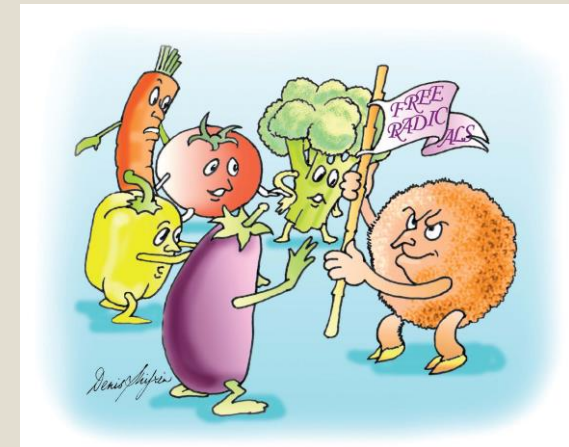


Chinese Saying --



○ 药补不如食补

“Supplementation with drugs is never as good as supplementation with foods....”



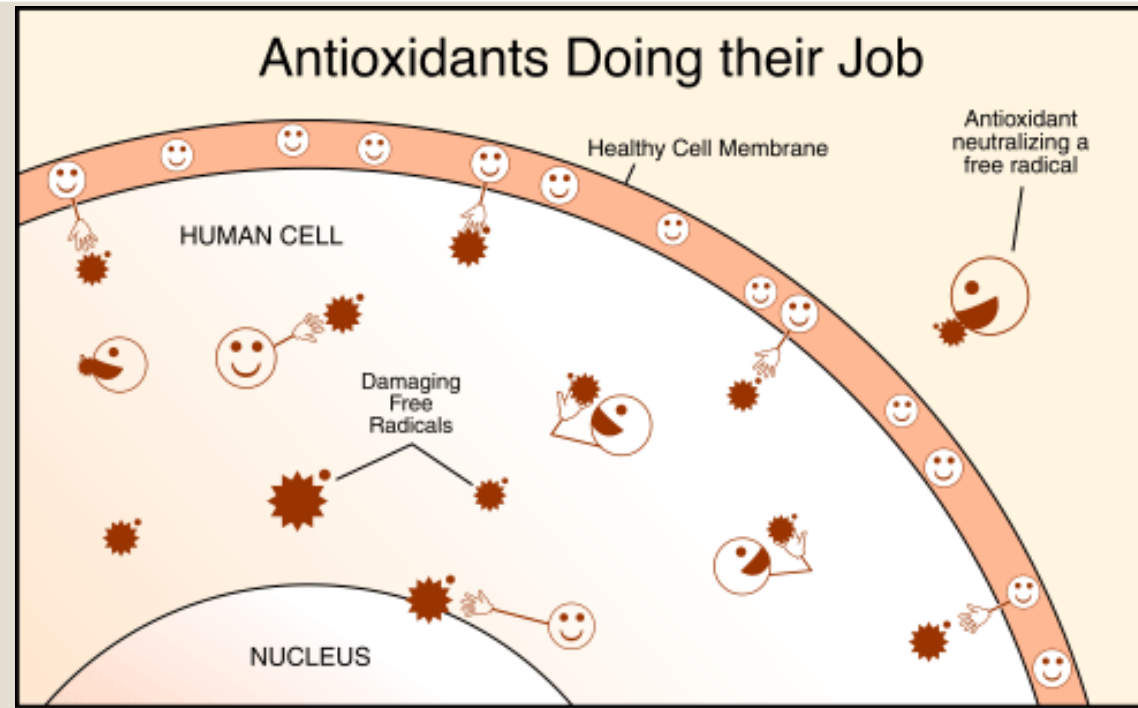
Antioxidant

The substance present in low concentrations relative to the oxidizable substrate that significantly delays or reduces oxidation of the substrate.

They reduce the effect of dangerous oxidants by binding together with these harmful molecules, decreasing their destructive power.

