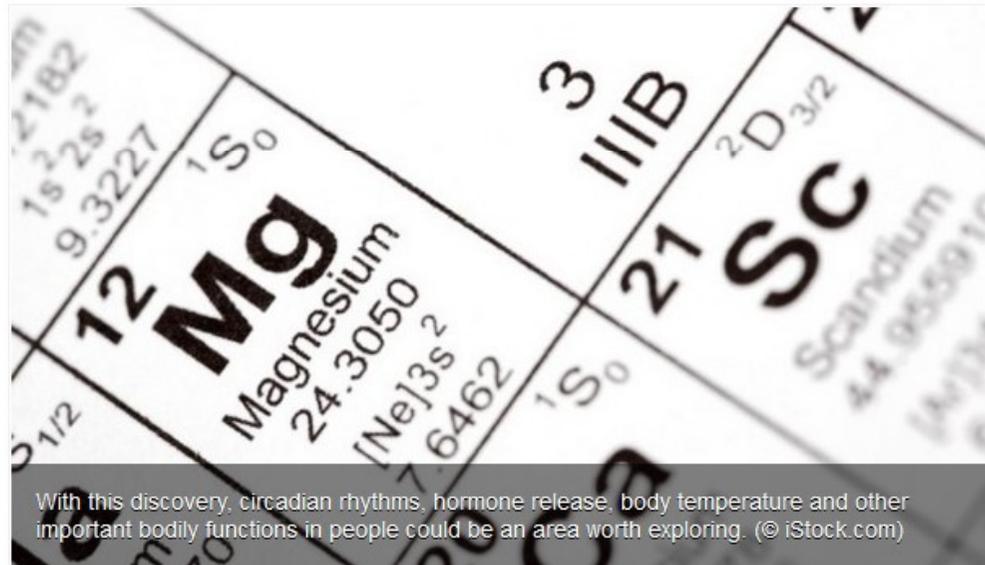
**400mg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

## Magnesium right on time as role in body rhythms is recognised

By Will Chu , 15-Apr-2016  
Last updated on 15-Apr-2016 at 13:17 GMT

 Post a comment



With this discovery, circadian rhythms, hormone release, body temperature and other important bodily functions in people could be an area worth exploring. (© iStock.com)

Related tags: Magnesium, Cell, Circadian, Edinburgh, Cambridge, Algae, Fungi, Agriculture, Photosynthesis

**The amount of magnesium in the diet plays a central role in helping to adapt to the rhythms of night and day, researchers have discovered.**



The revelation may also point towards magnesium as a gatekeeper of cellular energy balance and expenditure over the daily cycle.

The study pinpointed the nutrient magnesium as a determinant of how cells keep to a schedule helping them adjust to the natural **environmental cycle of day and night**, also known as circadian rhythms.

# Insufficient toenail magnesium linked to a higher risk of type 2 diabetes



By Cheryl Marie Tay+ 

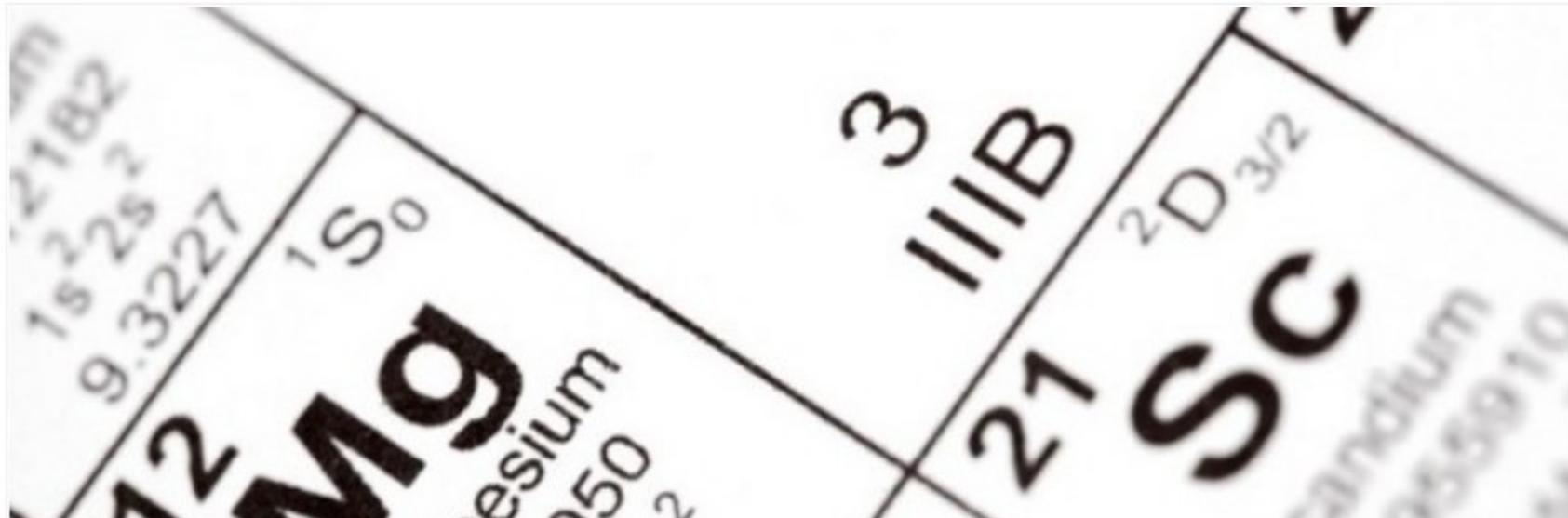
09-Aug-2017

Last updated on 09-Aug-2017 : "Association between Toenail Magnesium and Type 2 Diabetes in Chinese Adults"

Source: *Nutrients*

<https://doi.org/10.3390/nu9080811>

Authors: Jiguo Zhang, *et al.*



**Insufficient toenail magnesium might be linked to a higher risk of type 2 diabetes among Chinese adults, according to a study by the Chinese Center for Disease Control and Prevention (China CDC).**

Taking its data from the 2009 China Health and Nutrition Survey (CHNS), which had 5,683 respondents above the age of 18, the study found an inverse association between toenail magnesium and the prevalence of type 2 diabetes.

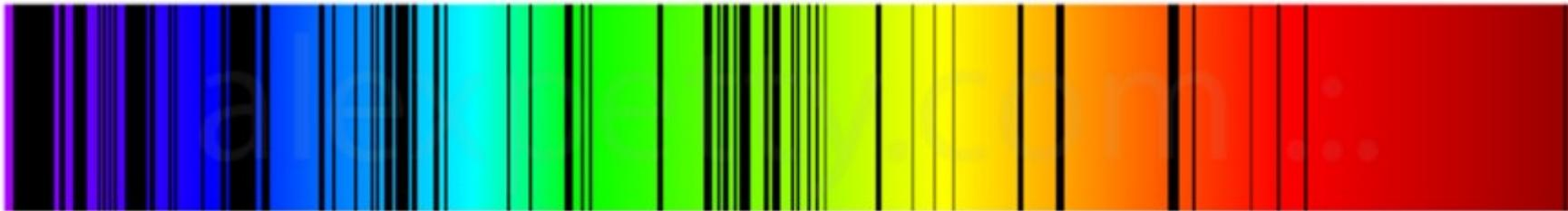
**25**

**Mn**

**Manganese**

# Manganese spectroscopy

absorption



emission



**Manganese** is an essential part of the construction of bone, cartilage and collagen. It plays an important role in energy production and brain function where it is often found in combination with lecithin.

**As a regulator of collagen formation, manganese is often required to improve the properties of intervertebral discs and joints.**

Due to its capability of accelerating the maturation of connective tissue, manganese has been proven to stimulate the **repair of wounds**, in particular, if the repair rate is delayed.

Manganese aids in the protection of cells from **oxidative injury**, especially in combination with curcumin, an active ingredient of turmeric.

Manganese is a vital component of various **metalloenzymes** – pyruvate carboxylases and decarboxylases, transferases, hydrolases and the antioxidant enzyme superoxide dismutase.

An excess of manganese,  
usually associated with  
**occupational exposure**, leads  
to neurotoxicity.

**Think manganese in cases of SLE. Must use for at least 3 months.**

**Symptoms are similar to hydrazine intoxication.**

**Think about supplementing  
manganese in excess dreaming  
with a lot of action.**

## **Supplement products**

**Manganese citrate**

**Manganese picolinate**

**Manganese sulfate**

## **Plant sources**

**Vaccinium myrtillus**

**(Bilberry)**

**Camellia sinensis**

**(Tea)**

**Syzygium aromaticum**

**(Clove)**

**Vitis vinifera (Grape)**

**Foeniculum vulgare**

**(Fennel)**

**Spinacia oleracea**

**(Spinach)**

**Trifolium pratense**

**(Red clover)**

## Sources

• Beans • Nuts • Pineapple •  
Spinach • Sweet potato • Whole  
grains

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**2mg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

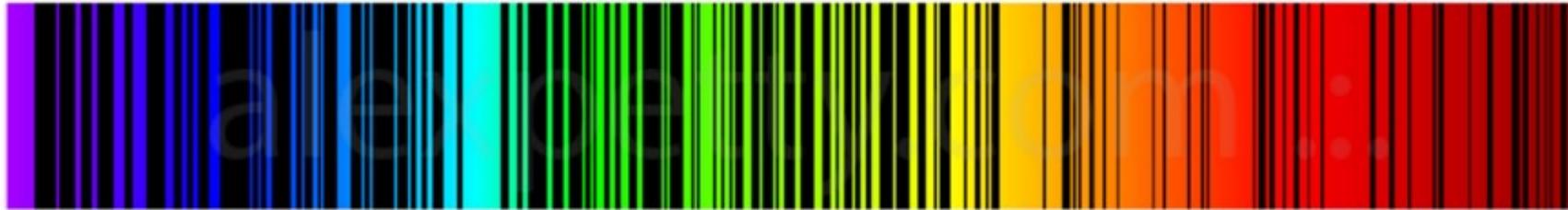
42

**Mo**

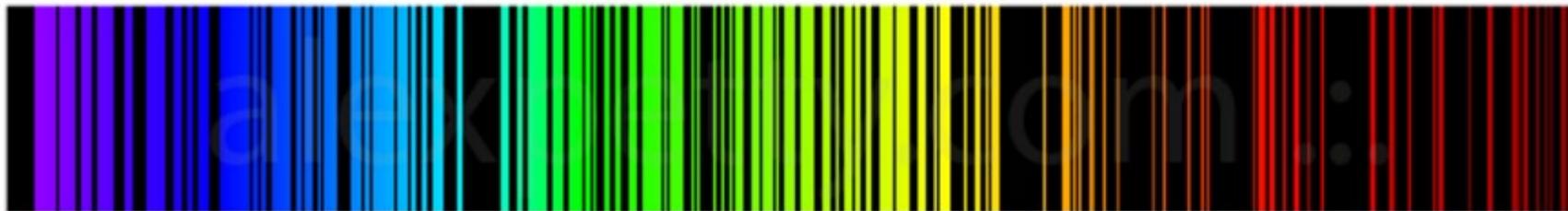
**Molybdenum**

# Molybdenum spectroscopy

absorption



emission



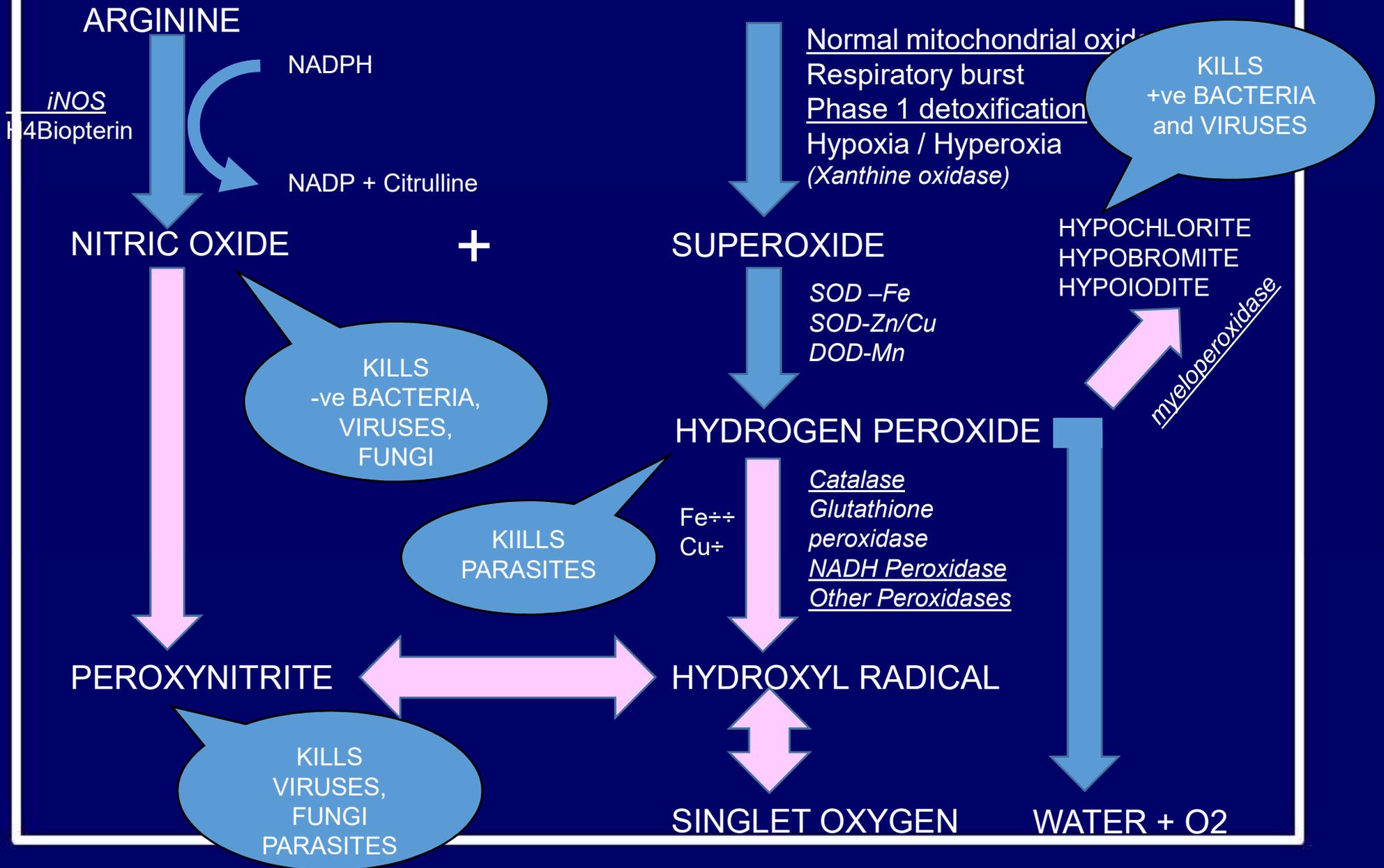
Molybdenum is an essential component of three metalloflavoprotein enzymes, namely, **xanthine oxidase, aldehyde oxidase and sulfite oxidase.** Xanthine oxidase catalyzes the production of uric acid.

