
بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ
Bismillahirrahmanirrahim


PP
A
K
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D
C

VITAMINS

Introduction and classification

Dr Gulnaz

Objectives

- Define vitamins
- Discuss the history of vitamins
- Classify vitamins
- Difference between fat soluble and water soluble vitamins.
- Vitamins like substances.

VITAMINS

- "VITAMIN" means "vital for life"
- VITAMINS are organic substances required in small amount for everyday healthy functioning of the body.
- OR
- These are micronutrients required in small amount, as they are not synthesised in body in amount sufficient for maintenance of normal functioning of body.

History

History

- In 17th century-sailors of British navy got scurvy on ships.
- James Lind, ship surgeon prescribed lemon juice as preventative measure.
- This experiment proved that lemon juice prevents scurvy.
- Nowadays we know that scurvy is due to vitamin C deficiency .

History of vitamins

- In 1906 Frederic Hopkin, a English biochemist said that food contains "accessory factors" needed to sustain growth and life.

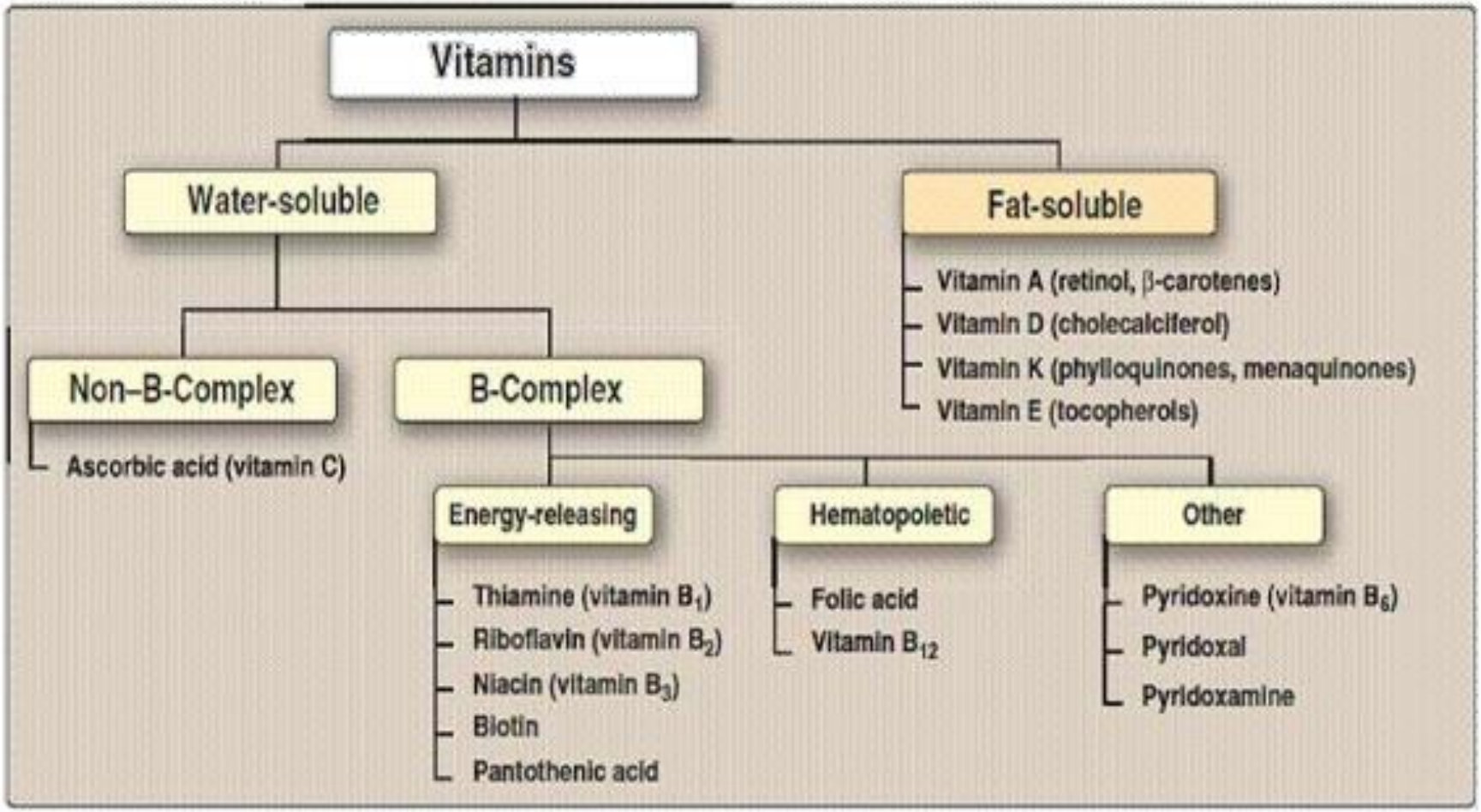
- In 1912 Casimir Funk named these growth factors VITA+AMINES because they were required for life(vita),and also contain nitrogen.
- As he found thiamine isolated from rice husk contain nitrogen(called : amine: i.e nitrogen containing).

In 1930 when the scientists identified, purified and synthesized all the vitamins.
Funk original term: vitamine: changed to ‘vitamin’

Functions

- Required for growth and reproduction e.g. vitamin A.
- They act as co enzymes in several energy transmission reactions in the body e.g. B-complex.
- Antioxidants e.g. vitamin C,E.
- Hormone like functions as regulator of mineral metabolism e.g. , vit D

Classification



Previous name[41][42]	Chemical name[41][42]	Reason for name change[41]
Vitamin B_4	Adenine	DNA metabolite
Vitamin B_8	Adenylic acid	DNA metabolite
Vitamin F	Essential fatty acids	Needed in large quantities (does not fit the definition of a vitamin).
Vitamin G	Riboflavin	Reclassified as Vitamin B_2
Vitamin H	Biotin	Reclassified as Vitamin B_7
Vitamin J	Catechol, Flavin	Protein metabolite
Vitamin L_1[43]	Anthranilic acid	Protein metabolite
Vitamin L_2[43]	Adenylthiomethylpentose	RNA metabolite
Vitamin M	Folic acid	Reclassified as Vitamin B_9
Vitamin O	Carnitine	Protein metabolite
Vitamin P	Flavonoids	No longer classified as a vitamin
Vitamin PP	Niacin	Reclassified as Vitamin B_3
Vitamin U	S-Methylmethionine	Protein metabolite

Chemical name

Thiamine (B1)

Riboflavin (B2)

Nicotinamide (niacin) (B3)

Adenine (no longer considered a vitamin)

Pantothenic acid (B5)

Pyridoxine (B6)

Biotin (B7)

Inositol

Folacin (folic acid) (B9)

p-aminobenzoic acid (PABA) / H1

L-carnitine / b-hydroxy-g-trimethylammonium butyrate

Cyanocobalamin (B12)

Water soluble

- Cannot be stored in body - regular supply needed
- Excess is excreted in urine - no danger of toxic levels
- Unstable to heat and light, leach into cooking liquids

Fat Soluble

- Can be stored in body - regular supply not needed
- Can accumulate to toxic levels if large amounts ingested
- Fairly stable at normal cooking temperatures

Water Soluble Vitamins

- Digestion, Absorption, and Transport
  - No chemical digestion needed
  - Absorbed in the blood and moves freely in capillaries and water filled compartments of body.
    - Vitamin B12 must bind with a protein called the intrinsic factor (IF) in the stomach for absorption.
  - No carriers required for transport in the blood

Water Soluble Vitamins

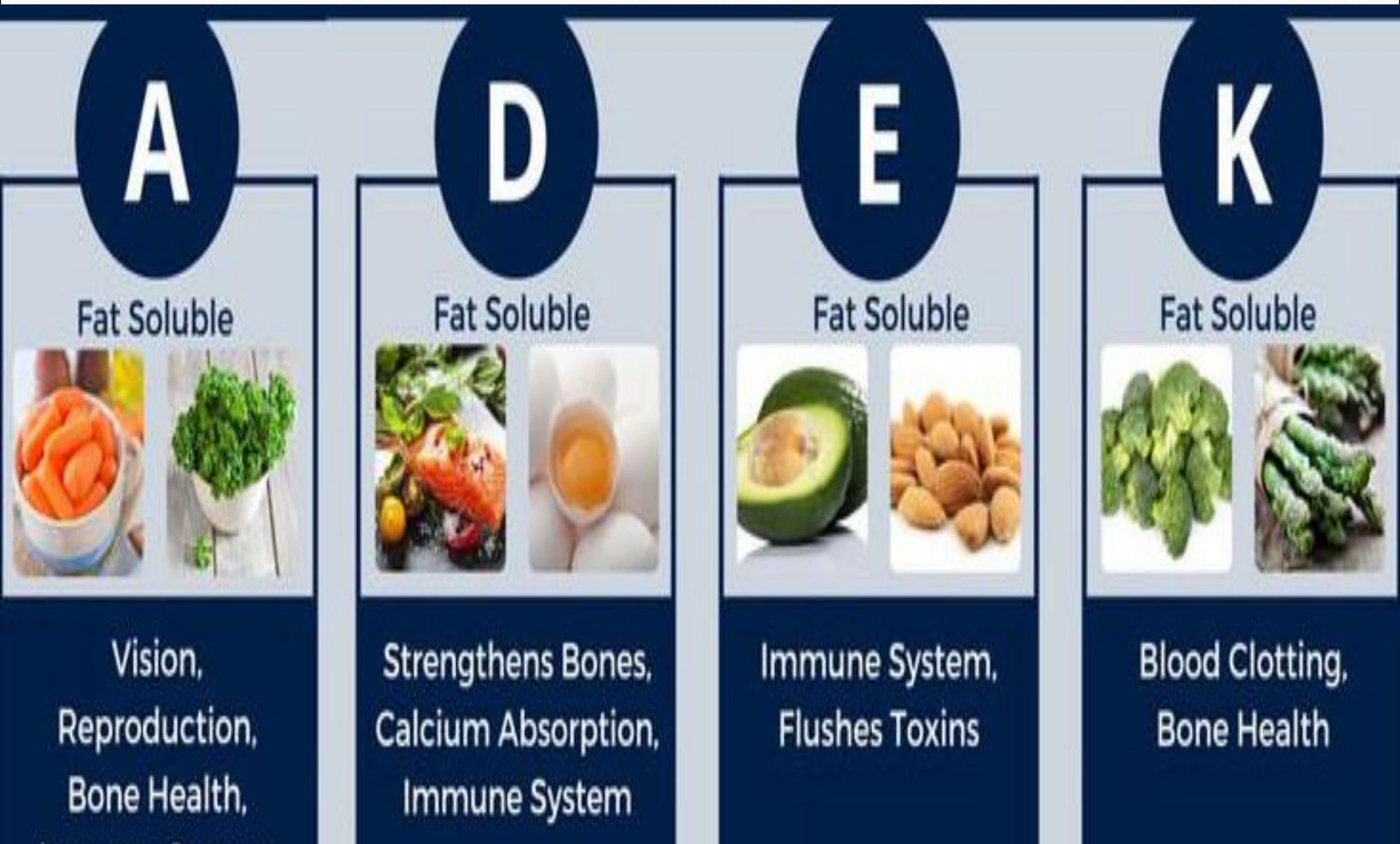
- Storage and excretion
  - Travel freely in the blood
  - Cells take up water soluble vitamins as needed
    - Limited storage beyond tissue saturation
  - Excess excreted in the urine

Water Soluble Vitamins

- Many are destroyed by light, heat, or exposure to oxygen
- Best to cook whole in a minimum amount of water

.