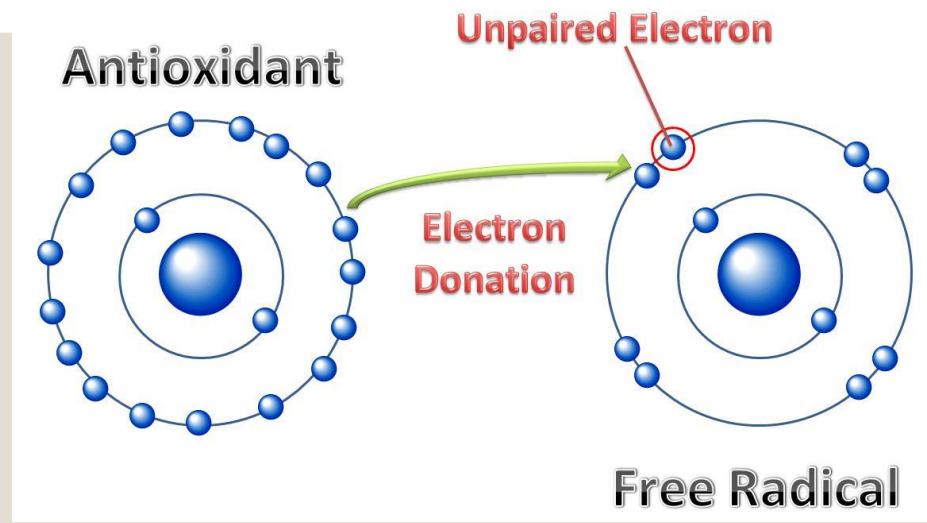
They can also help *repair damage* already sustained by cells.

They may be considered as the scavengers of free radicals.



- During this reaction the *antioxidant sacrifices itself by becoming oxidized*.
- However, antioxidant supply is not unlimited *as one antioxidant molecule can only react with a single free radical*. Therefore, there is a **constant need to replenish antioxidant resources**.

Antioxidants



Prevents the transfer of electron from O_2 to organic molecules

Stabilizes free radicals

Terminates free radical reactions

Classification of antioxidant

I. According to their location

a) Plasma antioxidants:

- ascorbic acid (Vitamin C), bilirubin, uric acid, transferrin, ceruloplasmin, β -carotene;

b) Cell membrane antioxidants:

- α -tocopherol (Vitamin E)

c) Intracellular antioxidants:

- superoxide dismutase (SOD), catalase, glutathione peroxidase (GPx)

Classification of antioxidant

II. According to their nature and action

a) Enzymatic antioxidants:

- SOD, catalase, GPx, glutathione reductase

b) Non-enzymatic antioxidants:

- Nutrient antioxidants:

β -carotene, α -tocopherol, ascorbic acid,

- Metabolic antioxidants:

bilirubin, uric acid, ceruloplasmin, ferritin, transferrin,
albumin, glutathione

Enzymatic antioxidant

1. superoxide dismutase (SOD)



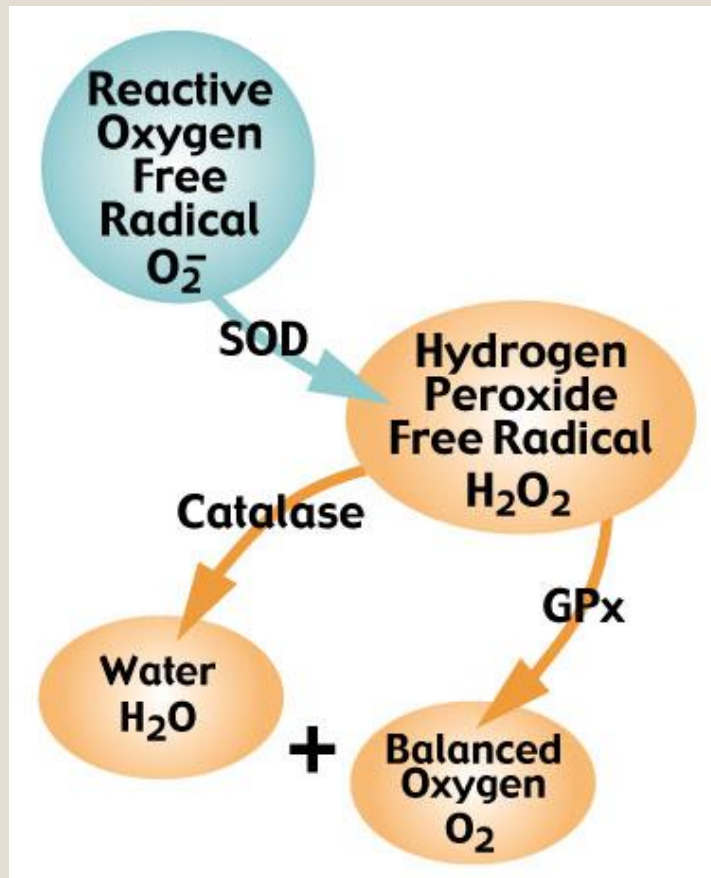
SOD is present in essentially every cell in the body which actually represented by a group of metalloenzymes with various prosthetic groups. SOD appears in **three forms**:

- a) Cu-Zn SOD: in the cytoplasm with two subunits
- b) Mn-SOD: in the mitochondrion
- c) Cu-SOD: extracellular SOD

This is the *first line of defence to protect cells* from the injurious effects of superoxide.

Enzymatic antioxidant

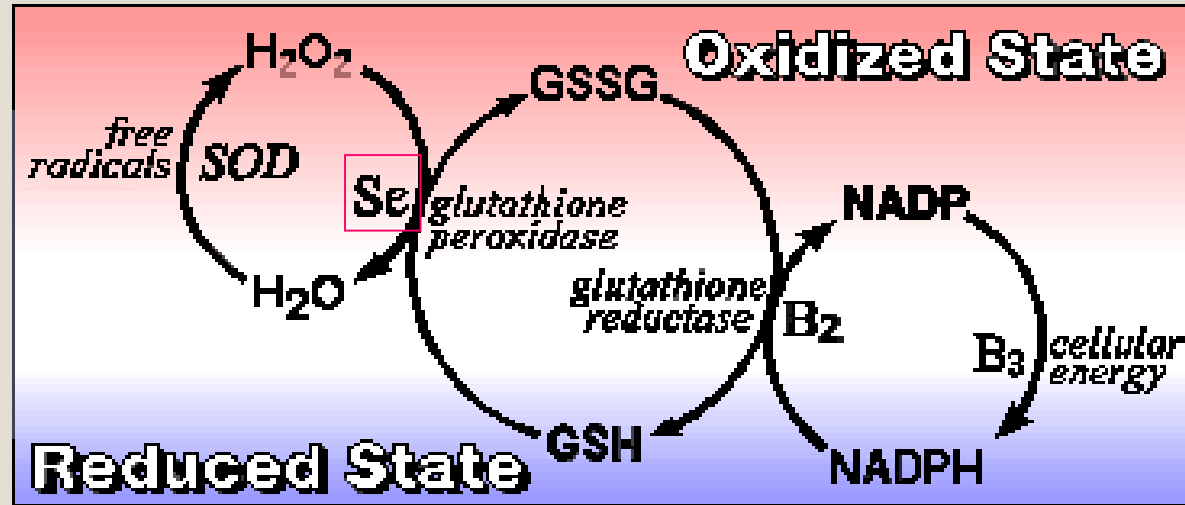
2. Catalase, CAT



Catalase, **iron dependent** enzyme, is present in all body organs being especially concentrated in the liver and erythrocytes. The brain, heart and skeletal muscle contains only low amounts.

Enzymatic antioxidant

3. glutathione peroxidase, GPx



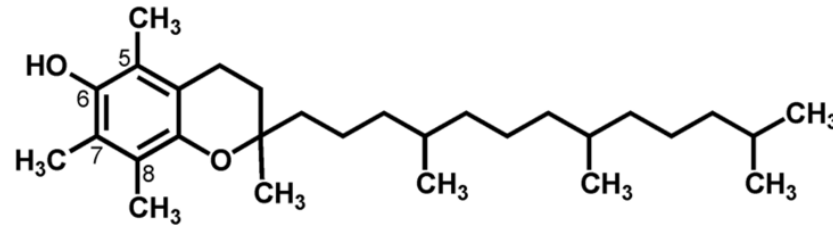
GPx is a **selenium-dependent** enzyme.