**Aldehyde oxidase** is necessary for the detoxification of inhaled and ingested aldehydes, and is involved (along with niacin) in the metabolism of alcohol.

**Sulfite oxidase** is an important enzyme required to make sulfates for the synthesis of active sulfur (PAPs).

**Xanthine oxidase** is also known as one of the most potent generators of peroxynitrite that, in physiological conditions, is formed by macrophages to kill pathogenic protozoa, worms and some fungi.

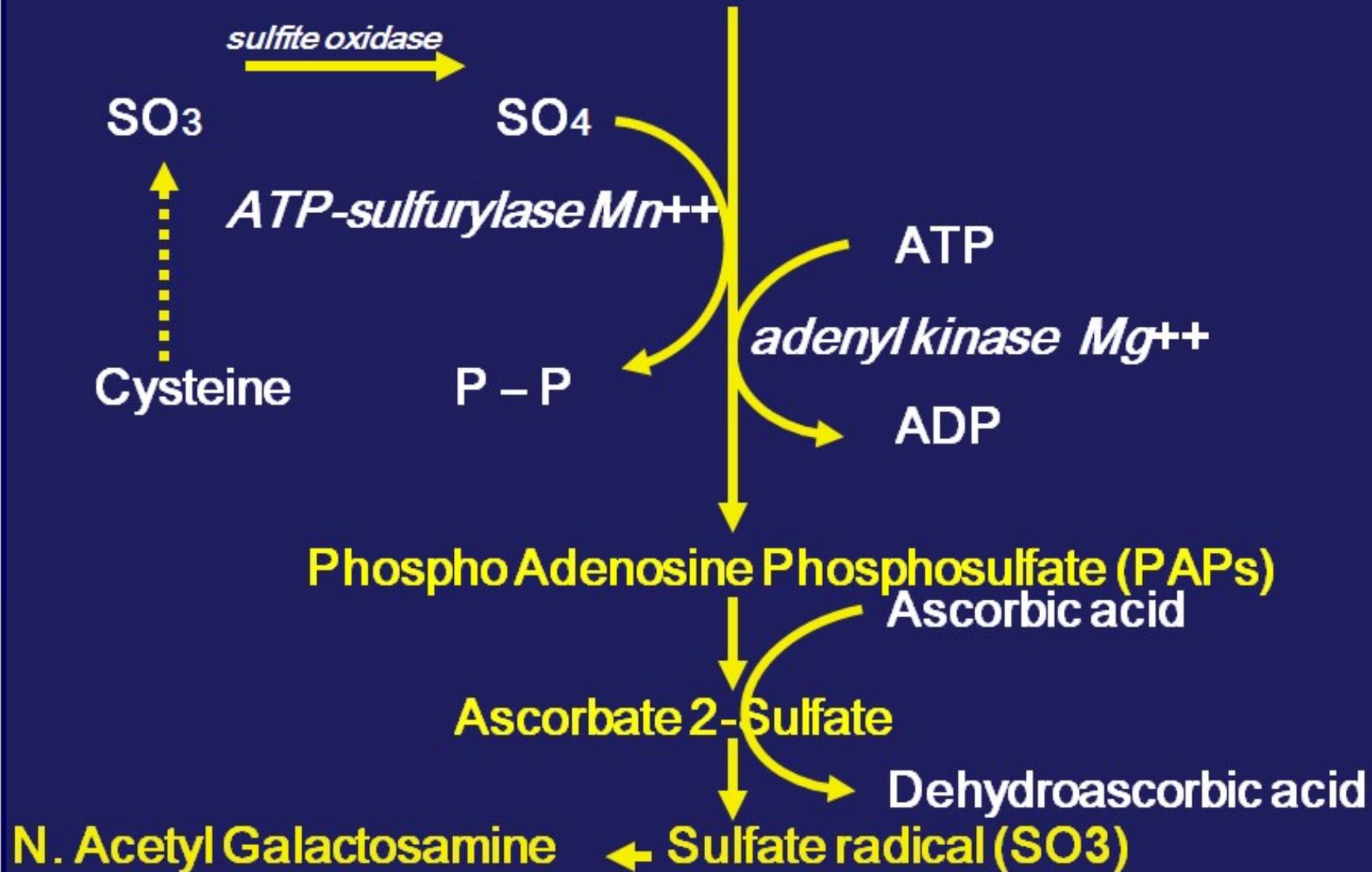
# Reactive Oxygen Species



**Sulfite oxidase** also produces free radicals which, when under a strict physiological control, act as a natural antifungal.

The major dietary source of molybdenum is **liver and lima beans.**

# ACTIVATED SULFATE ATP



## **Supplement products**

**Potassium molybdate**

**Sodium molybdate**

## **Plant sources**

**Phaseolus vulgaris**

**(Beans)**

**Capsicum annum**

**(Bell pepper)**

**Panax quinque**

**(Ginseng)**

**Petroselinum crispum**

**(Parsley)**

**Brassicaboleracea**

**(Cabbage)**

**Vigna unguiculata**

**(Asparagus)**

# Sources

- Beans and peas • Nuts • Whole grains

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**75mcg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

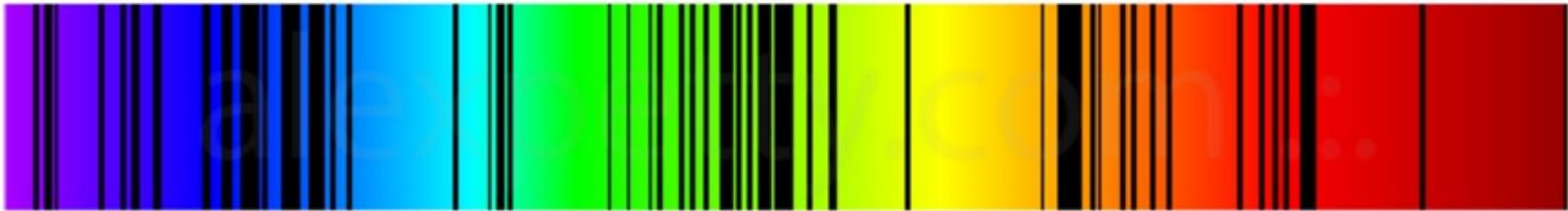
15

P

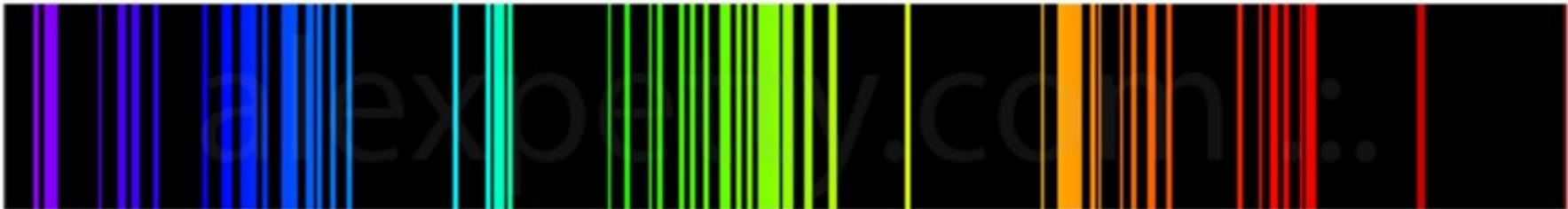
Phosphorus

# Phosphorus spectroscopy

absorption



emission



**Biomarker for imbalance in  
phosphorus / calcium /  
magnesium ratios**



**Dr Goodheart says**

Always think about  
**aluminium toxicity** in low  
phosphorus cases.

**Aluminium** removes the phosphorus from  
the phospholipid cell membranes.

## **Supplement product**

**Orthophosphoric  
acids**

## **Plant Sources**

**Beta vulgaris (Beet)**

**Linum usit (Flax)**

**Lepidium sativum  
(Garden cress)**

**Equisetum arvense  
(Horsetail)**

**Citrullus lanatus  
(Watermelon)**

**Lactuca sativa**

**(Lettuce)Pohaseolus  
vulgarus (Beans)**

**Cucurita (Pumpkin)**

## **Sources**

- **Beans and peas • Dairy products**
- **Meats • Nuts and seeds • Poultry**
- **Seafood • Whole grain, enriched,  
and fortified cereals and breads**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**1000mg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

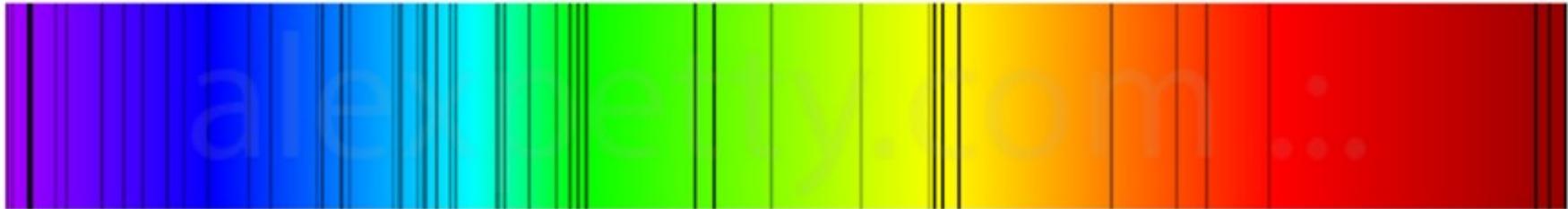
19

K

Potassium

# Potassium spectroscopy

absorption



emission



Potassium is the major cation found **inside** all plant and animal cells.

**Potassium** constitutes five percent of the total mineral content of the body even though only about 120-150 grams are found in the body at one time. It is easily absorbed but at least 90% it is excreted, mainly through the kidney but it is also found in faeces.

Potassium is vital to eliminate wastes in the body. It is a natural **diuretic**, helping excrete water and sodium, thus possibly lowering blood pressure.

It is fundamental to the function of membrane  $\text{Na}^+/\text{K}^+$  ATPase and uptake of various molecules by cells, to neuromuscular transmission and acid-base balance. It is one of the key **regulators of osmolality** of both intracellular and extracellular fluids.

Potassium deficiency is usually results from vomiting, use of diuretics, diarrhoea, steroid administration, primary overproduction of aldosterone (Cohn's syndrome). It is a threatening condition leading to **generalised muscle weakness** and cardiac arrhythmias.

**Dr Goodheart**  
**says** patient  
needs potassium  
if they have a dry  
mouth.

Lump in the  
throat give  
potassium. In  
need of  
alkalizing.



## **Supplement products**

Potassium ascorbate

Potassium chloride

Potassium citrate

Potassium phosphate

Potassium sulphate

Potassium citrate

## **Plant sources**

*Lactuca sativa*

(Lettuce)

*Cichorium endivia*

(Endive)

*Raphanus sativa*

(Radish)

*Avena sativa* (oats)

*Anethum graveolens*

(Dill)

*Cucumis sativa*

(Cucumber)

*Brassica chinesis*

(Pak Choi)

## **Sources**

**• Bananas • Beet greens • Juices (e.g., carrot, pomegranate, prune, orange, and tomato) • Milk • Oranges and orange juice • Potatoes and sweet potatoes • Prunes and prune juice • Spinach • Tomatoes and tomato products • White beans • Yogurt**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**3500mg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# Can potassium affect your body clock?