Fat soluble vitamins



Fat Soluble Vitamins

- Digestion, Absorption, and Transport
  - Bile needed to emulsify fat soluble vitamins.
  - Form chylomicrons (along with long chain fatty acids and monoglycerides)
  - Chylomicrons are absorbed into the lacteals
  - Travel through lymph system → blood → liver
  - Many require protein carriers to be transported in the blood

Fat Soluble Vitamins

- Storage
  - Stored in liver and fatty tissue
  - Unlimited stores possible
- Greater risk of toxicity than deficiency for fat soluble vitamin.

Fat Soluble Vitamins

- Found in the fatty parts of food
- Removed with the fat when low-fat products are made
  - Many low-fat foods are supplemented with these vitamins to make up for this
    - E.g. skimmed milk is fortified with vitamin A and D .

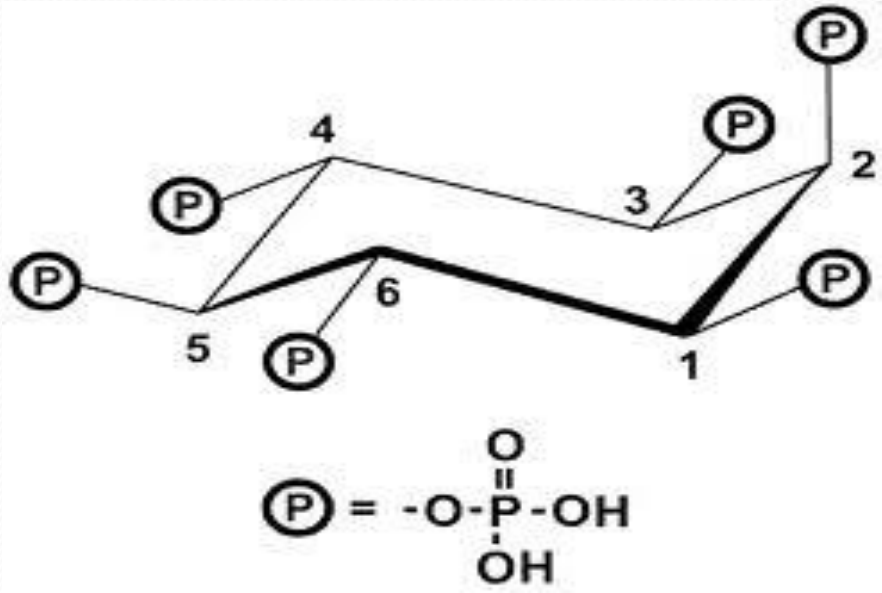
Vitamins like substances

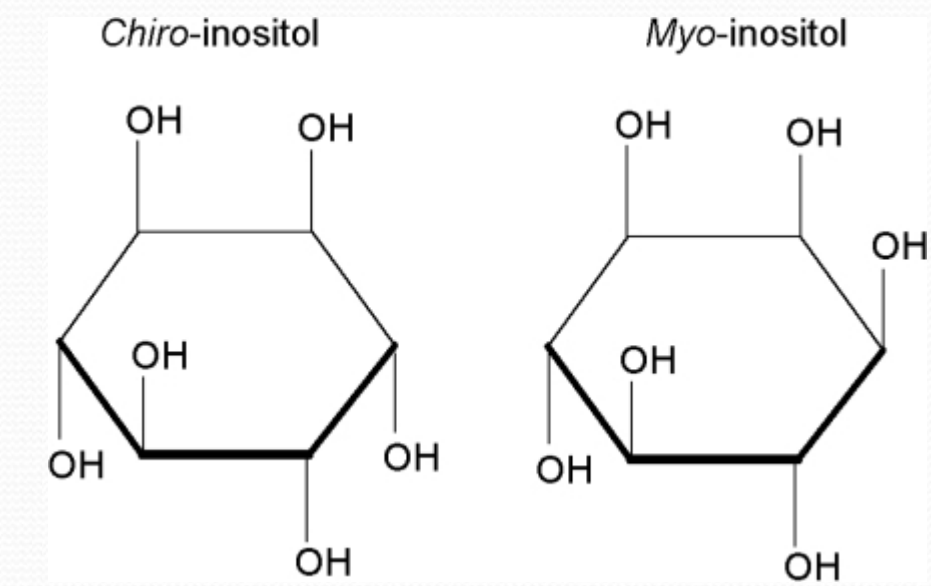
- There are substances which have vitamin like activity, they are essential for human nutrition and metabolism, but their role as true vitamin is not established.
- These are
- Inositol
- Lipoic acid
- Choline
- Para amino benzoic acid

INOSITOL

CHEMISTRY

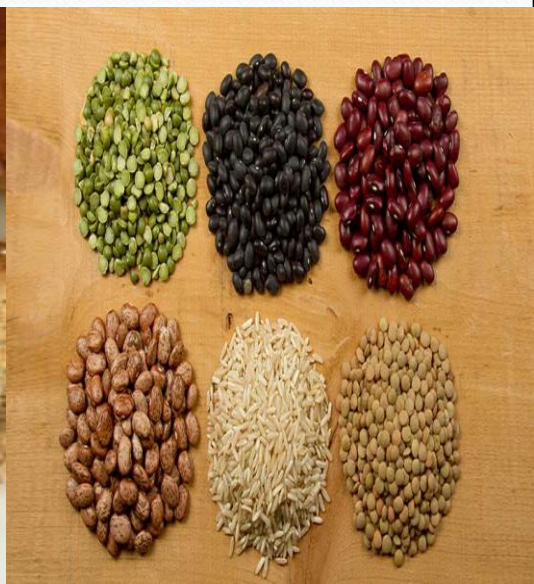
- Hexahydroxy cyclohexane having nine stereoisomers.
- Myoinositol is biologically active form.
- Synthesize in the body from glucose-6-phosphate.





SOURCES

- Found both in plants (phytic acid)and animals.
- Found in melon, oranges, cereals, beans, nut, liver, brown rice.
- RDA: 100 mg/day.



Types of Inositol

- Free state.

  As Muscle sugar .

- Bound forms

  Mostly as phospholipids phospho inositides, present mostly in brain and liver, RBCs and tissues of eye.

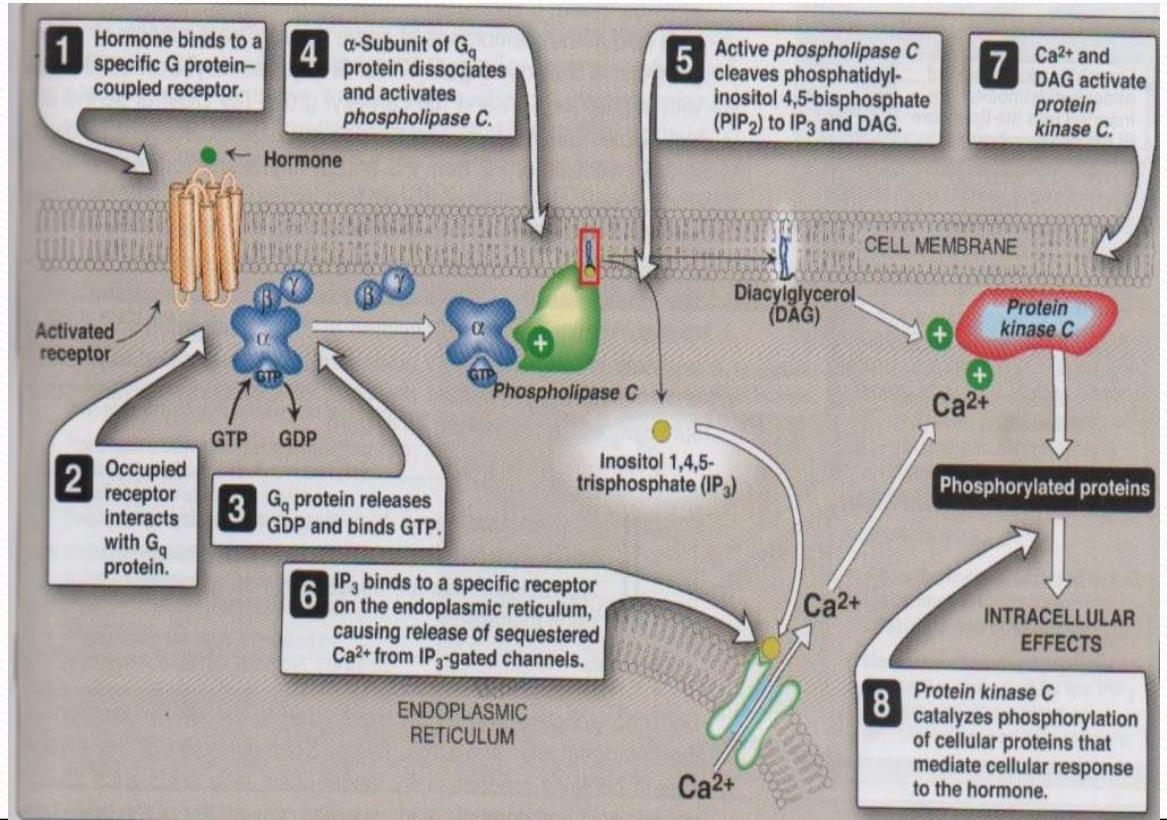
Absorption and Transport

- Absorbed in small intestine.
- Carried by portal blood to tissues.
- Not stored ,excess excreted in urine.
- Hexa phosphate of inositol is called phytin found in vegetables ,is hydrolyzed by phytase.

  It interferes with absorption of calcium and iron.

METABOLIC ROLE

- Inositol + choline produce lecithin, a type of lipid (phosphatidylinositol) constituent of cell membrane.
- Act as 2nd messenger for some hormones for the release of ca^{++} ions at the level of cell membrane.



- Required for the growth of fibroblast.
- Constituents of phospholipids.
- It occurs in large quantity in mammalian heart muscles, keeps liver, brain and heart healthy.
- Lipotropic factor, prevents accumulation of fat in liver.