The entire process is driven by energy production at the cellular level, which involves proper thyroid hormone levels, healthy mitochondrial function, and an active pentose-phosphate metabolic pathway.

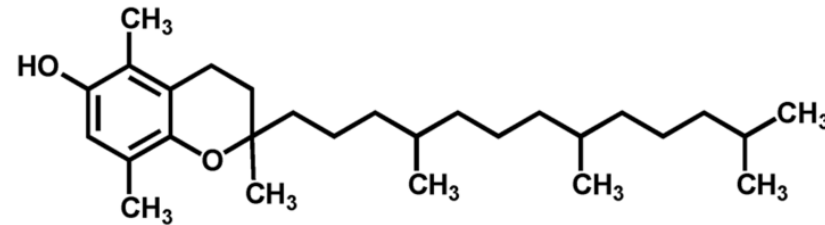
Nutrient antioxidant

1. α -tocopherol (vitamin E)

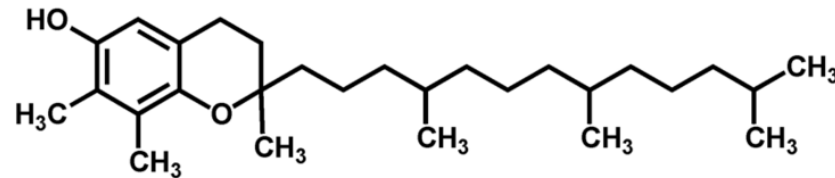
α -Tocopherol



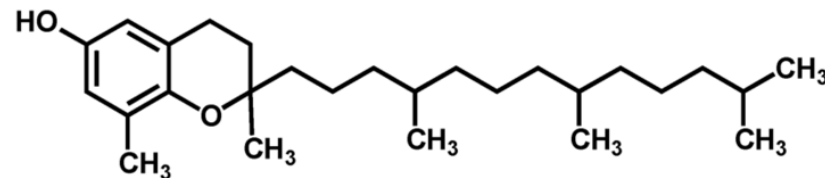
β -Tocopherol



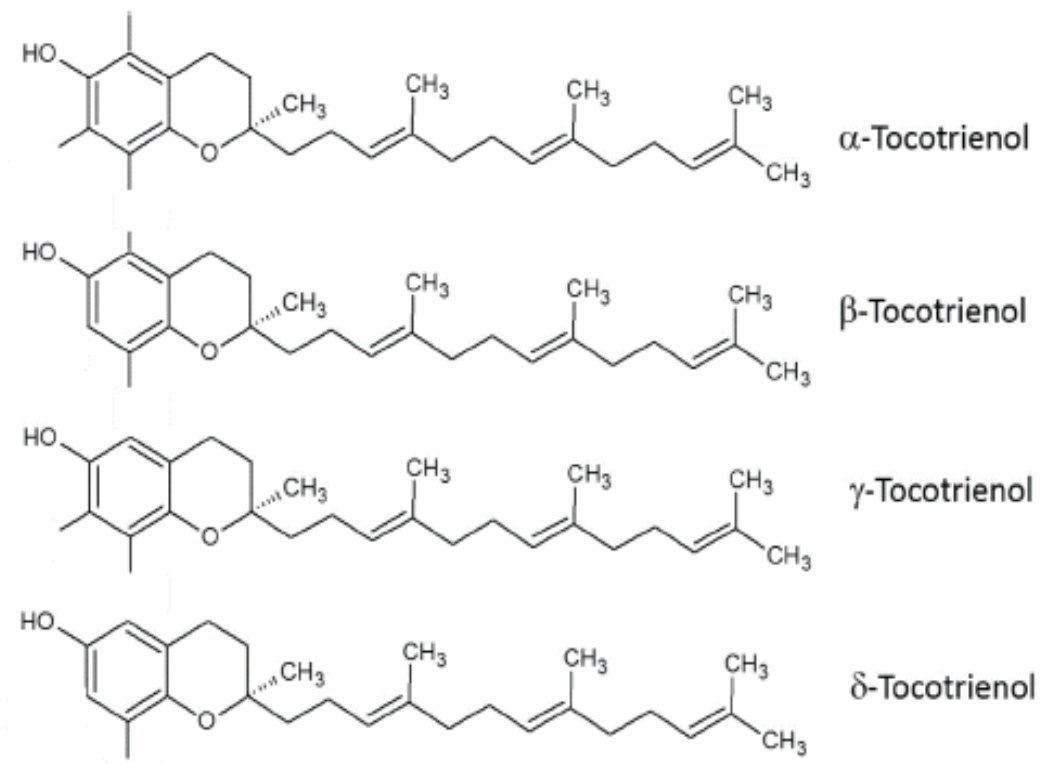
γ -Tocopherol



δ -Tocopherol



Nutrient antioxidant