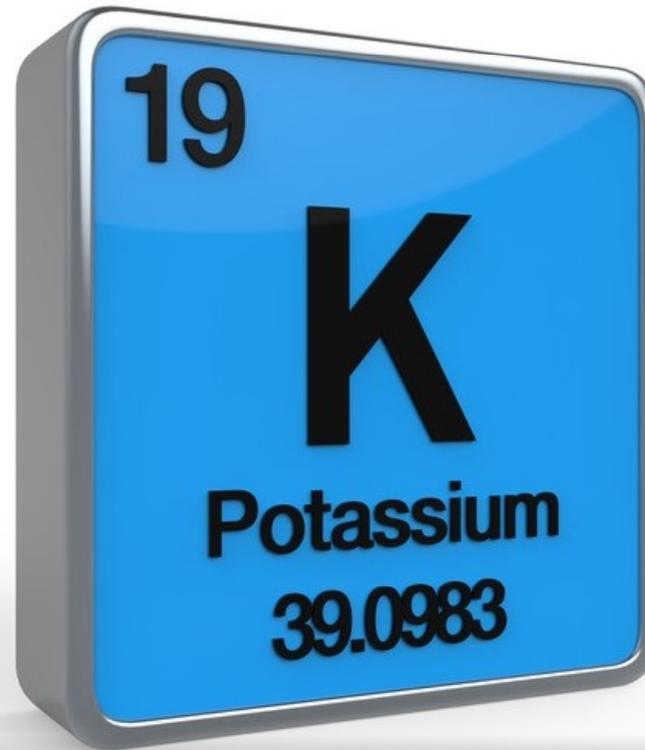
By Tim Cutcliffe [↗](#)

18-Dec-2017 - Last updated on 18-Dec-2017 at 11:34 GM

Circadian rhythms in human red blood cells (RBCs) may be regulated by potassium, according to a new study in *Nature Communications*.

Significant fluctuations in RBC potassium levels, which followed the circadian rhythm, were discovered by researchers from the University of Surrey.

RBC potassium concentrations increased during the day and declined at night.



Source: *Nature Communications*

Volume 8, article 1978, published online 7 December 2017, doi: [10.1038/s41467-017-02161-4](https://doi.org/10.1038/s41467-017-02161-4)

*Rhythmic potassium transport regulates the circadian clock in human red blood cells*

Authors: Erin A. Henslee, Fatima H. Labeed, *et al*

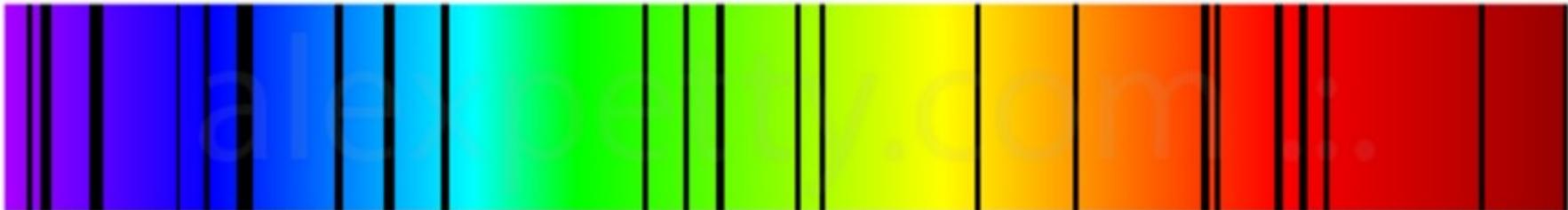
34

Se

Selenium

# Selenium spectroscopy

absorption



emission



**Selenium** is a chemical element with symbol Se and atomic number 34. It is a nonmetal with properties that are intermediate between those of its periodic table column-adjacent chalcogen elements sulfur and tellurium. It rarely occurs in its elemental state in nature, or as pure ore compounds.

**Named for the moon goddess Selene, the mineral selenium deserves to be treated with reverence. Selenium is versatile and has a wide array of health benefits. Selenium is crucial for antioxidant defences, boosts the immune system, and helps prevent cancer in several distinct ways.**

**Selenium is required for the functioning and development of certain areas of the brain that open a person to higher emotions and higher thought. It is also an essential mineral for thyroid functioning, along with iodine.**

# **Selenium dependant enzymes**

## **Selenoproteins**

**At least 25 selenoproteins have been identified, but the metabolic functions have been identified for only about one-half of them**

## **Main ones are**

- 1. Thyroid deiodinase (T4 > T3)**
- 2. Glutathione peroxidase**

## **1. Thyroid deiodinase (T4 > T3)**

**Three different selenium-dependent iodothyronine deiodinases (types I, II, and III) can both activate and inactivate thyroid hormone by acting on T<sub>3</sub>, T<sub>4</sub>, or other thyroid hormone metabolites essential for normal development, growth, and metabolism.**

# Thyroxin (T4)

*DIO 1*  
*DIO 2*

35%

*DIO 1*  
*DIO 3*

45%

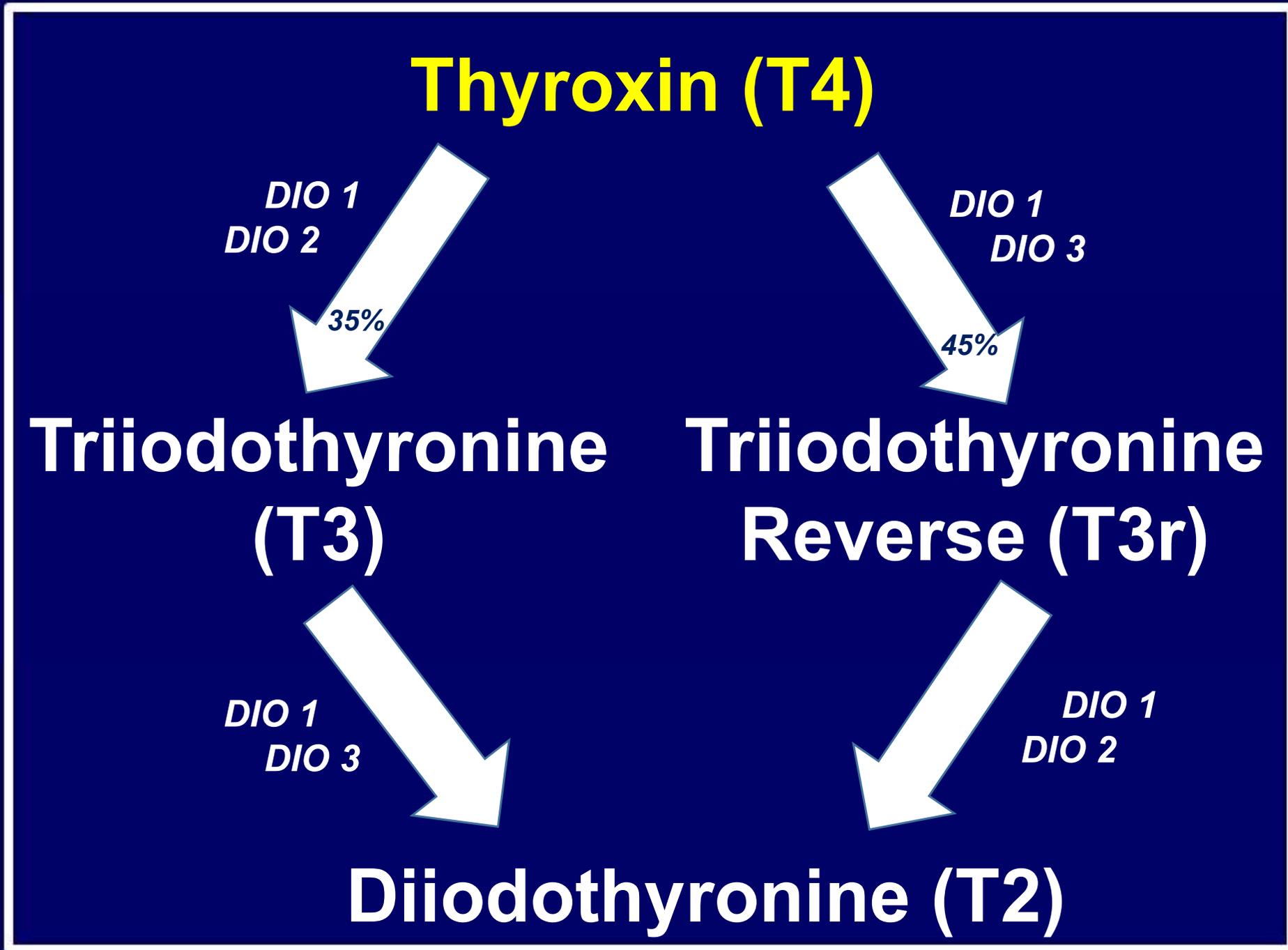
**Triiodothyronine  
(T3)**

**Triiodothyronine  
Reverse (T3r)**

*DIO 1*  
*DIO 3*

*DIO 1*  
*DIO 2*

**Diiodothyronine (T2)**



## **2. Glutathione peroxidase\***

**Five selenium-containing glutathione peroxidases (GPx) have been identified:**

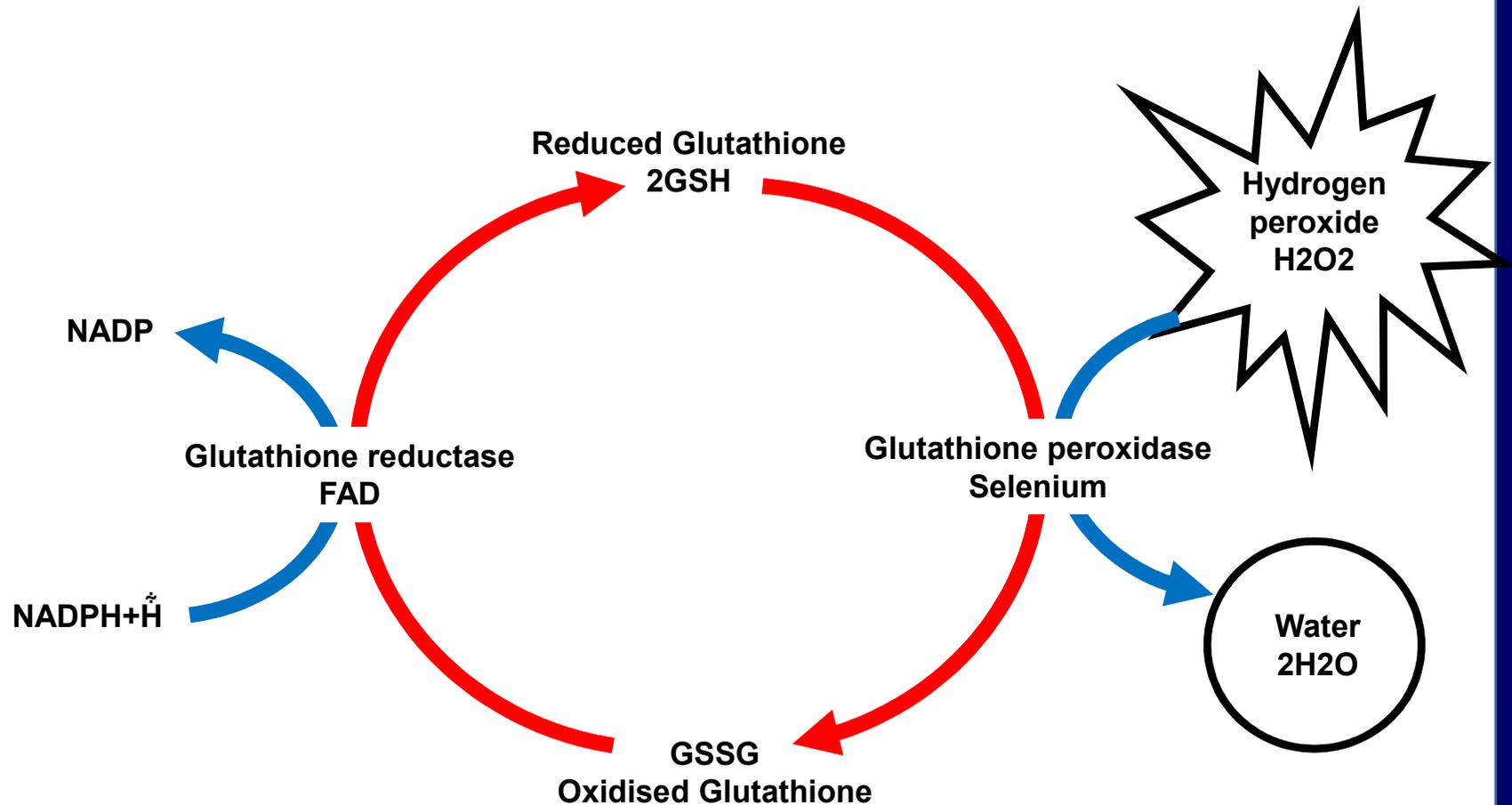
- 1. Cellular or Classical GPx**
- 2. Plasma or Extracellular GPx**
- 3. Phospholipid hydroperoxide GPx**
- 4. Gastrointestinal GPx**
- 5. Olfactory GPx**

\*G. V. Kryukov; S. Castellano; S. V. Novoselov; A. V. Lobanov; O. Zehtab; R. Guigó & V. N. Gladyshev (2003). "Characterization of mammalian selenoproteomes". *Science*. 300 (5624): 1439–1443.

Although each GPx is a distinct selenoprotein, they are all **antioxidant enzymes** that reduce potentially damaging ROS, such as hydrogen peroxide and lipid hydroperoxides, to harmless products like water and alcohols by coupling their reduction with the oxidation of glutathione.

**Sperm mitochondrial** capsule selenoprotein, an antioxidant enzyme that protects developing sperm from oxidative damage and later forms a structural protein required by mature sperm, was once thought to be a distinct selenoprotein but now appears to be phospholipid hydroperoxide GPx.

# Glutathione oxido-reductase cycle



One molecule of hydrogen peroxide is reduced to two molecules of water whilst two molecules of glutathione (GSG) are oxidised in a reaction catalyzed by the selenoenzyme glutathione peroxidase. Oxidised glutathione (GSSG) may be reduced by the Flavin adenine dinucleotide (FAD) dependent enzyme glutathione reductase.