- Decrease inositol in nerve fibers is responsible for peripheral neuropathy .
- Helps in the absorption of B1 + A.
- Vital for hair growth.
- Increase effectiveness of choline and vit E.

THERAPEUTIC USES

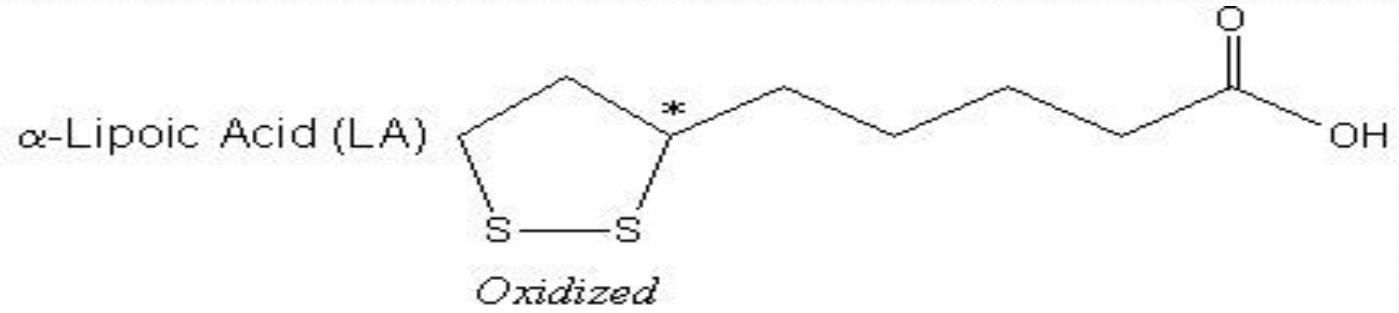
- liver problem.
- Depression.
- Diabetes.
- Polycystic overies.
- Alzehemir;s disease.

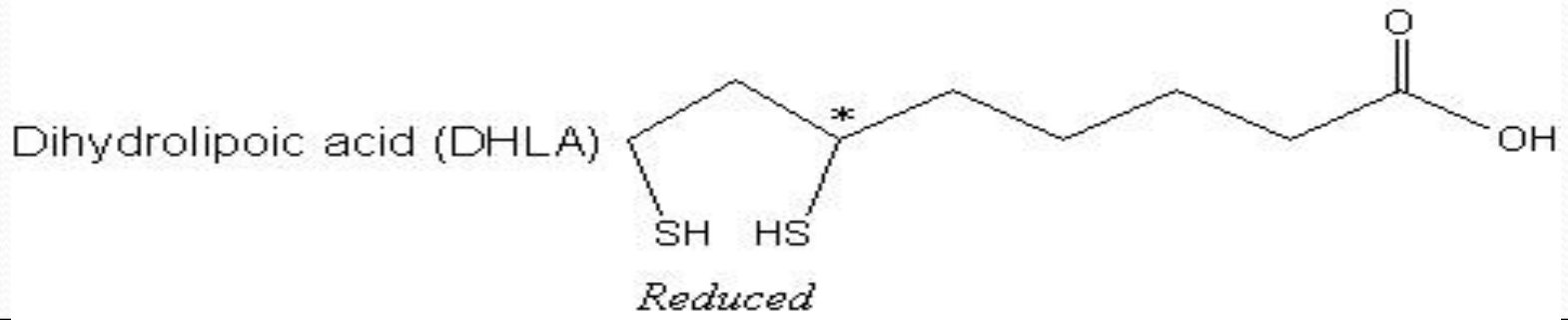
Lipoic acid

Sulpher containing fatty acid.

Chemical structure

- Organosulfur compound (6,8-di-thio- octanoic acid).
- Contain two sulfur atoms linked by disulfide bonds.



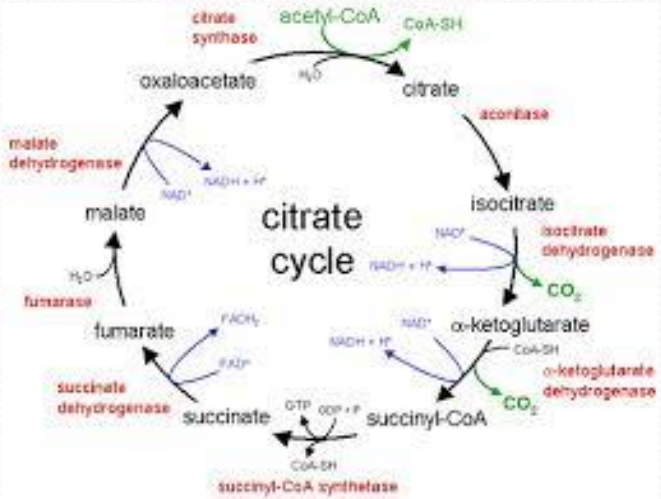


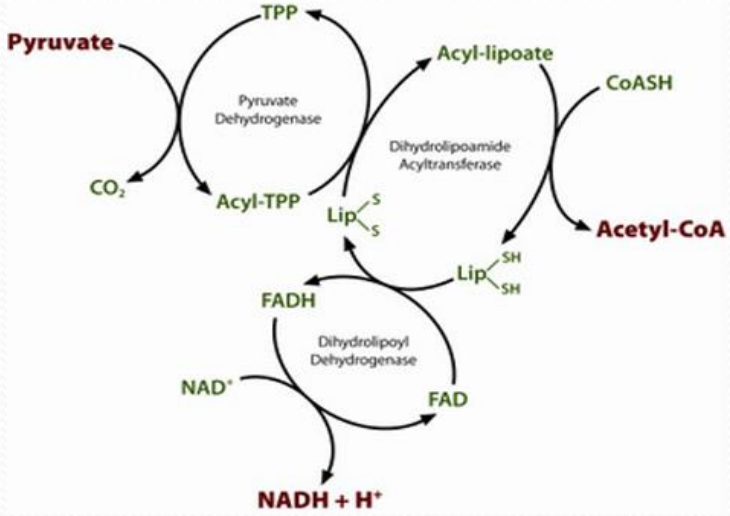
SOURCE

- Both fat soluble and water soluble.
- Found inside every cell in the body.
- Exist in oxidised and reduced form.
- Sources,
- Kidney, liver, heart, spinach and yeast.
- RDA: 50-100 mg/day.

METABOLIC ROLE

Co enzyme of pyruvate dehydrogenase complex for formation of acetyl CoA from pyruvate and succinyl CoA from α ketogluterate.





- Anti oxidant, Protect brain and nerve tissue from free radical damage by producing glutathione.
- Recycle anti oxidant like vitamin C and glutathion.

USES

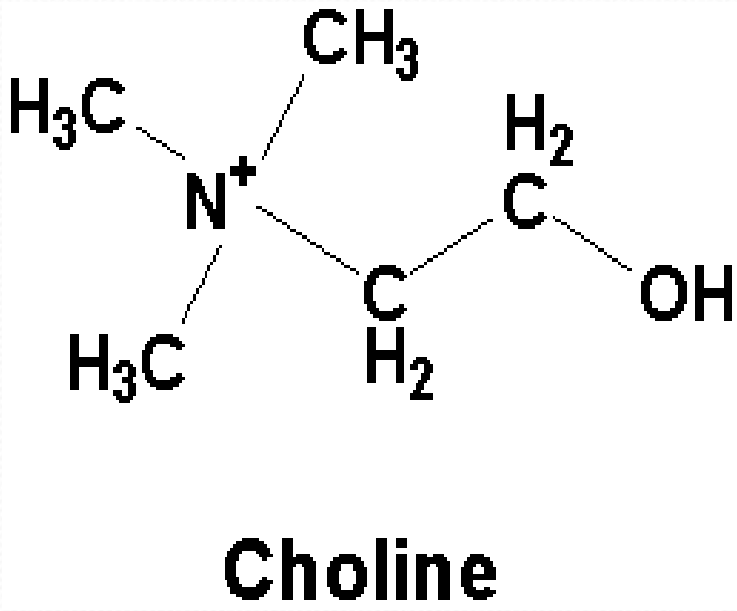
- 1. Hepatoprotective, improve liver circulation, used in liver cirrhosis, jaundice, hepatitis.
- 2. Used in myocardial infarction and stroke.
- 3. Used in multiple sclerosis, Alzheimer's disease(reduce free radicals).
- 4. Reduce insulin resistance and brings down plasma LDL.

TOXICITY

- Headach
- Tingling
- Skin rash
- Muscle cramps.

Choline

- Trimethylhydroxy ethenolamine
- Synthesized in body from serine.



Choline

Dietary sources

- Milk ,eggs , liver, brain, heart,cereals and leafy vegetables

- RDA: 400-500mg/day

Functions

- Promotes synthesis of phospholipids and lipoproteins, so component of cell membrane.
- Phospholipids are involved in the transport of fat and cholestrol from liver. It is Lipotropic factor and prevents fatty liver.
- Actively involved in one carbon metabolism after conversion to betaine by donating three methyl groups.
- Involved in transmethylation reactions.

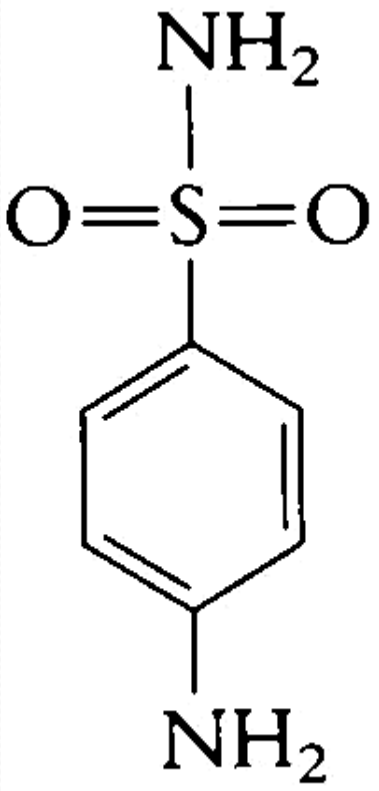
- Myelin sheath is also made up of phospholipids, so demyelination causes severe nervous disorders.

- Precursor of acetylcholine required for transmission of nerve impulse.