Structure of tocotrienols.

The most important lipid-soluble antioxidant

Present in all cellular membranes.

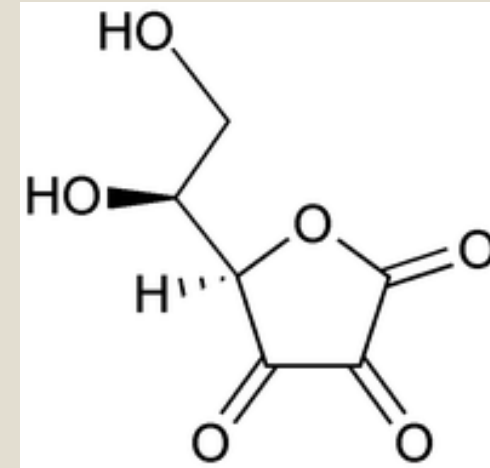
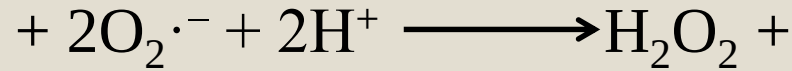
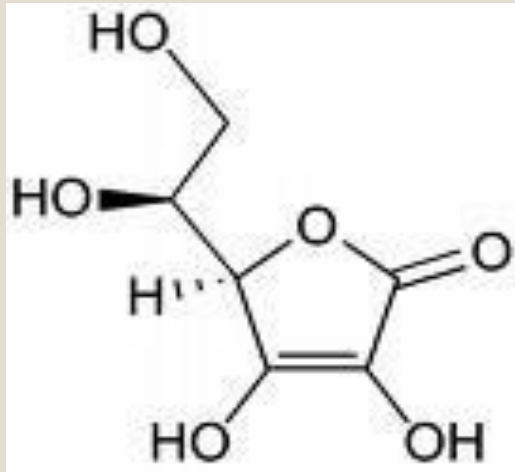
Protect against lipid peroxidation.

1. Vitamin E was shown to be stored **in adipose tissue**.
2. Vitamin E prevents the peroxidation of membrane phospholipids and **avoids cell membrane damage** through its antioxidant action.



Nutrient antioxidant

2. ascorbic acid (vitamin C)