# Hydroxylated toxin

glutathione  
-S-  
transferase  
Zn<sup>++</sup>

glutathione reductase  
NADPH

GSH

Glycine  
P-5-P  
ATP  
Glutamic acid  
Cysteine

GSSG

glutathione peroxidase  
Selenium

Glutathione conjugate



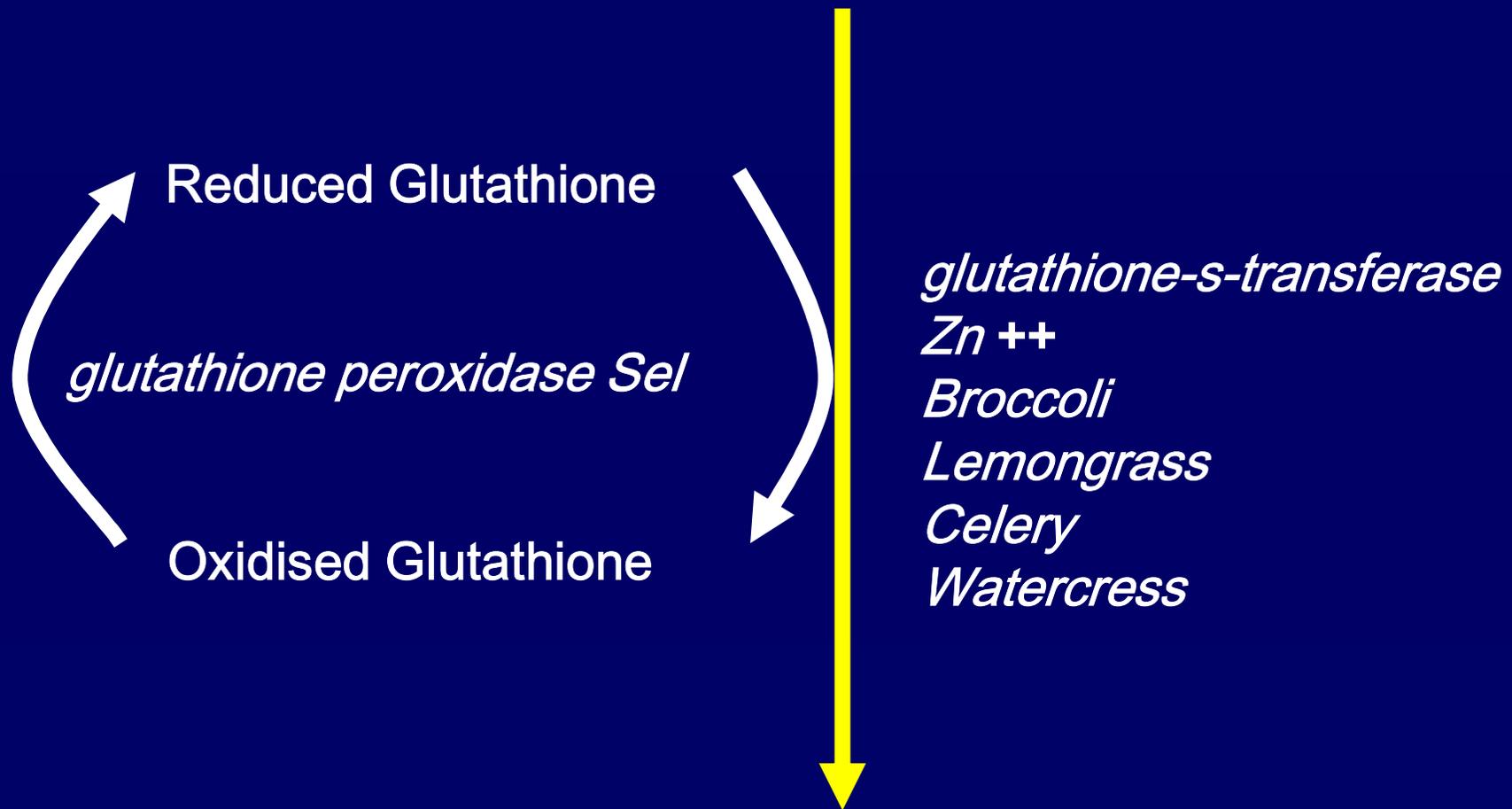
## **Glutathione conjugation**

(cysteine, glycine and glutamic acid) is catalyzed by *glutathione-S-transferase*.

This enzyme is present mostly in the cell cytosol.

This enzyme is inhibited by Lead

# Phase 1 toxic intermediate



**Glutathione (P-5-P) conjugate**

A failure in the **glutathione conjugation** would lead to covalent combination to DNA and RNA and other cell proteins creating serious cell damage. They are further metabolised before excretion. The glutamic and glycine groups are removed and an acetyl group donated by Acetyl CoA is added to the cysteine moiety.

The resulting compound is a mercapturic acid, a conjugate of **N. Acetyl Cysteine**, which is then excreted in the urine.

**N. Acetyl Cysteine** is thus an excellent supplement to use to up-regulate this pathway.

**N.Acetyl Cysteine** aids  
detoxification

- 1. Glutathione**
- 2. Acetylation**
- 3. Sulfation**
- 4. Cysteine**

# Glutathione

1. Antioxidant
2. Detoxification conjugator
3. PGE and Leukotrien modulator  
(inhibits *lipoxigenase* enzyme  
conversion of arachidonic acid  
to leukotriens)

## **Other Selenium dependant enzymes**

### ***3. Thioredoxin reductase***

**participates in the regeneration of several antioxidants, possibly including vitamin C and Vitamin E.**

**4. Selenoprotein P\*** is found in plasma and also associated with vascular endothelial cells (cells that line the inner walls of blood vessels).

It functions as an antioxidant that protects endothelial cells from damage induced by peroxynitrite.

\* Reeves, MA & Hoffmann, PR (2009). "The human selenoproteome: recent insights into functions and regulation". *Cell Mol Life Sci.* 66 (15): 2457–78

**5. Selenoprotein W\*** is found in muscle. Although its function is presently unknown, it is thought to play a role in muscle metabolism

\* Reeves, MA & Hoffmann, PR (2009). "The human selenoproteome: recent insights into functions and regulation". *Cell Mol Life Sci.* 66 (15): 2457–78

## **6. Selenophosphate synthetase**

**Incorporation of selenocysteine into selenoproteins is directed by the genetic code and requires the enzyme selenophosphate synthetase. A selenoprotein itself, selenophosphate synthetase catalyzes the synthesis of monoselenium phosphate.**

**7. Methionine-R-sulfoxide reductase** studies revealed that the protein catalyzes stereospecific reduction of oxidized methionine residues in reactions that use thioredoxin as a reductant.

**8. Sep15** is mammalian protein located in the endoplasmic reticulum of the cell. Here, it binds UDP-glucose:glycoprotein glucosyltransferase, an enzyme that senses protein folding. Sep 15 has a redox function and is also implicated in cancer prevention.

**9. Selenoprotein V\*** is expressed exclusively in testes and is thought to function in spermatogenesis.

\* Reeves, MA & Hoffmann, PR (2009). "The human selenoproteome: recent insights into functions and regulation". *Cell Mol Life Sci.* 66 (15): 2457–78

**10. Selenoprotein S\*** is involved in retrotranslocation of misfolded proteins from the endoplasmic reticulum to the cytosol.

This protein may also be involved in inflammatory and immune responses.

\* Reeves, MA & Hoffmann, PR (2009). "The human selenoproteome: recent insights into functions and regulation". *Cell Mol Life Sci.* 66 (15): 2457–78

**Selenium** neutralises  
methylmercury in the CNS.

Should always be administered  
with dental amalgam removal and  
when NAC or Cysteine is used to  
stimulate Glutathione.

## **Heavy metal detoxification.**

**This has to do with glutathione production, mainly, although thyroid activity and other functions related to selenium are required for all metal detoxification. This is why garlic, and the other sources of selenium are so important.**

**Infection-fighting ability.  
Selenium enhances the immune  
response in most cases. This  
has to do with thyroid enzymes,  
and other factors as well.**

## **Mental health.**

**Selenium, along with silicon, share certain characteristics. They help impart a silky, smooth quality to the personality. They help with feelings of joy and happiness, and give a certain lightness to the personality.**

**Symptoms of selenium deficiency are exhaustion, high cholesterol, infections, liver impairment, and pancreatic insufficiency.**

**May prevent muscular dystrophy and cystic fibrosis (J. Wallach)**

## **Supplement products**

**Colloidal Selenium**

**Sodium selenate**

**Selenium cysteine**

**Selenium methionine**

**Selenium phosphate**

## **Plant sources**

**Bertholleria excelsa**  
**(Brazil nuts)**

**Silybum marianum**  
**(Milk thistle)**

**Polygonum multifol**  
**(Wheat grass)**

**Cymbopogon citratus**  
**(Lemon grass)**

**Mentha pulegium**  
**(Pennyroyal)**

**Valeriana officinalis**  
**(Valerian)**

## **Sources**

- Eggs • Enriched pasta and Rice • Meats • Nuts (e.g., Brazil nuts from east coast only) and seeds • Poultry • Seafood • Whole grains

**Watercress**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**75mcg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# Low selenium levels increase prostate cancer risk: Study

By Will Chu , 11-Apr-2016

 Post a comment

Last updated on 11-Apr-2016 at 14:14 GMT



Se, an essential trace mineral, has been noted for its cancer-protective effects. (© iStock.com)

Related tags: Selenium: Selenoprotein P: Prostate cancer: Prevention: Survival

**Low selenium levels could lead to a higher risk of prostate cancer, a study has concluded.**



Essential trace mineral Selenium (Se), has been noted to possess cancer-protective effects. The variation in human dietary intake is reflected in the global variation in **blood Se levels** , observed in **Europe** .

# Heightened liver cancer risk linked to low selenium levels: Study

By Will Chu , 05-Jul-2016

 Post a comment

Last updated on 05-Jul-2016 at 10:29 GMT



Selenium can be found in foods such as shellfish, salmon, Brazil nuts, meat, eggs, grains, and onions. (© iStock.com)

Related tags: Gallbladder and biliary tract cancers, GBTC, Intrahepatic bile duct cancer, IHBC, SePP, Selenium, Liver cancer, Shellfish, Salmon, Brazil nuts, Meat, Eggs, Grains, Onions, International Agency for Research on Cancer, IARC, Hepatocellular carcinoma, HCC, EPIC

**Low levels of selenium have been linked with an increased risk of developing liver cancer, according to a study, which blamed western diets and lifestyles for the deficiency.**

# Selenium may protect against epileptic seizures, mouse study suggests

By Tim Cutcliffe

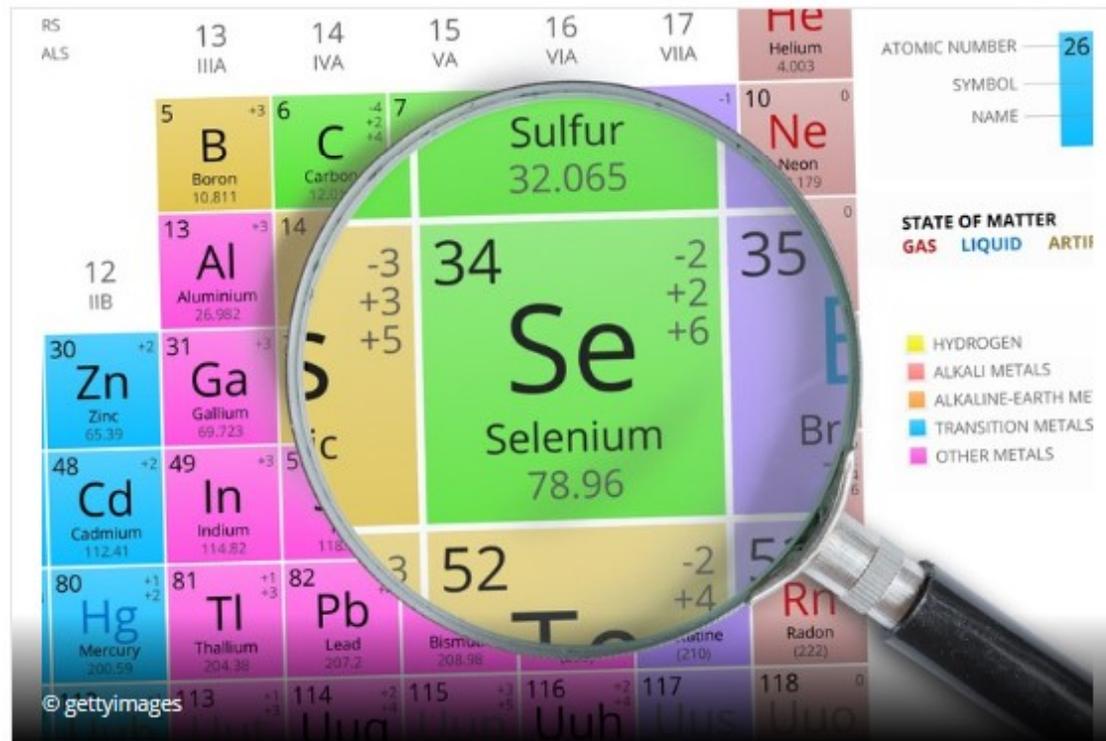
03-Jan-2018 - Last updated on 03-Jan-2018 at 09:19 GMT

Source: Cell

Published online, doi: 10.1016/j.cell.2017.11.048

"Selenium utilization by GPX4 is required to prevent hydroperoxide-induced ferroptosis"

Authors: Irina Ingold, et al



**The presence of selenium in an enzyme involved in fighting oxidative stress may be critical in preventing epileptic seizures, finds a new study in Cell.**

Glutathione peroxidase 4 (GPX4) is an important anti-oxidative enzyme which normally contains selenium in the form of the amino acid selenocysteine.