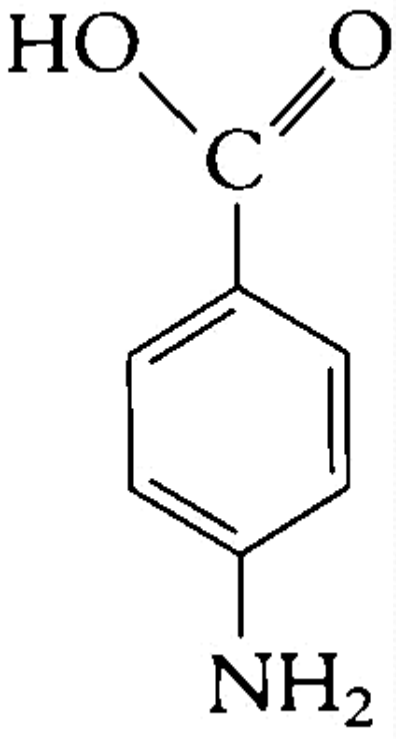
Para amino benzoic acid

Constituent of folic acid

Component of sulfonamides

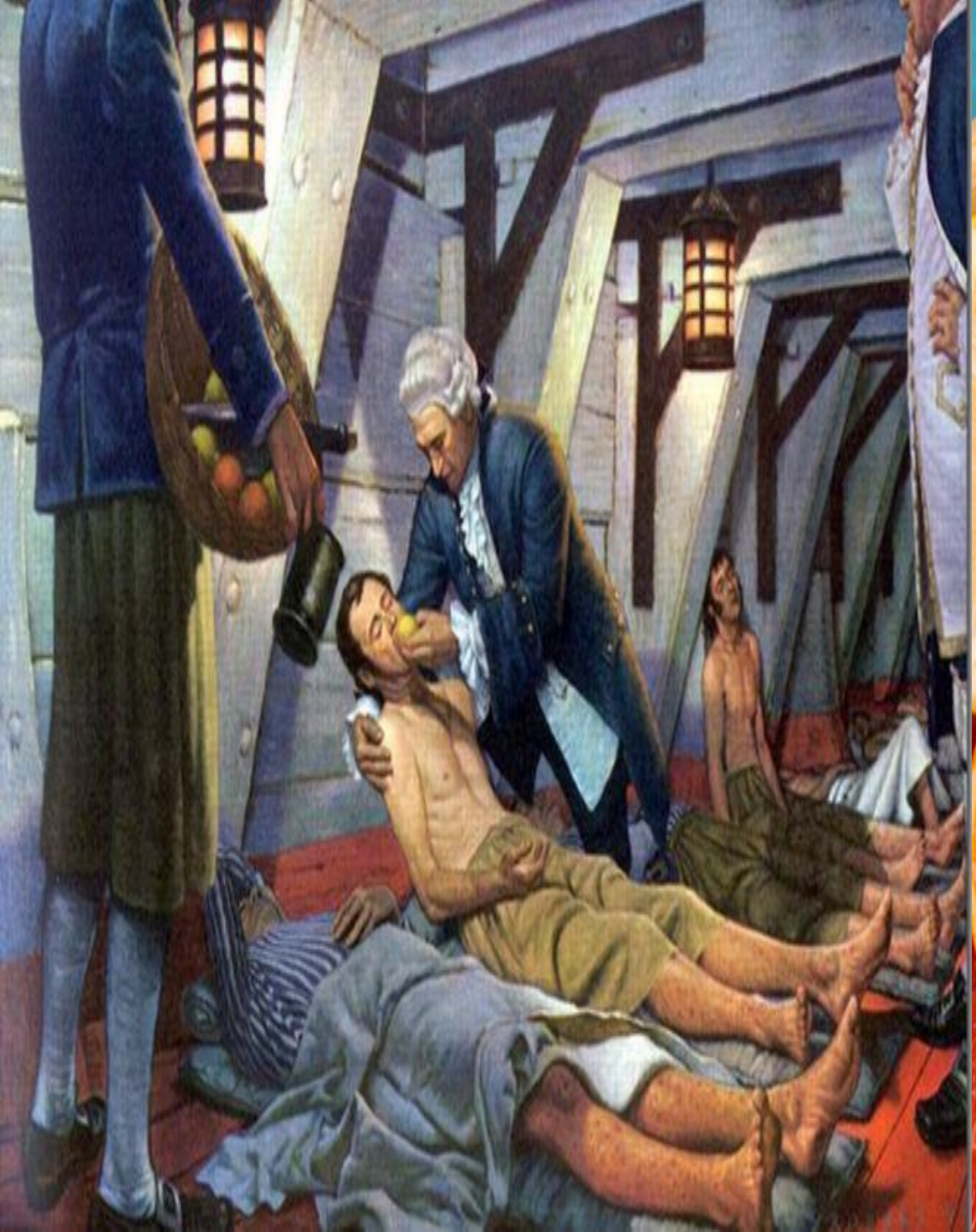


Sulfanilamide



PABA

sources: liver,yeast,rice bran and whole wheat




VITAMIN
C

Objectives

- Sources of Vitamin C
- Chemical structure
- Biochemical functions
- Deficiency disease
- Uses

WATER SOLUBLE VITAMINS

Non B-complex

Vitamin C

B-complex

Energy Yeleasing

Thiamine (B_1)

Riboflavin (B_2)

Niacin(B_3)

Pantothenic Acid(B_5)

Pyridoxine(B_6)

Biotin(B_7)

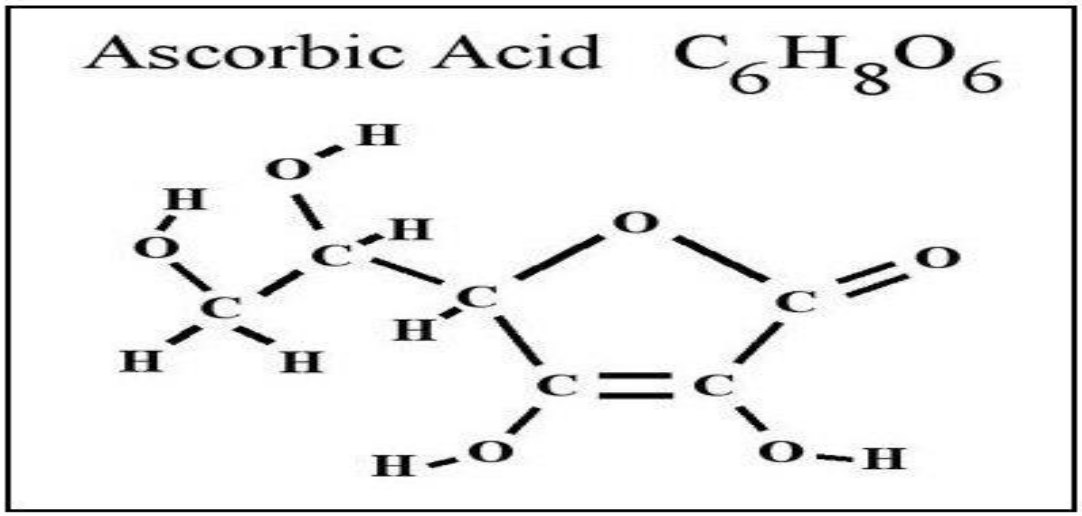
Hematopoietic

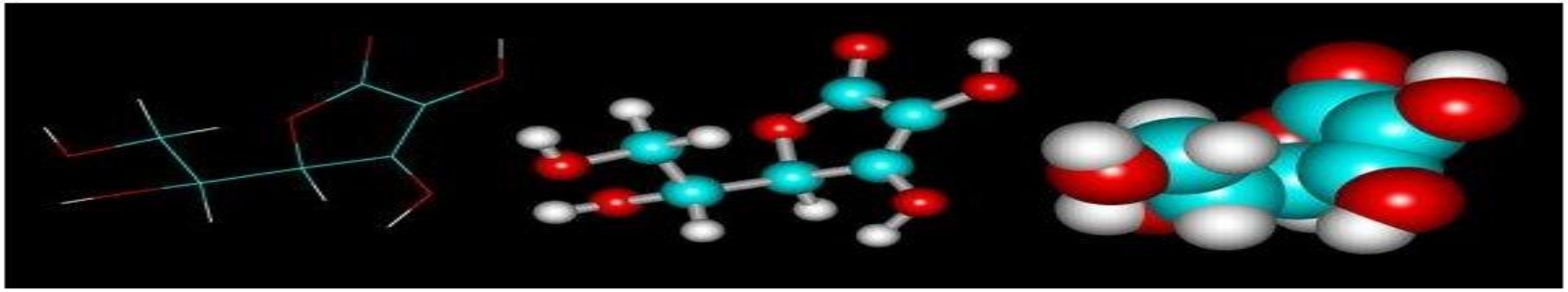
Folic Acid

Vitamin B_{12} / Cyanocobalamin

Vitamin C

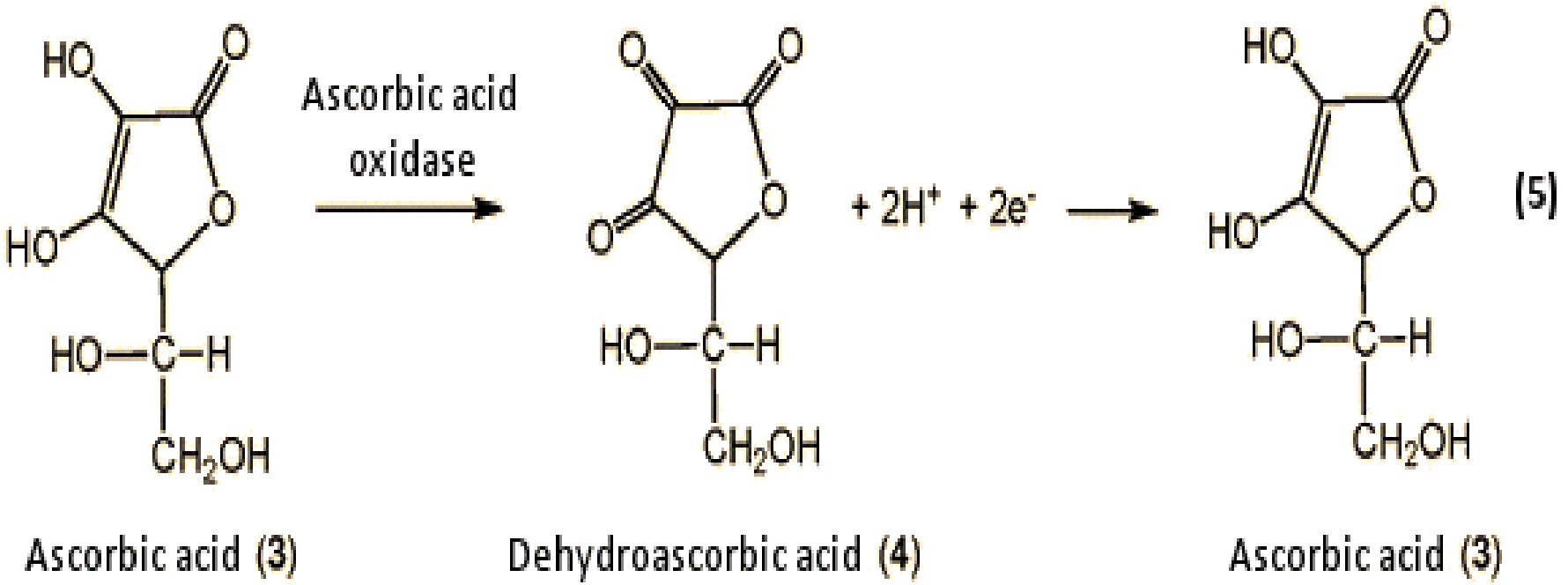
- Vitamin C is a water-soluble vitamin.
- L-ascorbic acid and dehydroascorbic acid are biologically active forms
- D-ascorbic acid is biologically inactive.