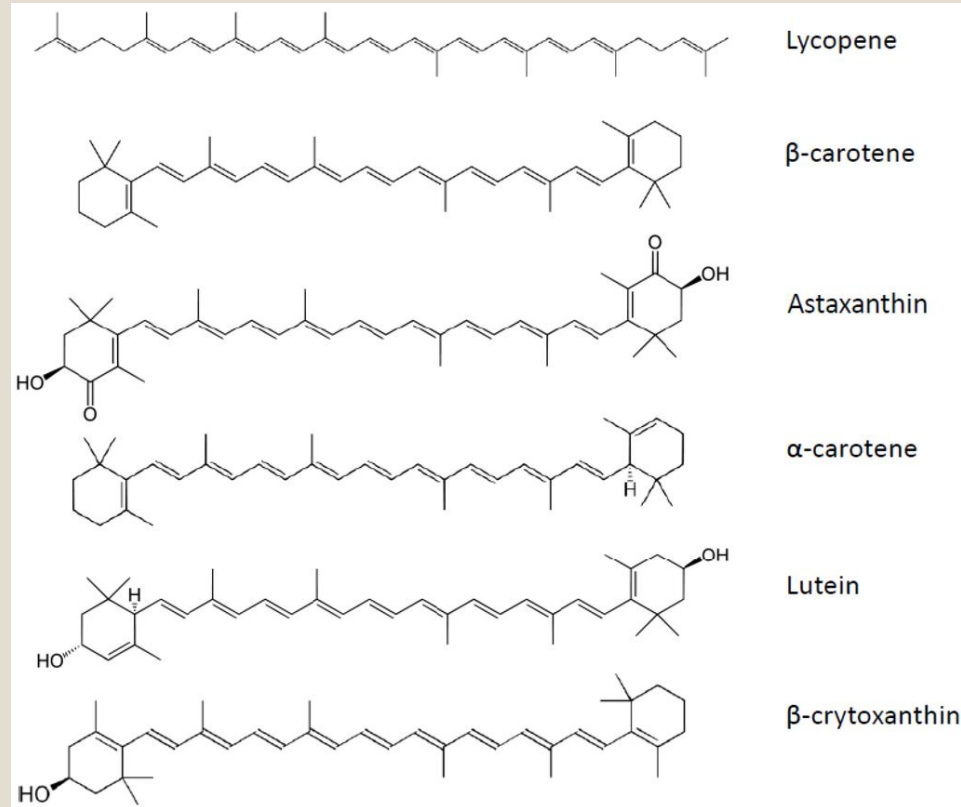
Dehydroascorbate, DHA

It is a *water-soluble, antioxidant* present in citrus fruits, potatoes, tomatoes and green leafy vegetables.

It is a *chain breaking antioxidant* as a reducing agent or electron donor. It scavenges free radicals and inhibits lipid peroxidation. It also promotes the regeneration of α -tocopherol.

Nutrient antioxidant

3. carotenoids



Carotenoids consist of C₄₀ chains with conjugated double bonds, they show *strong light absorption* and often are *brightly colored* (red, orange). They occur as pigments in bacteria, algae and higher plants.

β-carotene is the ***most important***.

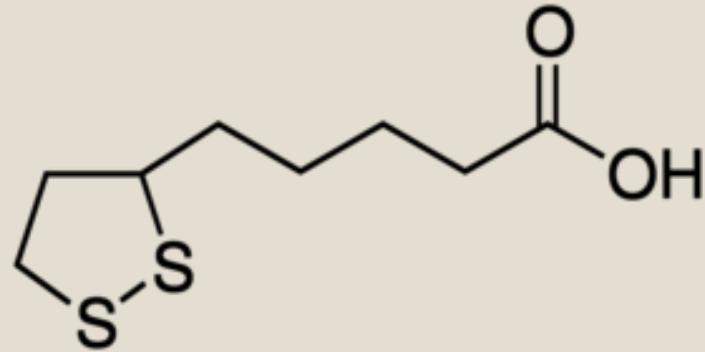
- It is composed of two molecules of **vitamin A (retinol)** joined together.
- Dietary β-carotene is converted to retinol at the level of the intestinal mucosa. It can ***quench singlet oxygen***.
 - Quenching of singlet oxygen is the basis for its well known therapeutic efficacy in **erythropoietic protoporphyria** (a photosensitivity disorder).

Lycopene is responsible for color of certain fruits and vegetables like **tomato**. It also possesses **antioxidant** property.



Nutrient antioxidant

4. α -lipoic acids



It is *vitamin-like compound*, produced in the body, besides the supply from plant and animal sources.