Mutant mice which lacked selenium in their GPX4 enzymes, failed to develop specialised brain cells called parvalbumin (PV) interneurons and consequently suffered fatal epileptic seizures within three weeks, found the research team led by the Institute of Developmental Genetics (IDG) at Helmholtz Zentrum, Munich.

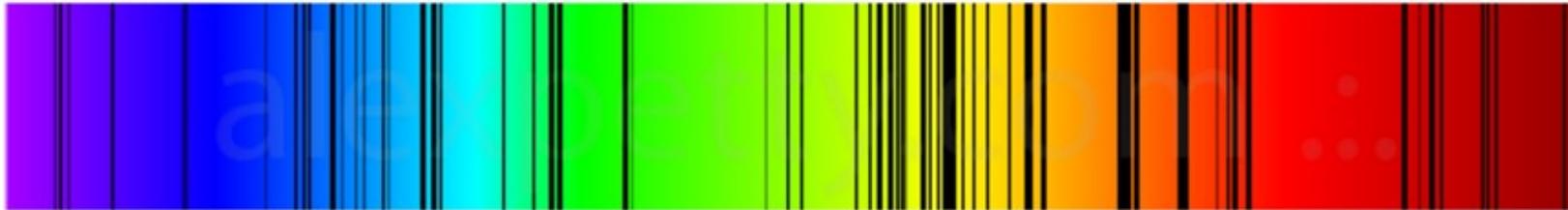
Si

14

Silicon

# Silicon spectroscopy

absorption



emission



**Biomarker for Silica for joints,  
skin, nails and hair.**

Quite how **Silica** may be involved in collagen synthesis and or its stabilisation is still not established. It has been implicated in gene transcription of type I collagen gene, a cofactor for prolyl hydroxylase the enzyme involved in collagen synthesis, in the utilisation (i.e. gastrointestinal uptake and metabolism) of essential elements that are required for bone and collagen synthesis, such as copper, calcium and magnesium and in the scavenging and detoxifying toxic aluminium. Silicon has also been found at the mineralisation front of growing bone suggesting also an involvement in early calcification/mineralization of bone matrix.

**Scientific Opinion on the substantiation of health claims related to **silicon** and protection against aluminium accumulation in the brain, “cardiovascular health”, forming a protective coat on the mucous membrane of the stomach, neutralisation of gastric acid, contribution to normal formation of collagen and connective tissue, maintenance of normal bone, maintenance of normal joints, maintenance of normal appearance and elasticity of the skin, and contribution to normal formation of hair and nails.**

*Panel on Dietetic Products, Nutrition and Allergies*

*EFSA Journal:*

*EFSA Journal 2011;9(6):2259 [28 pp.].*

*DOI:*

*10.2903/j.efsa.2011.2259*

## **Supplement Products**

**Silica from Bamboo**

**Silica from millet**

**Silica from oat straw**

## **Plant sources**

**Urtica dioica (Stinging nettle)**

**Bertholleria excelsa (Brazil nut)**

**Pistacia vera (Pistachio)**

**Petroselinum crispus (Parsley)**

**Juglans nigra (Black walnut)**

**Anacardium occidentale (Cashew nut)**

# Sources

**Millet, Bamboo, Oat straw**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**Unknown**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

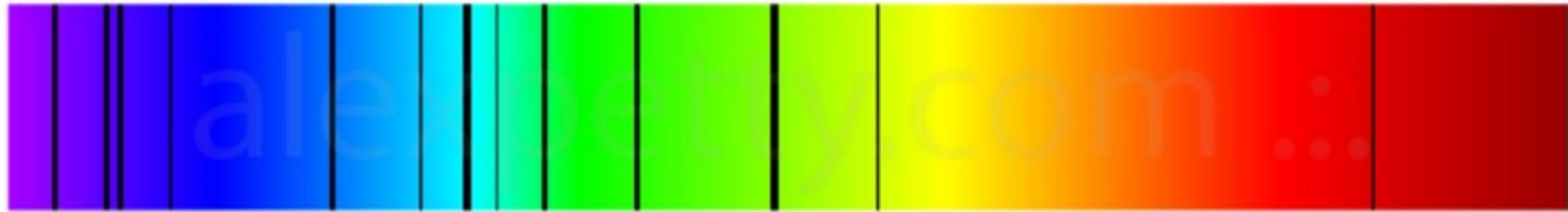
47

Ag

Silver

# Silver spectroscopy

absorption



emission



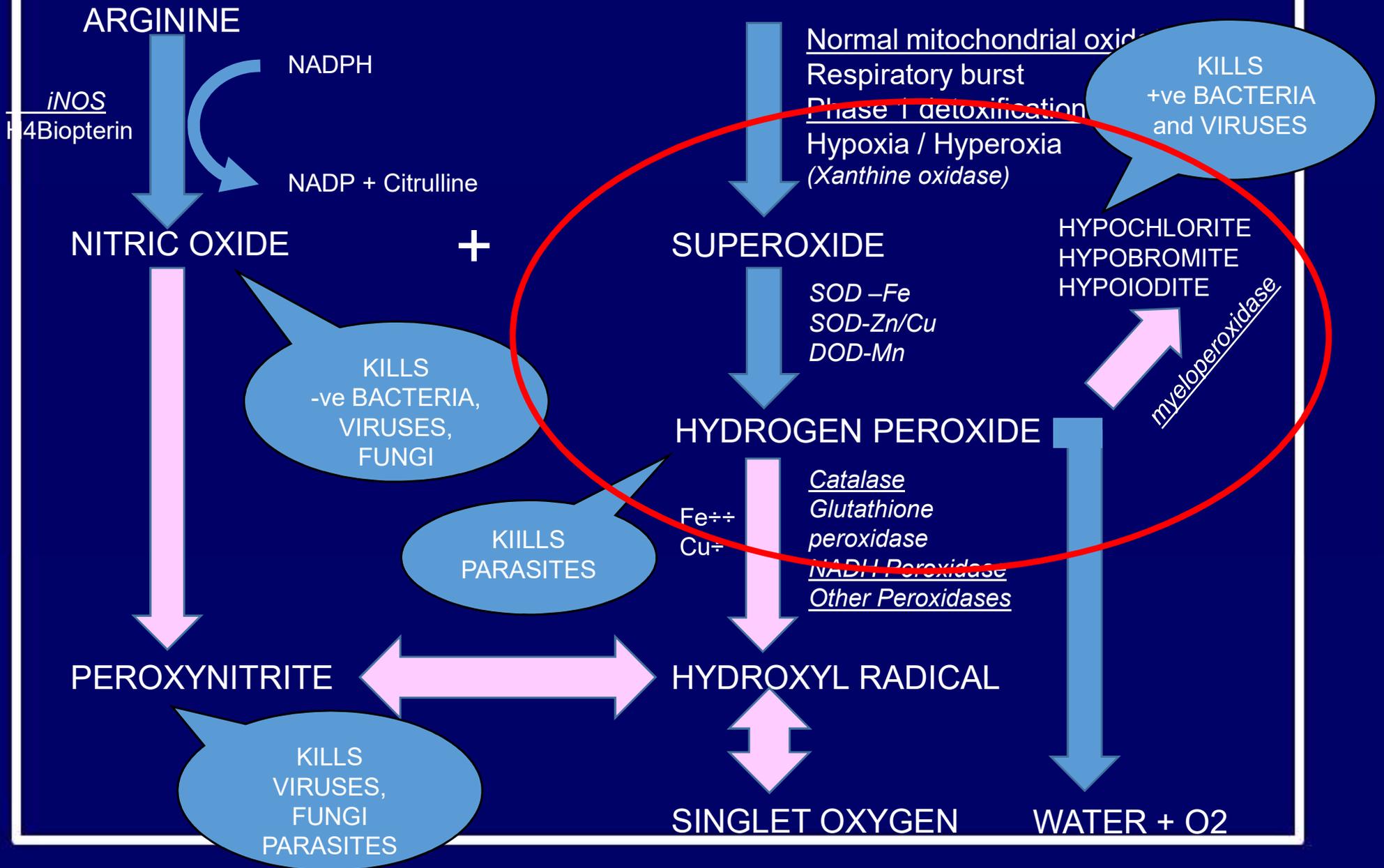
**Silver is a natural element that occurs as a trace mineral in the soil.**

**The use of silver for health care has been documented since ancient Roman time.**

**It has been proven to inactivate ATP-producing enzymes of micro-organisms, by damaging their cell membranes and suppress the replication of bacteria by inhibiting the functions of their DNA.**

It tends to inhibit bacterial **catalase** - a defence against free radicals produced by activated macrophages and neutrophils in order to kill ingested microorganisms.

# Reactive Oxygen Species



**Silver may act by an allosteric activator on the **myeloperoxidase** enzyme in phagocytes, thus stimulating them to secrete reactive halogen anions to kill bacteria, some viruses and fungi.**

**Popular Products**

**Colloidal Silver**

# Sources

None known

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**Not known as not considered  
essential**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

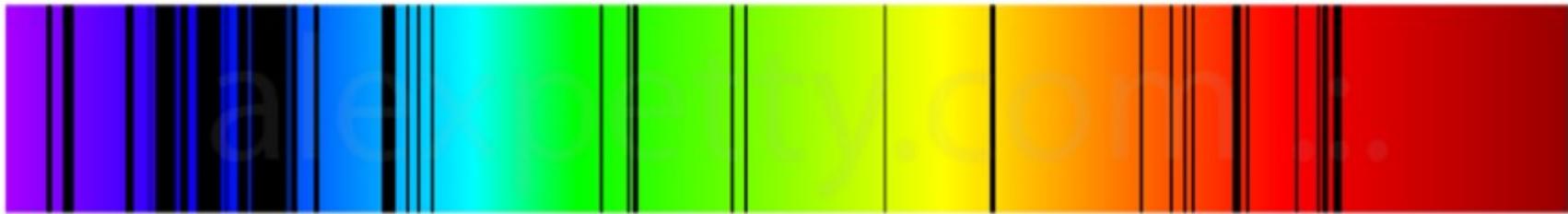
11

Na

Sodium

# Sodium spectroscopy

absorption



emission



**Biomarker for Sodium  
electrolyte.**

**Hyperadrenal – weakens**

**Hypoadrenal - strengthens**

## **Supplement Products**

## **Plant sources**

**Urtica dioica**

**(Stinging nettle)**

**Olea subsp**

**(Olive fruit)**

**Rhodymenia palmata**

**(Dulse)**

**Chondrus crispus**

**(Irish moss)**

**Fucus vesiculosus**

**(Bladderwrack)**

**Lactuca sativa**

**(Lettuce)**

# Sources

- Breads and rolls
- Cheese (natural and processed)
- Cold cuts and cured meats (e.g., deli or packaged ham or turkey)
- Mixed meat dishes (e.g., beef stew, chili, and meat loaf)
- Mixed pasta dishes (e.g., lasagna, pasta salad, and spaghetti with meat sauce)
- Pizza
- Poultry (fresh and processed)
- Sandwiches (e.g., hamburgers, hot dogs, and submarine sandwiches)
- Savory snacks (e.g., chips, crackers, popcorn, and pretzels)
- Soups
- Table salt

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**2400mg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

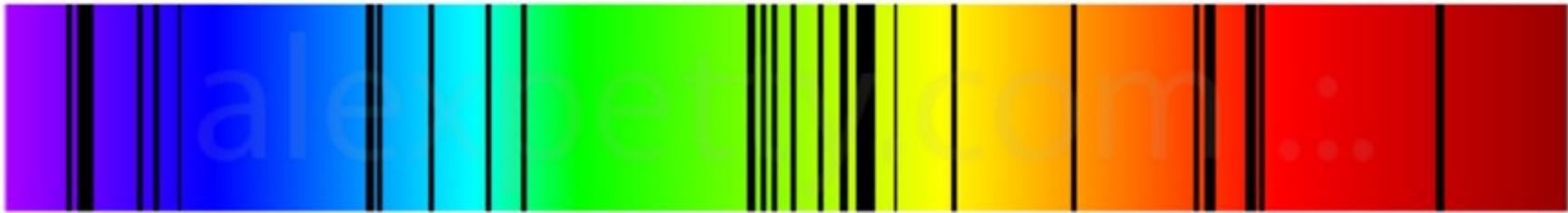
16

S

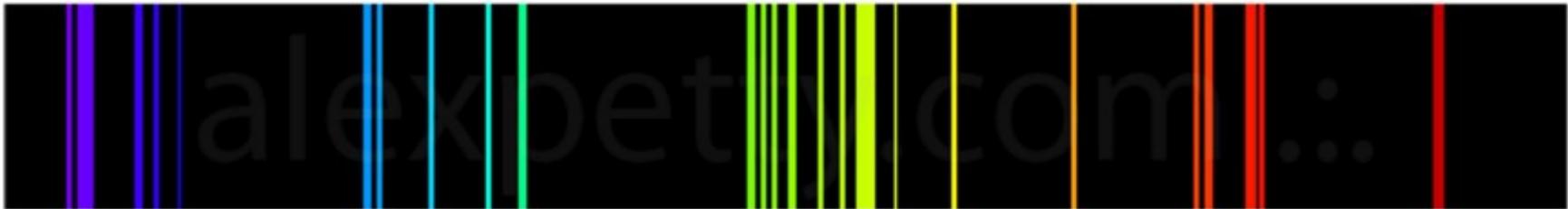
Sulphur

# Sulphur spectroscopy

absorption



emission



**It is a component of all proteins**

**It is essential for humans,  
animals and plants.**

**An average adult man's body  
contains about **140 g sulfur** (as  
much as potassium).**

**Compounds containing sulfur are found in all kinds of cells and are indispensable for life.**

**Sulfur resides** mainly in keratin, the superficial layer of the skin; in the hair; in the nails; and in the joint cartilage.