Chemistry

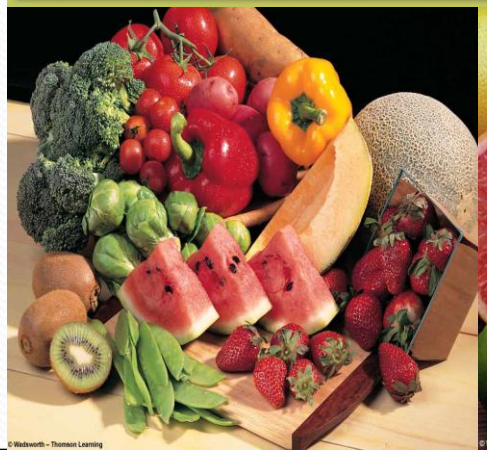
- **The strong reducing property of vitamin C is due to enolic hydroxyl groups.**
- **The L- Ascorbic acid is oxidized to de hydro ascorbic acid.**
- **Both are interconvert able.**



Sources

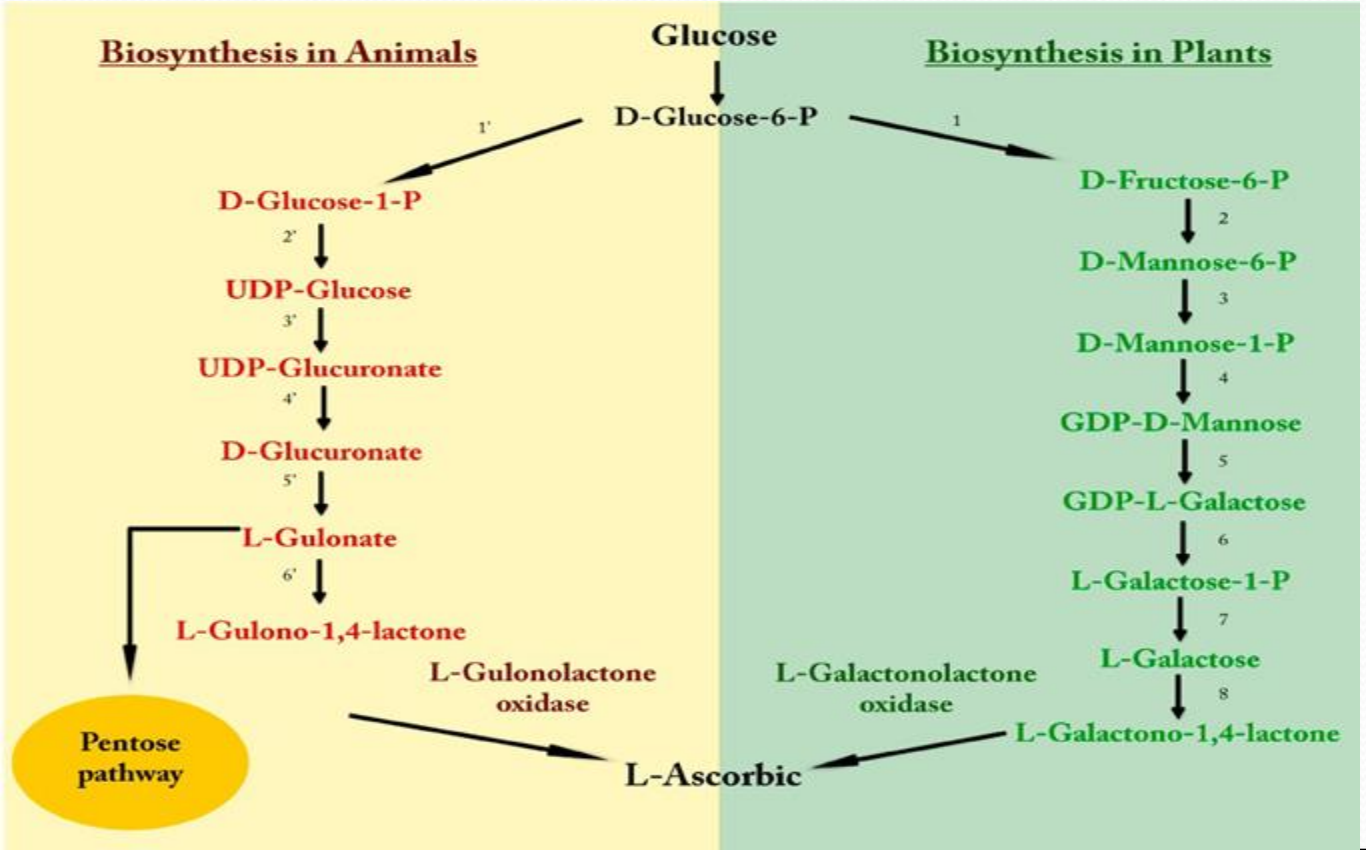
- **Vitamin C is obtained through the diet by the vast majority of the world's population. The richest natural sources are fruits and vegetables.**

- Daily requirement
- Adult—60mg/day
- Children—30mg/day

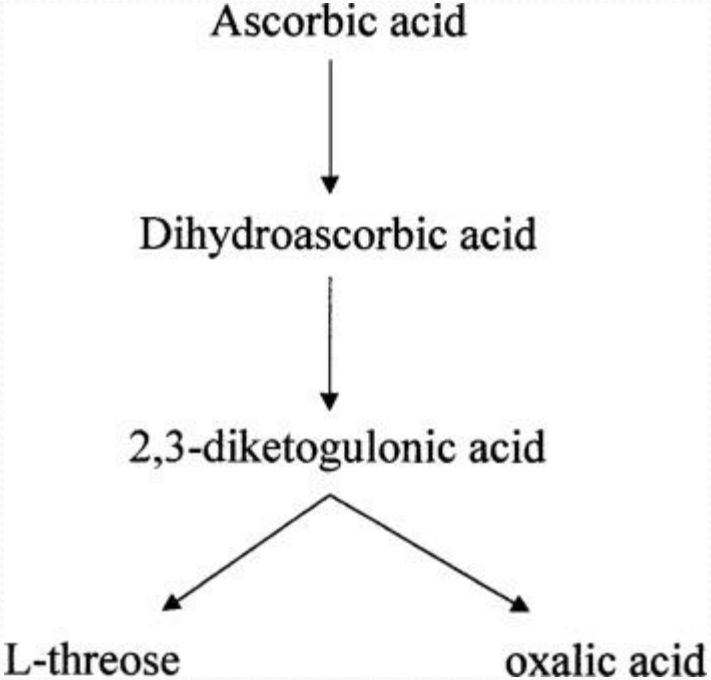


Biosynthesis and metabolism

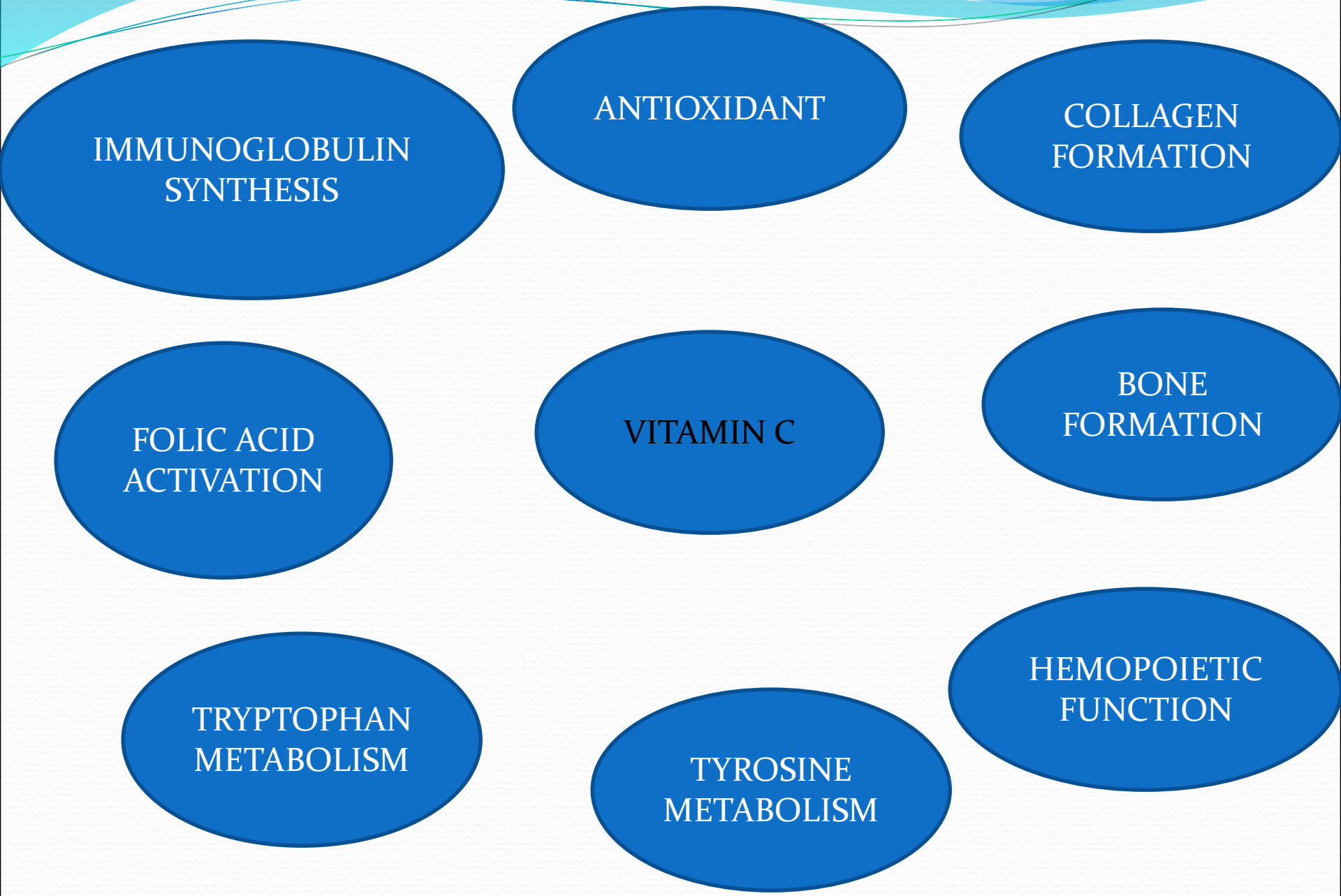
- Synthesize from glucose via uronic acid pathway
- Man can not synthesize due to lack of enzyme L-Gluconolactone oxidase.