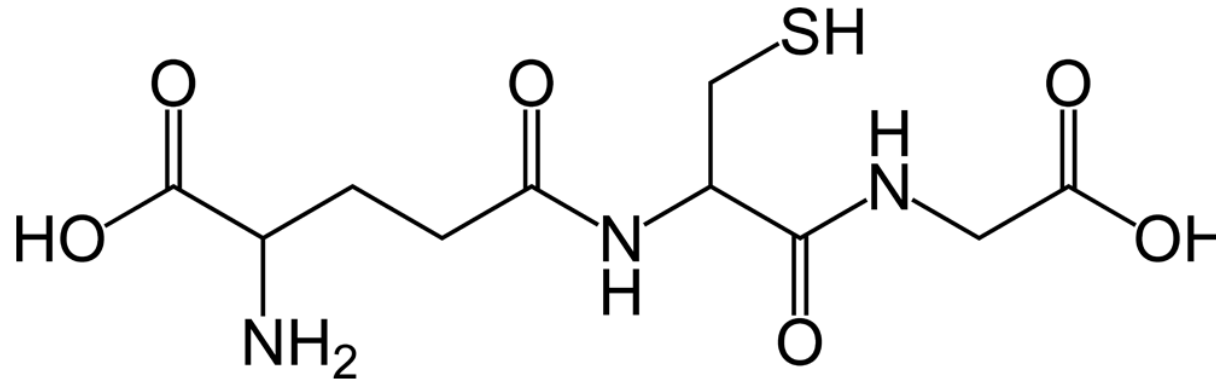
It *plays a key role in recycling other important antioxidants* such as ascorbic acid, α -tocopherol and glutathione.

Other important nutrient antioxidants

Antioxidant	Source
1. <u>Coenzyme Q₁₀</u>	organ meats (best heart), beef, chicken
2. <u>Selenium</u>	sea foods, meats, whole grains
3. <u>Proanthocyanidins</u>	grape seeds
4. <u>Catechins</u>	green tea
5. <u>Quercetin</u>	onions, red wine, green tea
6. <u>Ellagic acid</u>	berries, walnuts, pomegranates

Metabolic antioxidant

1. glutathione, GSH



In addition to its role as a substrate in GSH redox cycle, GSH is also a *scavenger of hydroxyl radicals and singlet oxygen*. GSH also has an important role in xenobiotic metabolism.

Metabolic antioxidant

1. Uric acid scavenge singlet oxygen and hydroxy radical
2. Ceruloplasmin inhibit iron and copper dependent lipid peroxidation
3. Transferrin prevents iron-catalyzed radical formation
4. Albumin scavenge radicals on its surface
5. Bilirubin protects albumin bound FFA from peroxidation
6. Haptoglobin bind to free Hb and prevent the acceleration
of lipid peroxidation

the body's own internal antioxidant defense system, including Superoxide Dismutase (SOD), Catalase and Glutathione Peroxidase (Gpx):



Normally, cellular homeostasis is a delicate balance between the production of free radicals and our antioxidant defenses.

GREEN TEA – A WONDERFUL ANTIOXIDANT

Primarily consumed in China, Japan,
Middle East, North Africa & North America
- Rich in **polyphenol** – an antioxidant

200 times more powerful than Vitamin E

Scavenges free radicals, high rate

Reduce the risk of heart diseases

Lowers LDL oxidation

Prevents Red blood Cell breakdown

Protects against digestive & respiratory infections

Prevents cancers of colon, pancreas & stomach



FOR A HEALTHY TOMORROW...



What should you do?



Notice: Countering the Harmful Effects of Free Radicals



Don't smoke – if you do then make it a point to quit

Don't overdo your exposure to the sun

Don't over consume alcohol

Don't consume foods containing trans fats or hydrogenated oils

Get your cardio exercise from sprinting or interval training

Do consume antioxidant rich foods and use a good antioxidant formula

Keep your stress levels down

Points

- **Antioxidant**
 - **Enzymatic antioxidants**
 - **SOD, catalase, GPx, glutathione reductase**
 - **Non-enzymatic antioxidants**
 - **Nutrient antioxidants: β -carotene, α -tocopherol, ascorbic acid,**
 - **Metabolic antioxidants: glutathione (GSH)**