Of primary importance are amino acids – **methionine, cysteine, cystine, glutathione, taurine**; their derivatives.

**It is constantly needed for the processes of **detoxification** of pharmaceuticals and environmental poisons as well as steroid hormones (including pathological kinds of estrogens) produces by our body.**

## **Supplement products**

**Methionine**

**Cysteine**

**Glutathione reduced**

**Taurine**

**MSN**

**alpha Lipoid acid**

**Cruciferous  
vegetables**

## **Plant sources**

**Brassica botrytis  
(Cauliflower)**

**Anethum graveolente  
(Dill)**

**Pastinaca sativa  
(Parsnip)**

**Armoracia rusticana  
(Horseradish)**

**Brassica capitata  
(Cabbage)**

**Urtica dioica  
(Stinging nettle)**

## Sources

broccoli, cauliflower, cabbage, brussel sprouts, radishes, watercress, kale, & collard greens, asparagus, onions, garlic, tomatoes, organic eggs, wild-caught fish, & grass-fed beef. Raw dairy from grass-fed cows .

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**Unknown**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

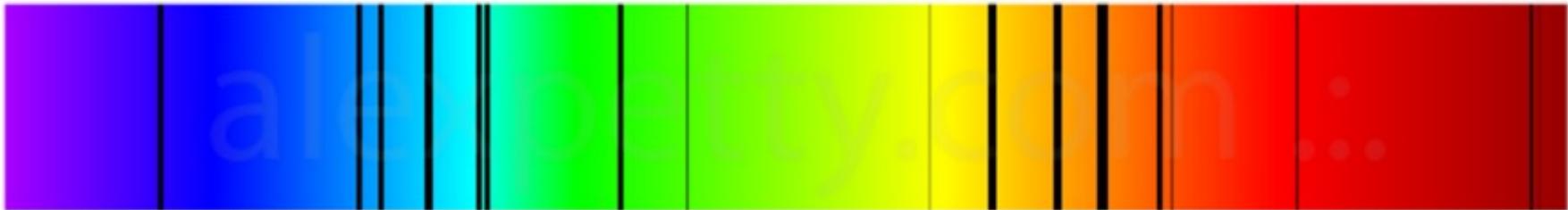
30

zn

Zn

# Zinc spectroscopy

absorption



emission



**Total body amount 1.4-2.0gm.**

Highest amounts are contained in the **placenta, choroid** of the eye and prostate followed by the liver, kidney, muscle, heart, pancreas, spleen, testes and brain.

**Zinc is stored in the liver, kidney and other organs as zinc **metallothionein**.**

**Zinc in serum is bound to number of proteins or single amino acids.**

**It's absorption is inhibited by dietary phytates and geophagia.**

To date over **100 zinc metalloenzymes** have been found present in the body carrying out reactions in the cells essential for growth, development and health.

**Other functions** include, taste, appetite, wound healing, prostate function, testes, brain and sexual development, immunity and cellular membrane function.

Only 20-30% of dietary zinc is absorbed. Absorption occurs in the duodenum by attaching to a low molecular zinc binding ligand thought to be **picolinic acid** secreted by the pancreas.

**Increased intestinal absorption occurs with the administration of prostaglandin E<sub>2</sub>.**

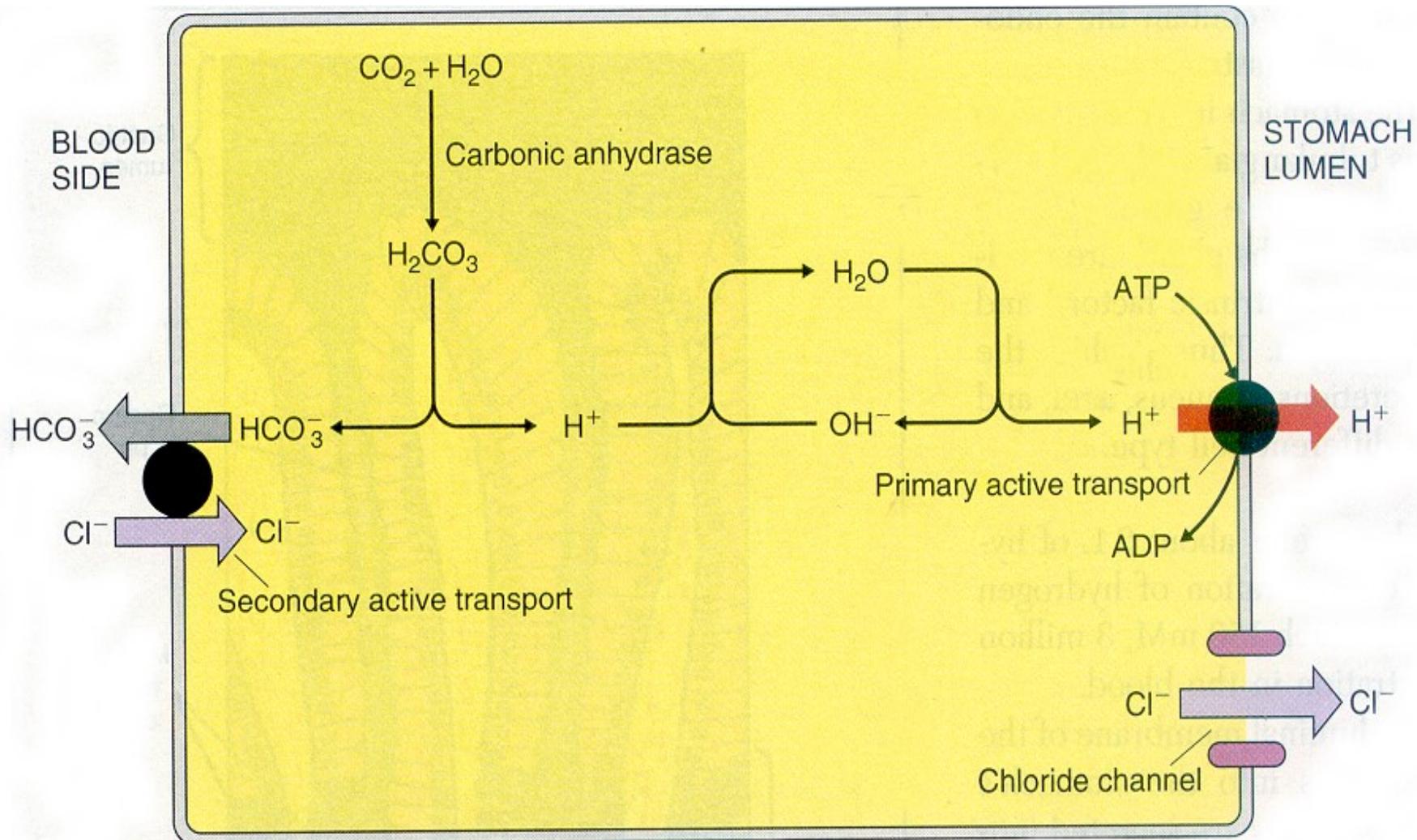
**PgE<sub>2</sub> mediates the orgasm.**

# Some common zinc enzymes

## ***1. Carbonic anhydrase*** –

catalyses the conversion of  
 $\text{CO}_2 + \text{H}_2\text{O} = \text{HCO}_3^- + \text{H}^+$

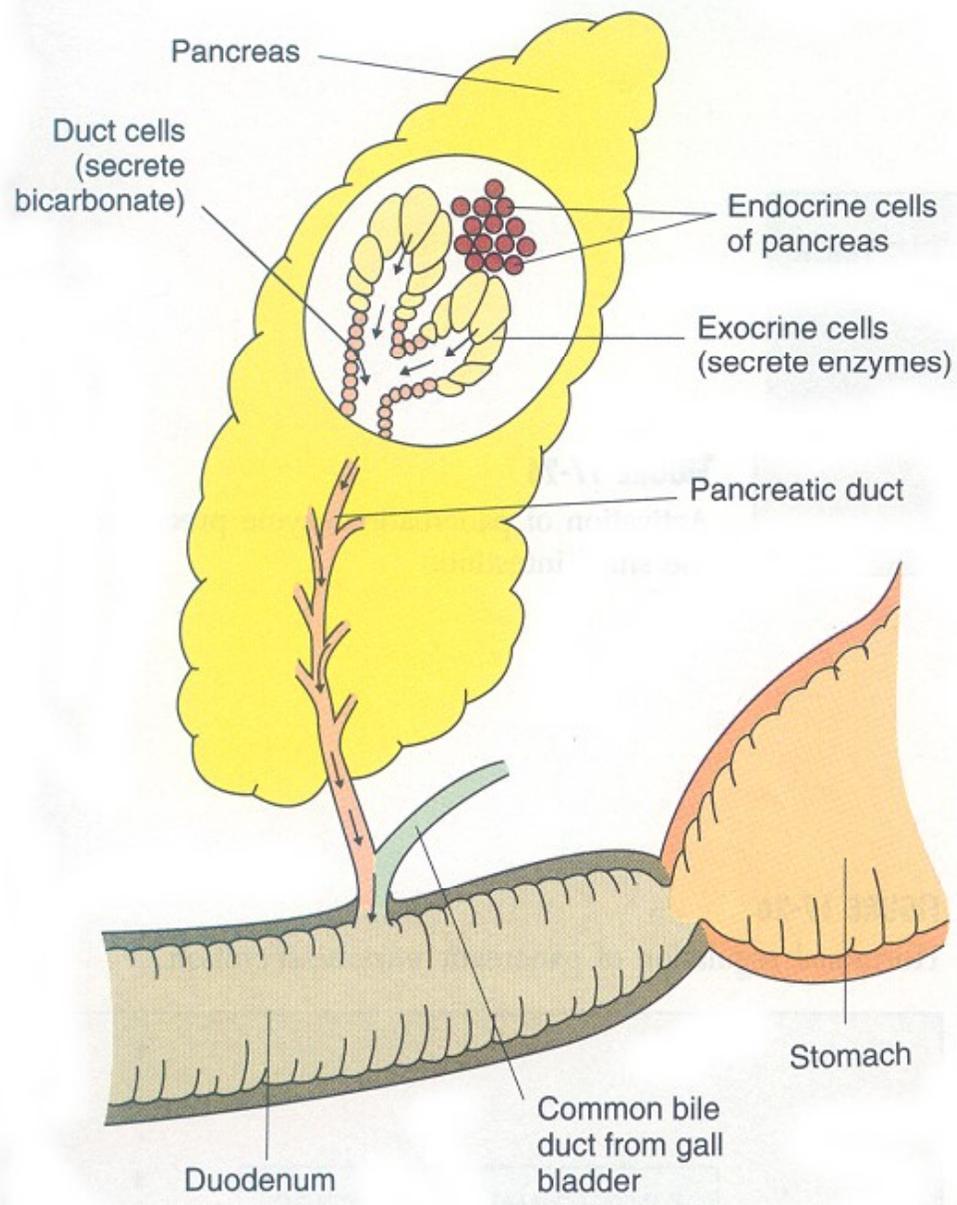
It is found in red blood cells,  
kidney tubule cells, parietal  
cells of the stomach and  
skeletal muscle cells.