- Destroyed by heat and light.
- Small amount is stored in body, mostly in retina, adrenal gland and pituitary.
- Excreted as diketogluonic acid and oxalic acid.

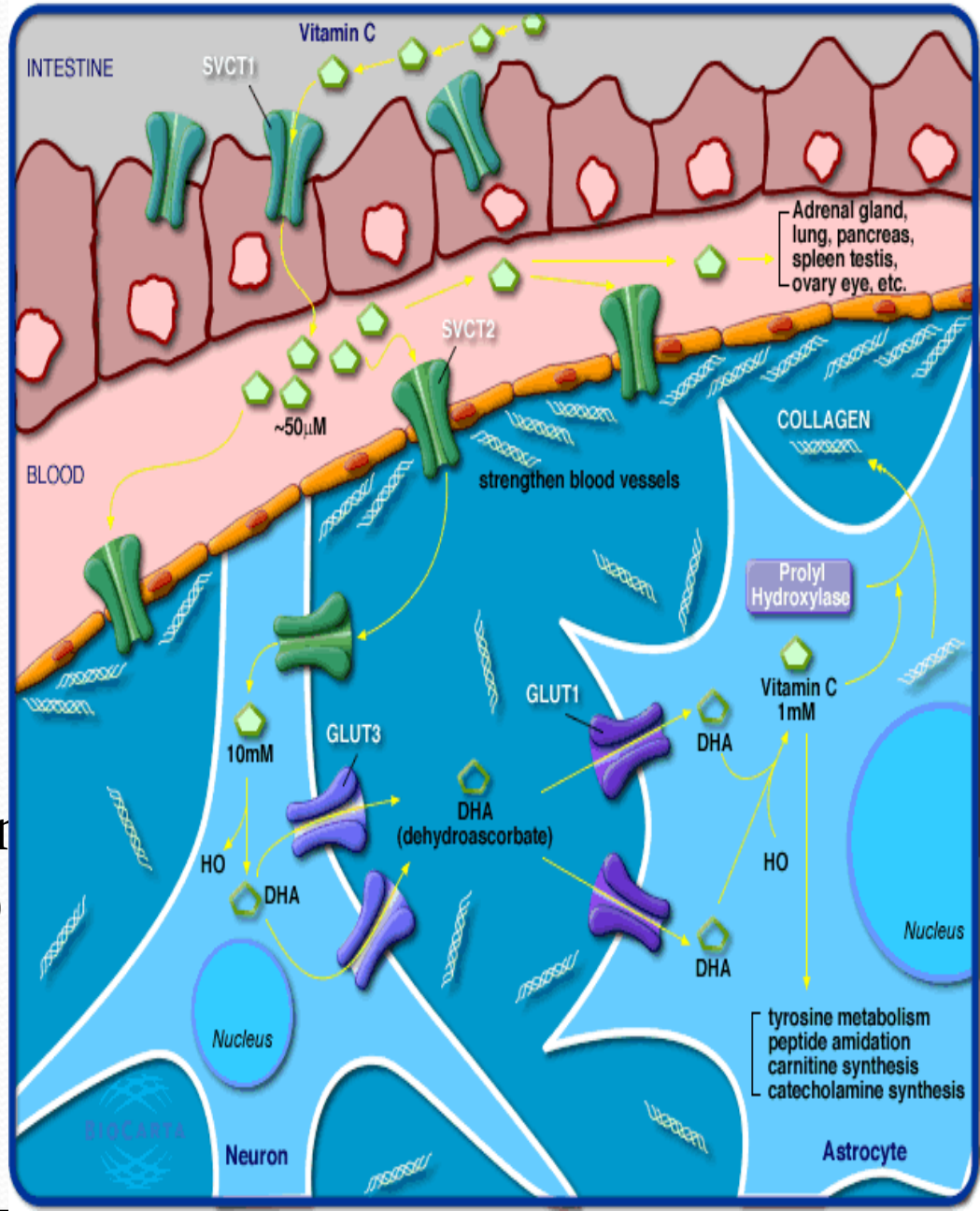


Functions of vitamin C

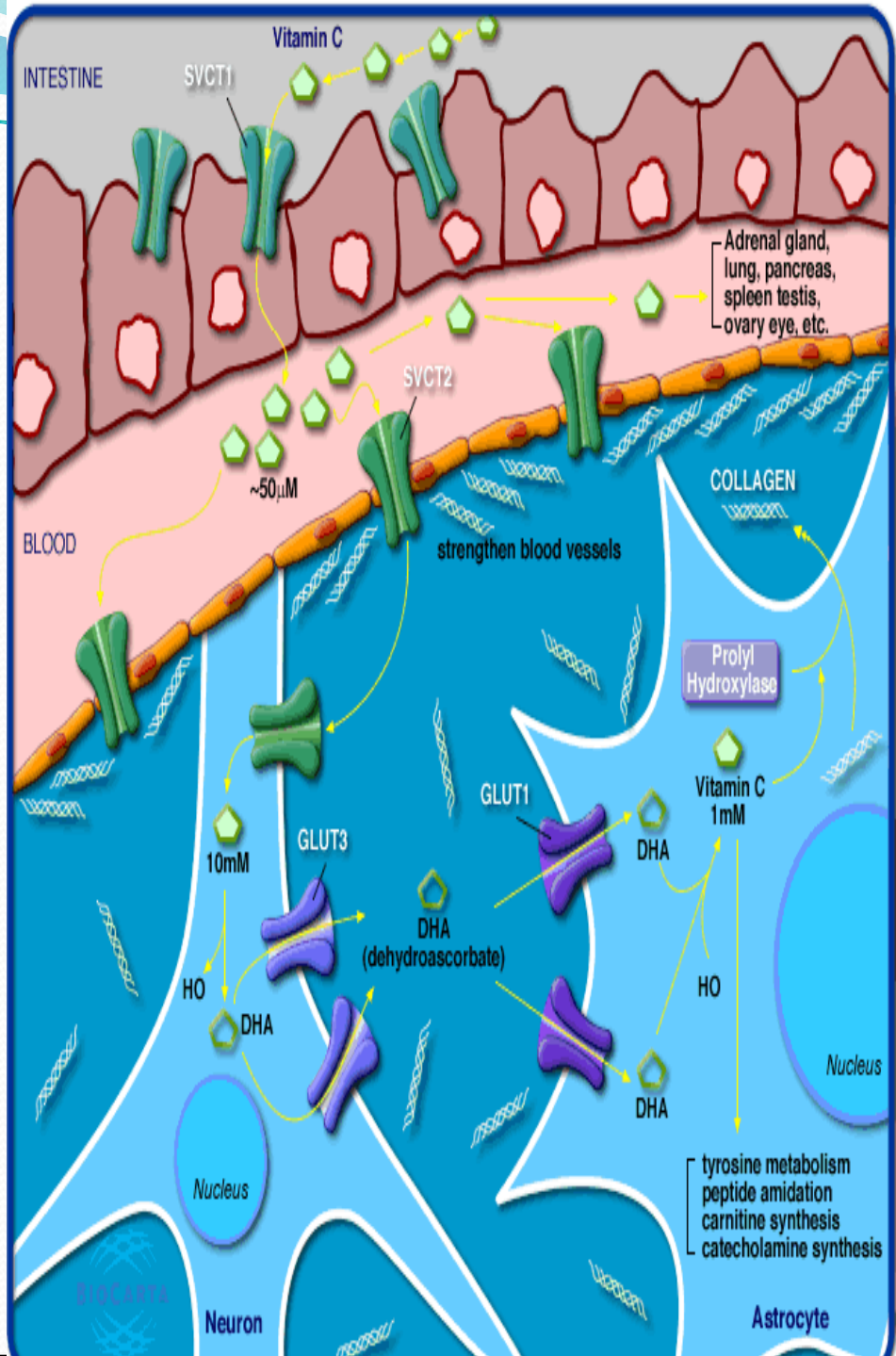


Functions of vitamin C

- Cellular oxidation reduction.
- Collagen synthesis.
- Antioxidant property.
- Involved in the tyrosine metabolism.
- Co factor in hydroxylation of tryptophan to serotonin
- Activate(arginase,papain) and inhibit(urease,β-amylase) enzymes.



- Co factor in synthesis of norepinephrine from dopamine.
- Formation of carnitin in liver.
- Role in stress due to high concentration in adrenal cortex.
- Formation of tetrahydrofolate (active form of folic acid).



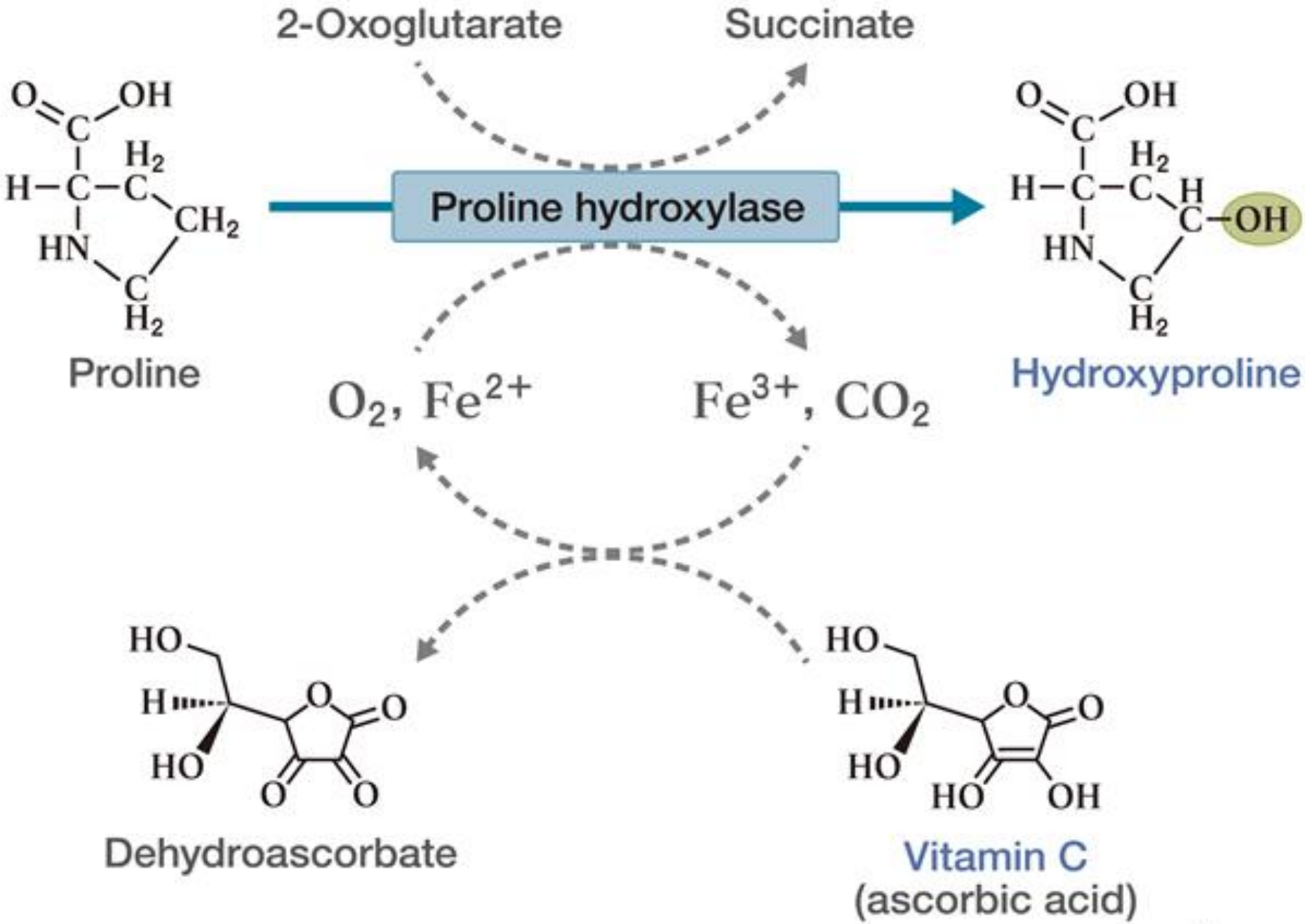
- Synthesis of immunoglobulins and
- increases phagocytic action of leucocytes.

Collagen synthesis

- Act as co enzyme in hydroxylation of proline and lysine catalyzed by prolyl hydroxylase and lysyl hydroxylase respectively.

- Hydroxyproline and hydroxylysine are essential for the collagen cross linking and the strength of fiber.

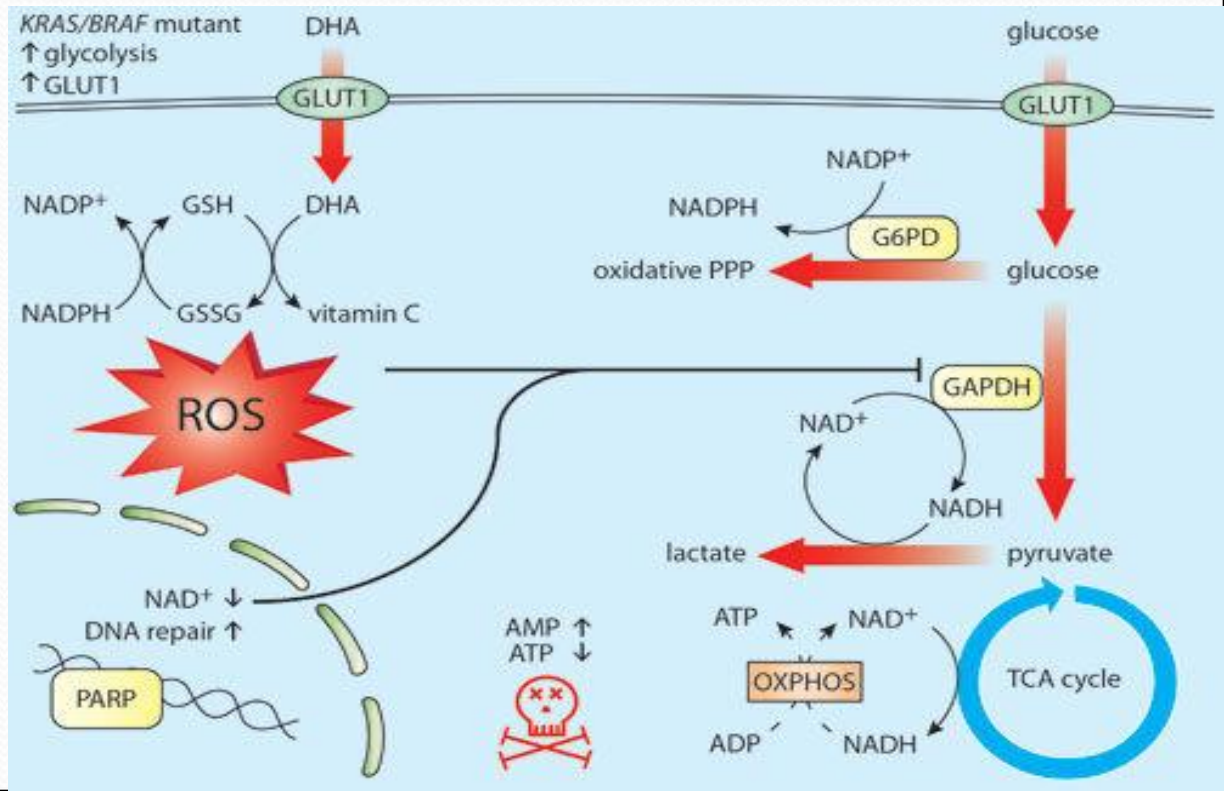
- In this way maintain normal connective tissue and wound healing.


2-Oxoglutarate
Succinate
Proline hydroxylase
Proline
Hydroxyproline
O_2, Fe^{2+}
Fe^{3+}, CO_2
Dehydroascorbate
Vitamin C
(ascorbic acid)

Antioxidant function

- Strong antioxidant, spare vitamin A .vitamin E and some B complex vitamins from oxidation.

- Reduces risk of cancer, catract,and coronary heart disease.

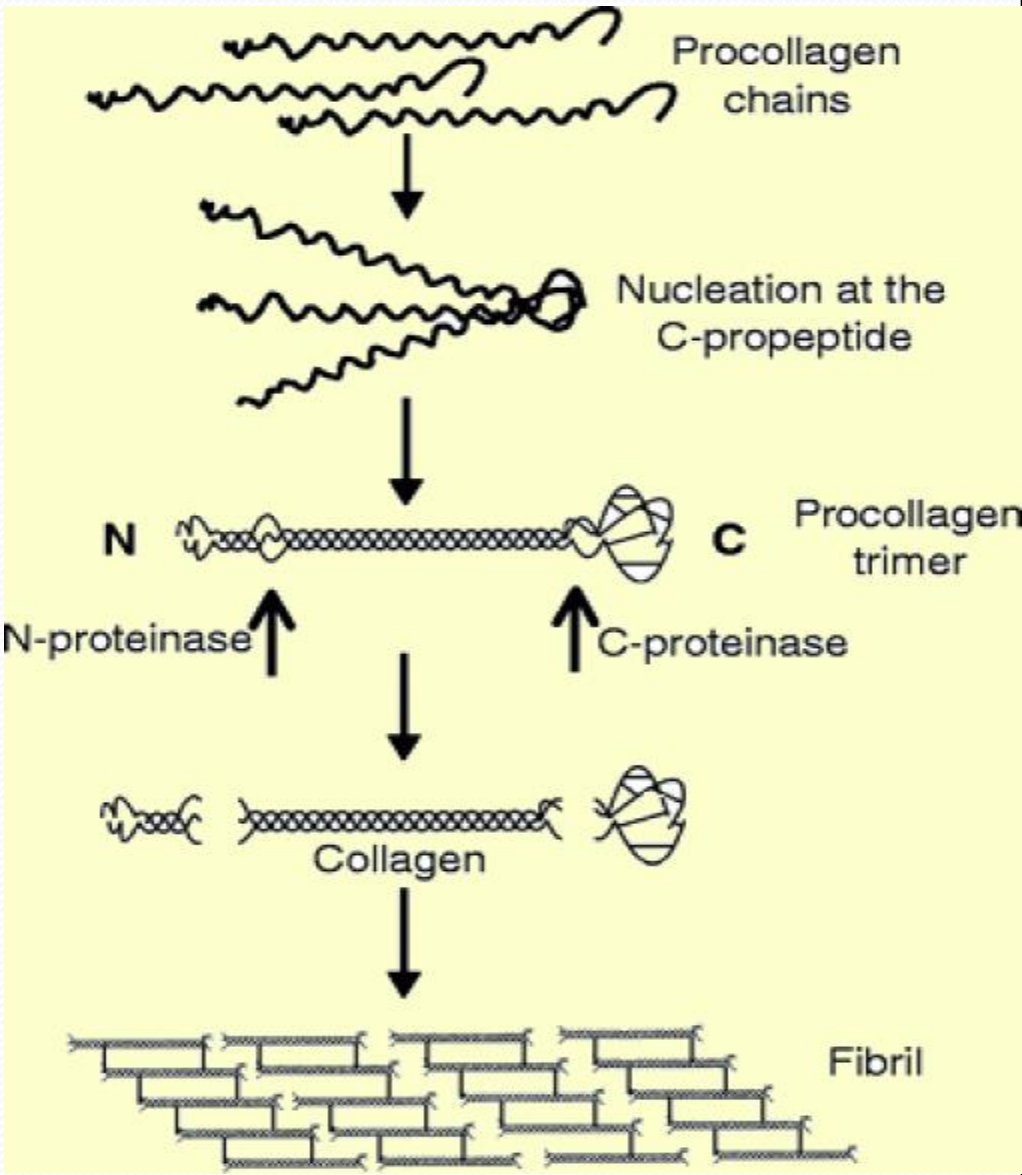


Bone formation

- Require for normal production of osteoid tissue

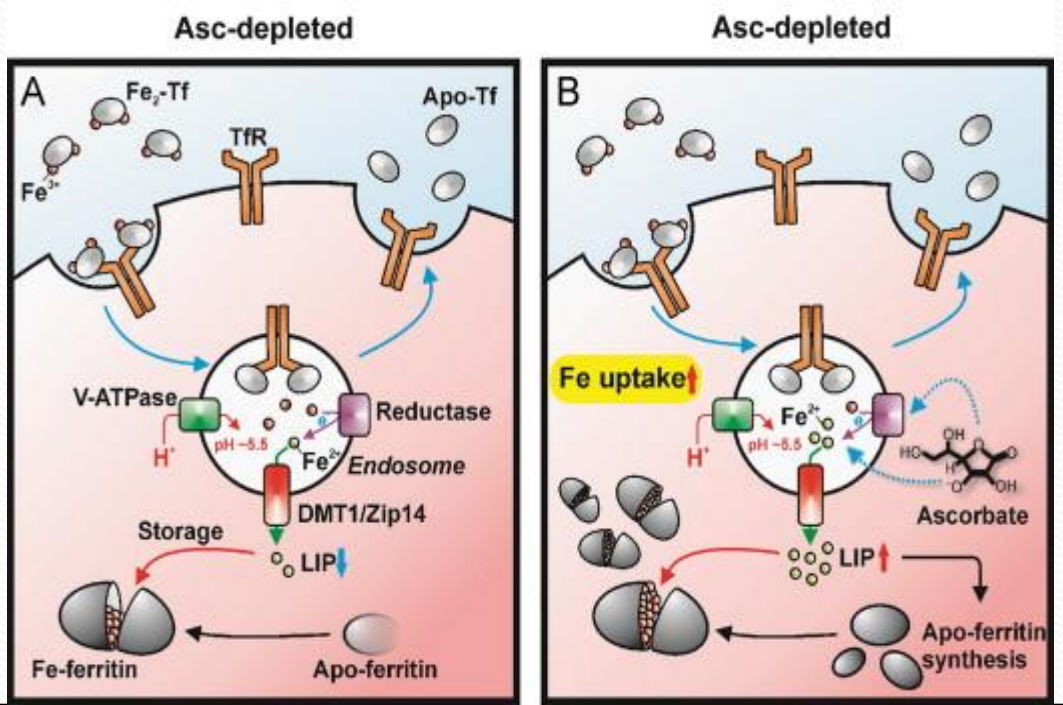
  So

  help in bone formation.