## **2. *Carboxypeptidase A* –**

**produced in the acinar cells of the pancreas.**

**It catalyzes the hydrolysis of specific aromatic amino acids.**



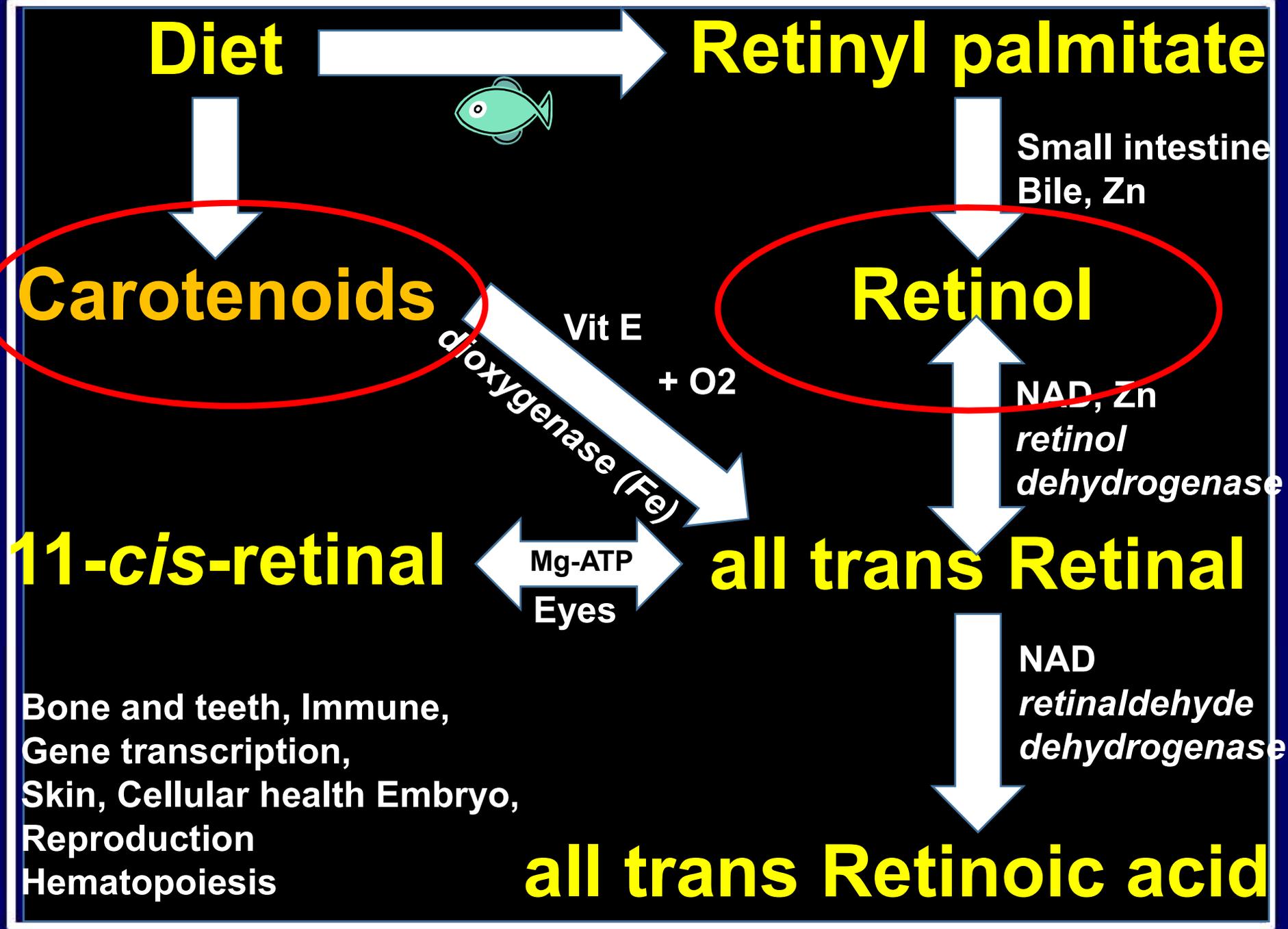
**3. *Alcohol dehydrogenase*** is a liver enzyme that catalyzes the conversion of ethanol to acetaldehyde.

It contains 4 atoms of zinc per molecule.

**Failure to oxidise alcohol with this enzyme shunts oxidation to the liver endoplasmic reticulum **P450 enzyme system** resulting in the production of free radicals and a need for extra antioxidant nutrients.**

***4. Retinol dehydrogenase*** is present in the retina and catalyzes the conversion of retinol to retinal.

The enzymatic activity of this zinc metalloenzyme in the eye accounts for the choroid containing the highest concentration of zinc per gram of tissue in the body.



**Diet**

**Retinyl palmitate**

Small intestine  
Bile, Zn

**Carotenoids**

**Retinol**

Vit E  
+ O<sub>2</sub>  
dioxygenase (Fe)

NAD, Zn  
retinol  
dehydrogenase

**11-cis-retinal**

**all trans Retinal**

Mg-ATP  
Eyes

NAD  
retinaldehyde  
dehydrogenase

Bone and teeth, Immune,  
Gene transcription,  
Skin, Cellular health Embryo,  
Reproduction  
Hematopoiesis

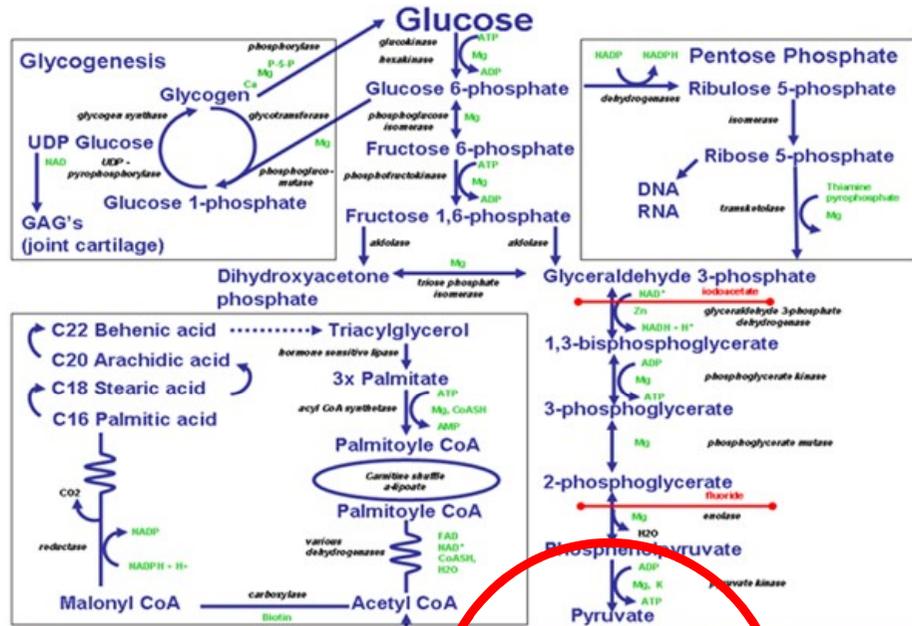
**all trans Retinoic acid**

***5. Lactic acid dehydrogenase***

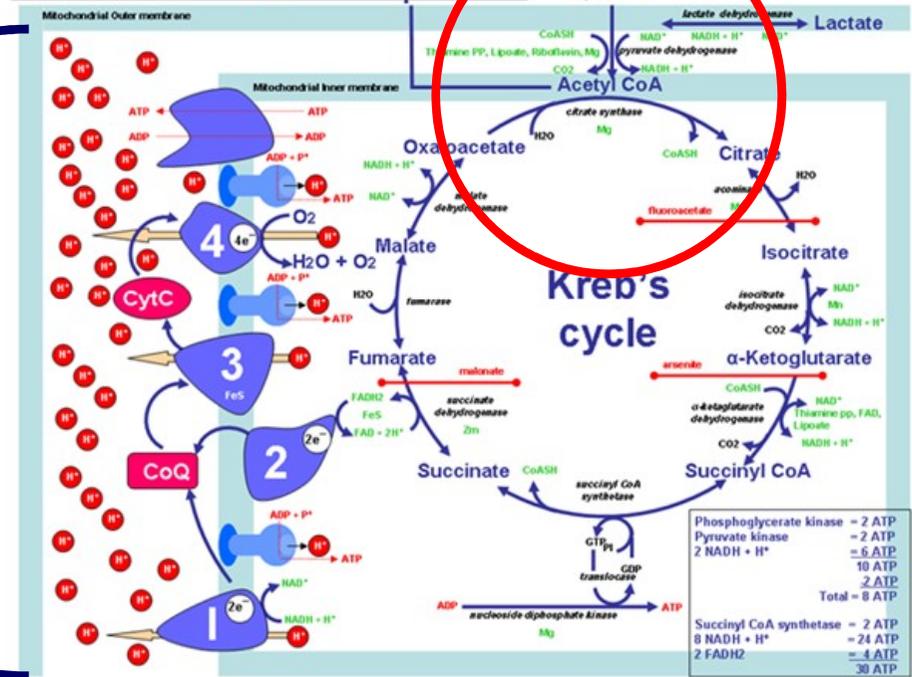
**catalyzes the conversion of lactate to pyruvate and requires NAD.**

**It is predominately present in the liver, kidney, heart and muscles.**

# Energy pathway



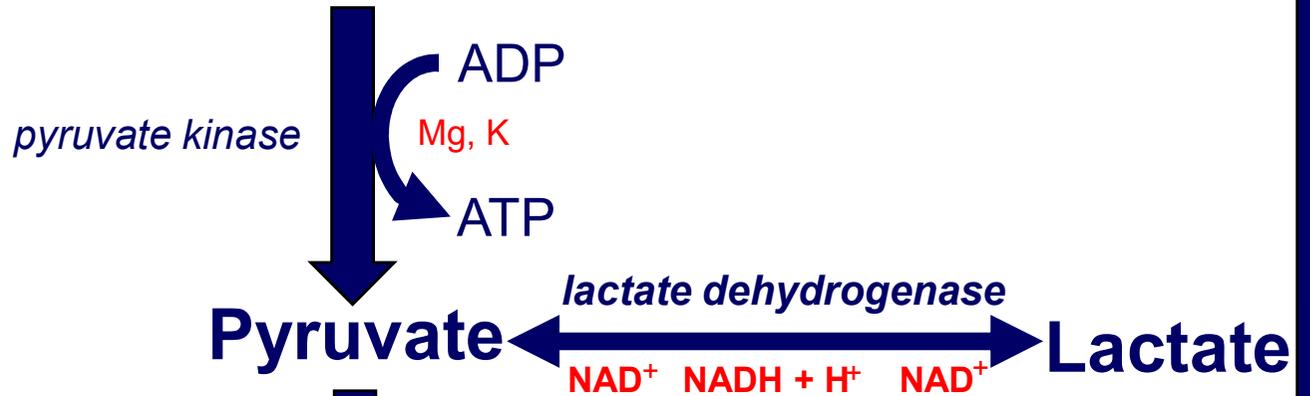
Glycolysis



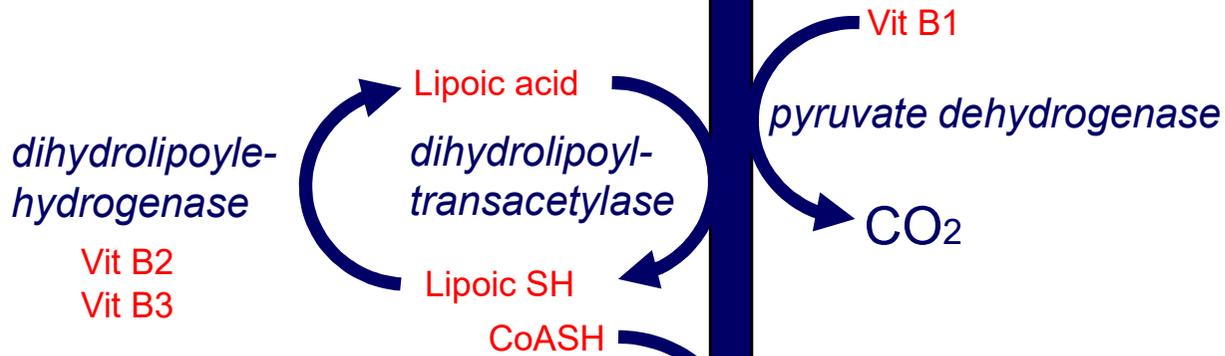
Citric Acid Cycle

Electron transport or Oxidative phosphorylation pathway

# Phosphoenolpyruvate



Mitochondrial outer membrane



Mitochondrial inner membrane

Acetyl CoA

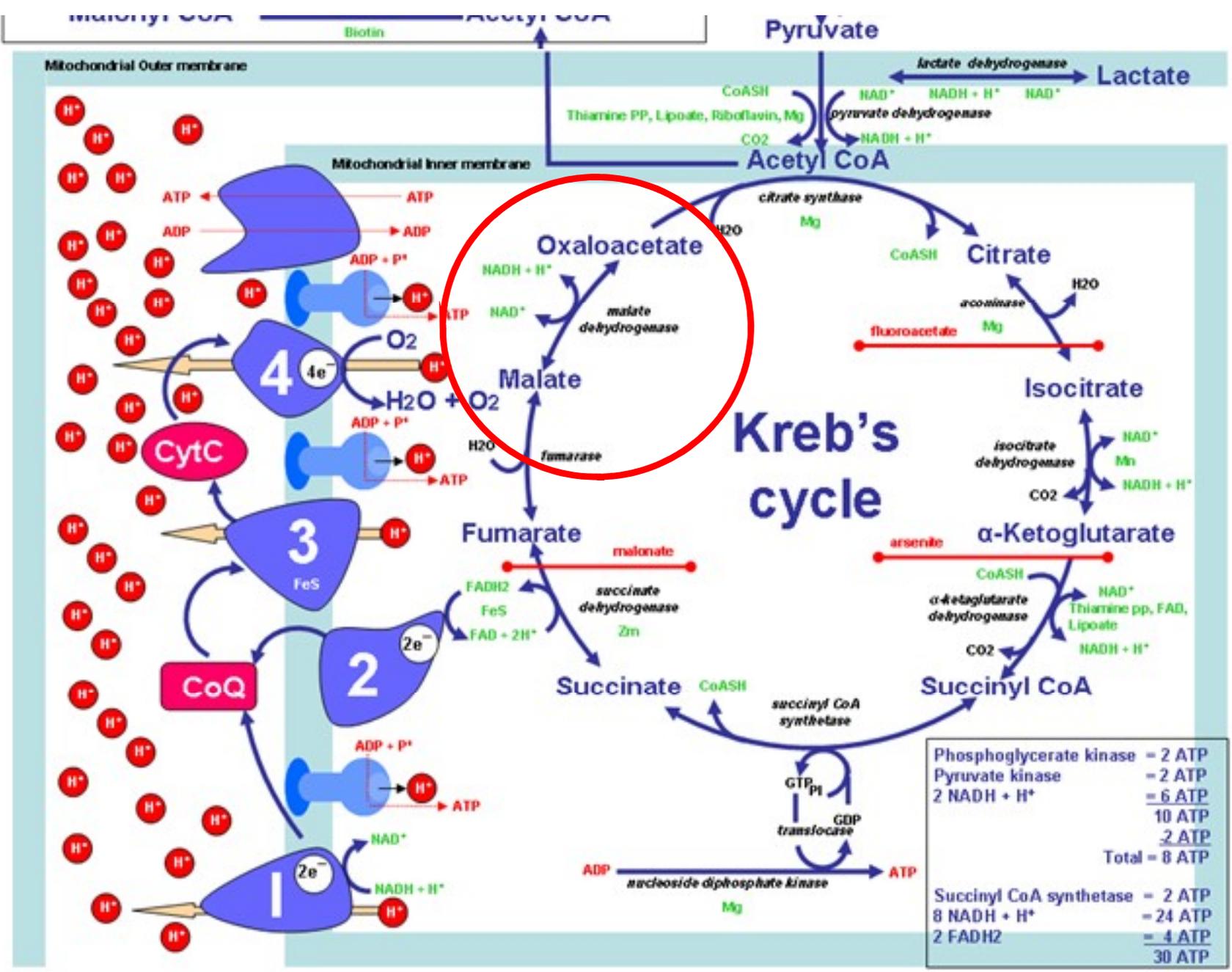


***Lactate dehydrogenase*** is elevated in myocardial infarction, congestive heart failure, angina, cirrhosis, hepatitis, anaemias, strenuous exercise, mononucleosis, pneumonia, leukemias and many malignant neoplasms.