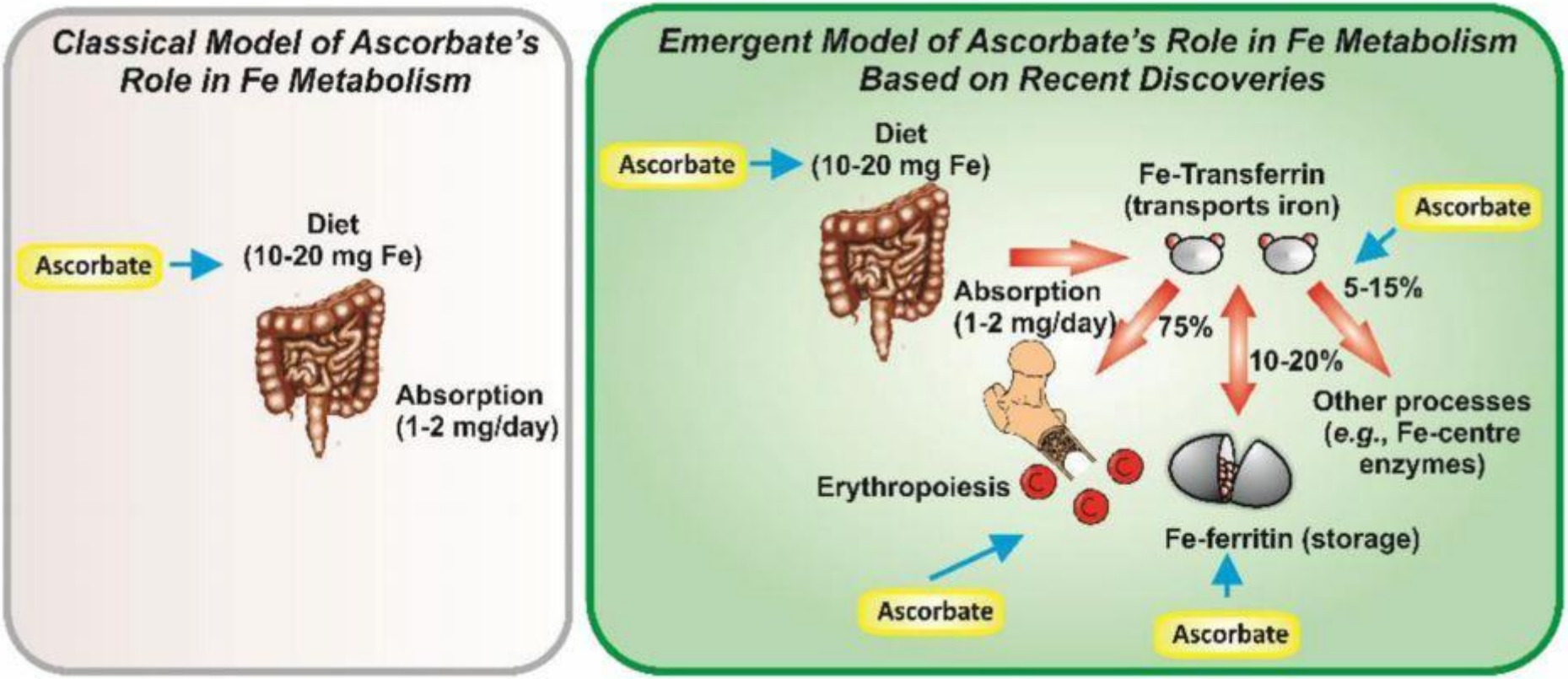
Hemopoietic function

- Enhance iron absorption, keeping it in ferrous form.
- Helps in formation of ferritin and mobilization of iron from ferritin.



Conversion of met hemoglobin to hemoglobin.

Degradation of Hb to bile pigment.

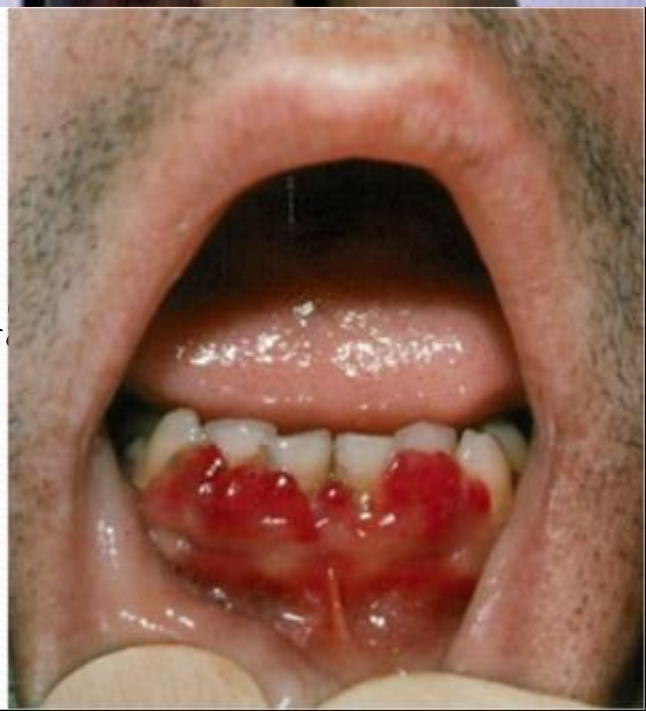


DEFICIENCY

- Scurvy:

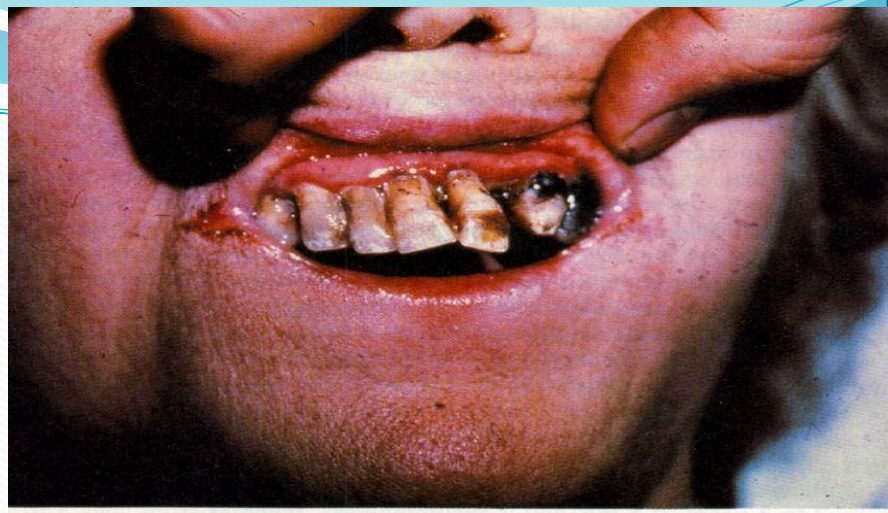
- Main defect is failure to deposit intercellular cement substances.

- Capillaries are fragile.
- Delayed Wound healing.
- Poor dentine formation.
- Swollen gums.
- In severe cases infection and loosenin and falling of teeth.
- Bones become weak.



Scurvy

- Loose teeth



From "Fundamentals of Clinical Nutrition" by R. L. Weinsier copyright 1993 by Mosby-Year Books Inc. N.Y.
Fig. 2-5 Periodontal disease seen in scurvy.

- Red, swollen, spongy and bleeding gum.

- Patecheal hemorrhages

- Hemorrhages

- Subperiosteal bleeding as well as hemorrhage into joint cavities.

- Renal ---Hematuria
- GIT ------ Malena
- Eye .....Retrorbital
- CNS .....Intracranial

Biochemical findings

- Decreased plasma ascorbic acid level, platelet and leucocytes count.
- Impaired vitamin C saturation test.
- Urinary excretion is low after a test dose of vitamin C.

Uses

- **Oral Vitamin C:**

- Preventing and treating scurvy.
- Preventing deficiency in people with gastrointestinal diseases and those on chronic total parenteral nutrition or chronic hemodialysis.
- Increasing iron absorption from the gastrointestinal tract.
- Increasing the healing rate of wounds, burns, fractures, ulcers, and pressure sores.
- Preventing and treating the common cold and other viral infections, bronchitis, human immunodeficiency virus (HIV)

TOXICITY

- **Vitamin C is generally regarded as safe in amounts obtained from foods**
- **side effects are rarely reported including nausea, vomiting, heartburn, abdominal cramps, and headache. Dental erosion may occur from chronically chewing vitamin C tablets.**
- **High doses/toxicity: High doses of vitamin C greater than 1-4g/day.**
- **These include kidney stones, severe diarrhea, nausea, and gastritis. Large doses may precipitate hemolysis in patients with glucose 6-phosphate dehydrogenase deficiency.**
- **Vitamin C is metabolized to oxalic acid. Increased consumption increases the urinary concentration of oxalic acid and increases the risk of oxalate stone formation**

Drugs affect Vitamin C level

- **Aspirin increases elimination of vitamin C. It reduces tissue and leukocyte uptake of vitamin C, leaving more in the plasma to be filtered into the urine.**
- **Diuretics increases urinary losses of vitamin C, due to increased water excretion.**
- **Estrogens can reduce vitamin C absorption or increase its breakdown.**
- **Smokers have lower plasma levels of vitamin C than nonsmokers due to increased use of vitamin C to counteract free radicals in cigarette smoke.**


Thank you for attention!