## **6. *Malate dehydrogenase***

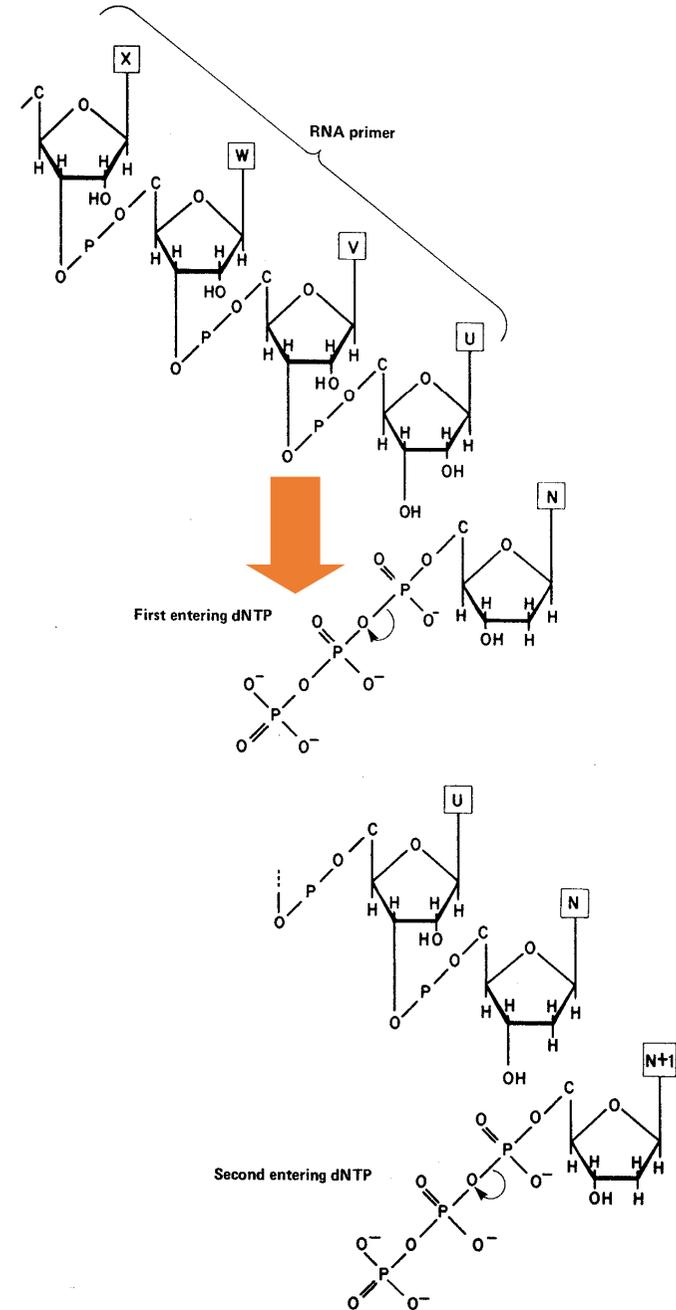
**catalyzes the conversion of  
oxaloacetate + NADH + H<sup>+</sup> =  
malate + NAD**

**Oxaloacetate is not permeable to  
the mitochondrial membrane and  
must be reduced to malate in  
order to cross the membrane.**



**7. *DNA polymerase*** is found in all cells and is involved with the initiation of DNA synthesis. This zinc dependant enzyme is critical for cellular growth, development and repair.

The initiation of DNA synthesis upon a primer of RNA and the subsequent attachment of the second deoxyribonucleoside triphosphate.





**Zinc deficiency**  
results in a  
decrease in DNA  
and RNA  
synthesis and  
repair.

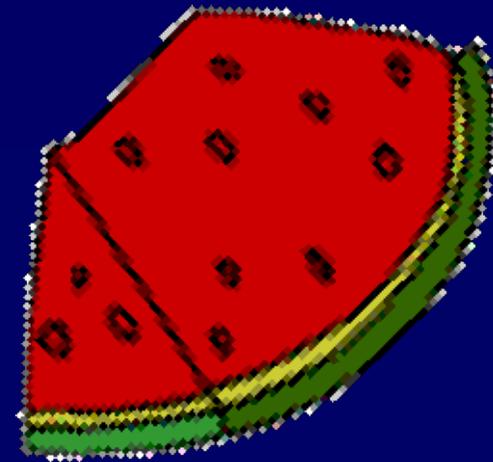
## **Zinc deficiency**

during the last trimester of pregnancy and during breast feeding results in impaired growth, decreased number of brain cells and retarded brain maturation.



**8. *Superoxide dismutase (SOD Zn/Cu)*** contains a single atom of zinc and copper.  
It catalyzes the conversion of superoxide to hydrogen peroxide.

**SOD (Zn/Cu) is found predominantly in the red blood cells, liver, kidney and brain. It is naturally found in **watermelon seeds.****



**Prostatic zinc binding protein** is stimulated by dihydrotestosterone which regulates testosterone reductase.

Its concentration changes with ejaculation.

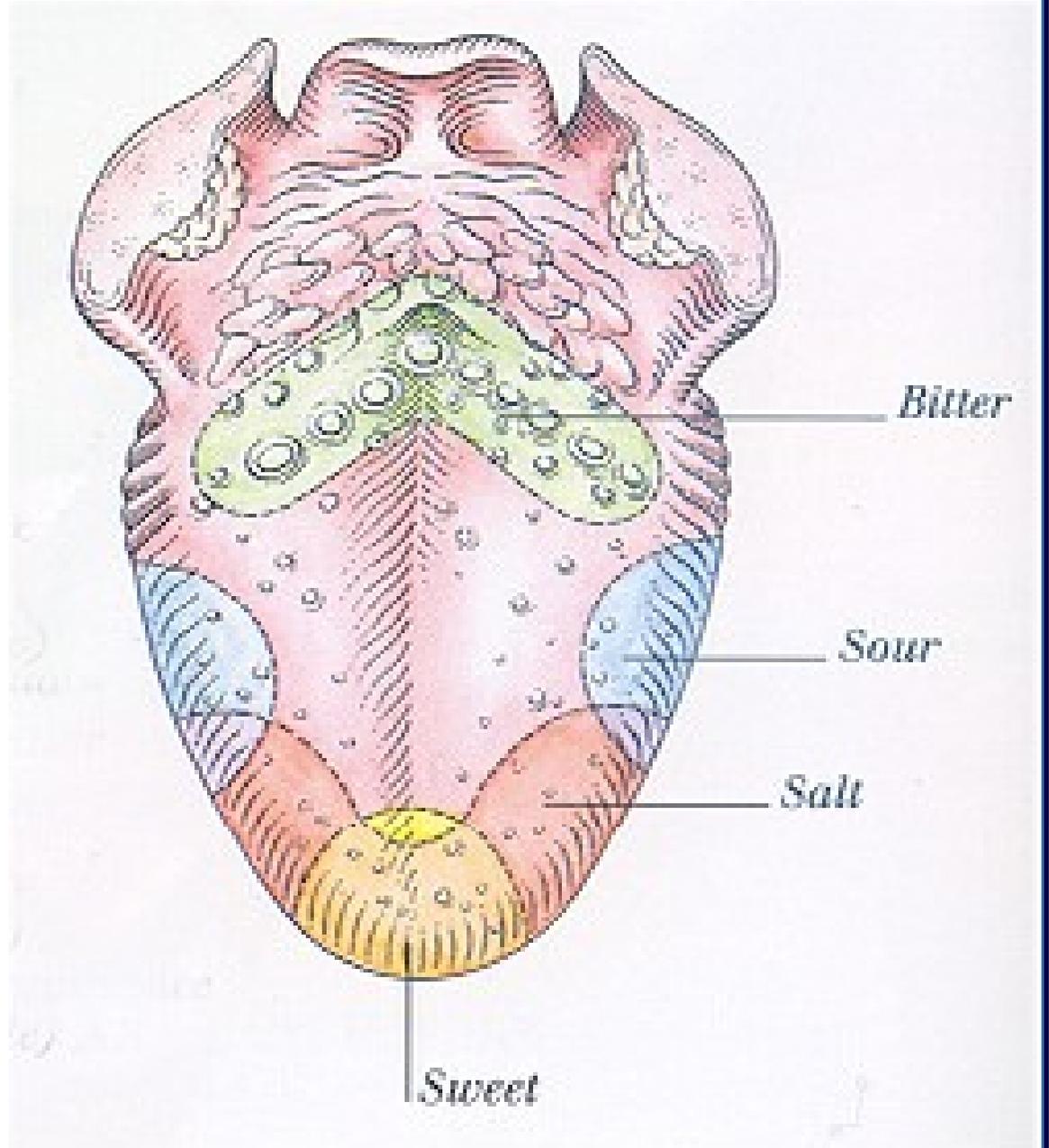
It is necessary for the integrity of the prostate **epithelium and lumen.**

## **Zinc and taste**

**Gustin** is the major protein found in parotid saliva and contains zinc.

It is a growth factor involved in the synthesis of a zinc containing protein found in the taste buds.

# TASTE



People with **taste and smell** dysfunction have a decreased level of zinc in parotid saliva and have a poor appetite.

**Nasal mucus protein** is also a zinc containing protein.

Traditional zinc taste test uses zinc sulfate 0.1% solution.

## **Zinc in wound healing**

**Administration of high dose zinc in patients with leg ulcers, bedsores and slow collagen synthesis resulted in accelerated wound healing.**

## **Zinc in testes development**

**Zinc deficient children have testicular atrophy, no pubic or facial hair.**

**Administration of zinc** resulted in testicular growth, growth of pubic and facial hair, nocturnal emission, penis growth in males and menarche in females.

## **Zinc in brain and body growth and development**

**Zinc deficiency in utero has been shown to produce decrease in brain size, brain DNA and RNA concentration and synthesis, utilization of amino acids in the synthesis of proteins and the level of serum proteins.**

**Zinc deficiency in pregnant animals** leads to abnormalities such as cleft palate, clubbed feet, heart abnormalities and hydrocephalus.

**Acrodermatitis enteropathetica** is a congenital defect in intestinal absorption of zinc.

## **Zinc and the immunity**

**The maintenance of normal zinc intake is important in host defence mechanism against infectious micro-organisms, on phagocytic cell function (neutrophils), complement activity, lymphocytes, and T helper cell function.**

**Zinc deficiency in animals has shown thymic atrophy, thymocytic cell depletion, depressed peripheral lymphocyte T cell number and function, a decrease in thymic hormones and decreased interleukin-2-production.**

## **Symptoms of zinc deficiency**

**Growth retardation, congenital malformation, decreased brain development, mental lethargy, male hypogonadism, anorexia, hypogeusia (decreased taste),**

**abnormal dark adaptation,  
alopecia, delayed immune  
response, inter-current  
infections, skin rashes, bullous-  
pustular dermatitis, and  
parakeratosis.**

**Look for zinc deficiency in people with **chocolate** cravings!**

**Look for white spots on the fingernails, body odour and eczema.**

## **Zinc taste tally**

**30ml dropper bottles containing  
Zinc sulphate 7 Hydrate 0.1%  
dilution or  
Ionic Zinc 300ppm**

## **Supplement products**

**Colloidal Zinc**

**Zinc ascorbate**

**Zinc bisglycinate**

**Zinc chloride**

**Zinc citrate caps**

**Zinc picolinate caps**

**Zinc sulphate caps**

## **Plant source**

**Prunus serotina**

**(Black cherry)**

**Diospyros virginiana**

**(Persimmon)**

**Lycopersicon**

**esculentum (Tomato)**

**Brassica capitata**

**(Cabbage)**

**Corylus avellana**

**(Hazelnut)**

**Sesamum indicum**

**(Sesame)**

## **Sources**

- **Beans and peas • Beef • Dairy products • Fortified cereals • Nuts**
- **Poultry • Seafood (e.g., clams, crabs, lobsters, oysters) • Whole grains**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)

# **FDA Daily Value (RDA)**

**15mg**

[https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin\\_and\\_Mineral\\_Chart.pdf](https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/factsheets/Vitamin_and_Mineral_Chart.pdf)