Water soluble vitamins

Vitamin C

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VITAMIN C

❖It is water-soluble vitamin.

❖Most animals are able to synthesize all vitamin C they need from dietary sugars; but **humans are unable.**

❖Also, animals are able to increase synthesis of vitamin C during stress but **humans' strictly depend on dietary sources, increases risk of deficiency during stress time.**

Natural Source of Vitamin C

Plum

Red pepper

Guava

Kiwifruit

Broccoli

Papaya

Strawberry

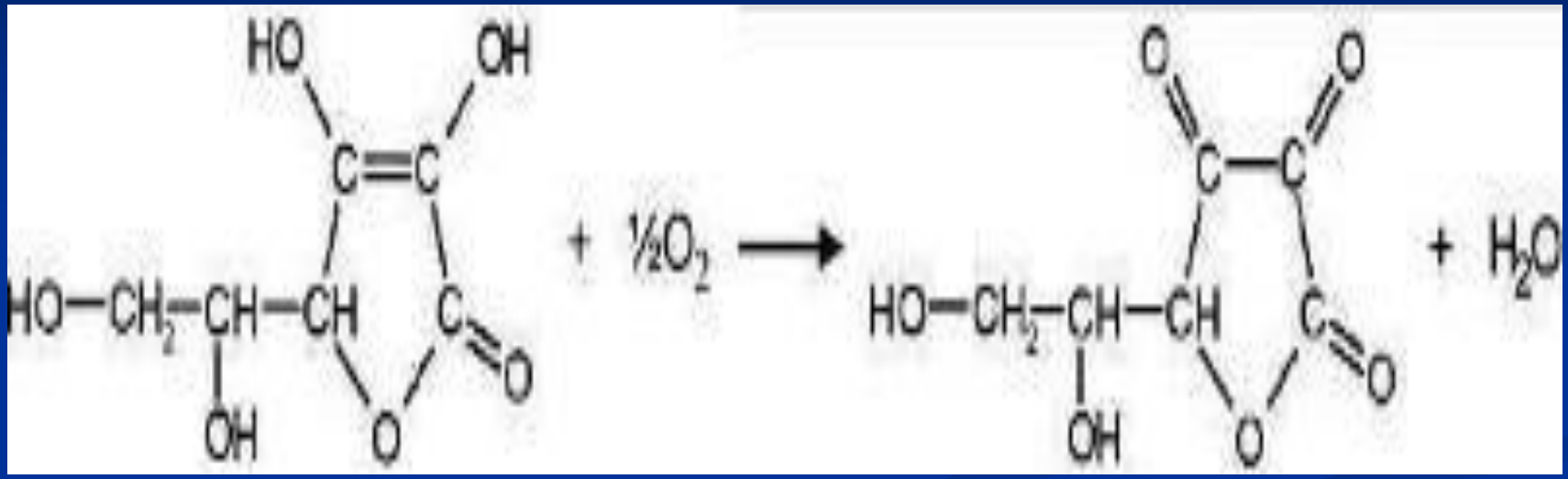
Orange

Lemon

Grapefruit

Mango

Vitamin C



L- Ascorbic Acid (Reduced Form)

L-Dehydroascorbic Acid (Oxidised Form)

Physiologically active forms for vitamin C

RDA: Adults: 60 mg/day
Children: 30 mg/day

Chemistry and Stability of Vitamin C

- It is a weak acid and its salts called ascorbate.
- Unstable in alkaline pH, high temperature, and in the presence of oxygen or metals.
- The D-enantiomer of ascorbic acid shows no biological activity.
- Ascorbic acid is strong reducing agent, serves as an **anti-oxidant** and co-factor in hydroxylation reactions.
- Ascorbic acid is reversibly oxidized to L-dehydroascorbic acid and both L-ascorbic and L-dehydroascorbic acids are physiologically active forms for vitamin C.

Functions of Vitamin C

- Antioxidant function: It helps protect against oxidation by free radicals.
- Helps in detoxification and excretion of drugs :
  It maintains the enzyme systems in liver that detoxify and excrete drugs and toxic pollutants.
- Synthesis of collagen: The major component of connective tissue in skin, joints, muscles, bones ligaments, tendons, and cartilages.
- Involved in **carnitine** synthesis (along with niacin and vitamin B6) which is an amino acid required in breakdown of fats for energy.
- It is a cofactor in the synthesis of neurotransmitters as epinephrine , norepinephrine and serotonin.

- **Important for healthy immune function:** It is essential for optimum activity of WBCs and production of chemical mediators which direct the immune response. Vitamin C seems to increase T-lymphocyte activity, phagocyte function, leukocyte mobility, and possibly antibody and interferon production.
- Involved in cholesterol breakdown and excretion (cholesterol level increase if vitamin C status is impaired).
- Protection of folate and vitamin E from oxidation.
- **Involved in control of histamine levels:** When vitamin C status is poor ⟶ High levels of histamine ⟶ aggravate allergies, asthma, stomach ulcers, and certain psychiatric disorders.

Symptoms of Vitamin C Deficiency

- **Scurvy:** Impaired connective tissue synthesis and fragility of blood vessels causes abnormal bleeding: easy bruising, subcutaneous hemorrhagic spots, inflamed and bleeding gums, joint stiffness and pain (due to bleeding into joints).

- Impaired wound healing.
- Build-up of keratin in hair follicles producing rough "sandpaper skin".

- Weakness, exhaustion, fatigue (due to impaired carnitine synthesis).
- Impaired immunity with increased risk of infection.
- Diminished antioxidant defenses: increase risk of cancer, heart disease, stroke, cataract.

Scurvy was common between Sailors, Pirates and others who were on ships for months without eating fresh fruits and vegetables.

People at High Risk of Vitamin C Deficiency

1. **Increased physical stress** (e.g. infection, fever, burns, surgery, trauma to soft tissues or bones, and chronic illnesses such as hyperthyroidism, diabetes, rheumatoid arthritis, alcoholism, and kidney failure).
2. **Chronic use of drugs** such as aspirin and oral contraceptives impair vitamin C status.
3. **Older people, particularly** those with chronic illness, and aging.
4. **Periods of rapid growth–**childhood, adolescence, pregnancy, and lactation.
5. **Regular cigarette smoking** sharply increases breakdown and excretion of vitamin C.

Uses of Vitamin C in Prevention and Therapy

- **Enhance ability to fight infection:** Vitamin C stimulates the activity and ability of WBCs to destroy bacteria and viruses.

- **Treatment of cold and flu:** At doses of 1-2 g, it slightly increases body temp. → ↑ functions of WBCs and ↓ blood histamine → ↑ immune response and ↓ nasal and bronchial congestion → ↓ duration and symptoms of Cold and Flu.

- **Helps reduce risk of cancer:** particularly cancers of GIT, bladder, breast, pancreas, and uterus (antioxidant + enhancer for immune defenses against cancer and + helps detoxify carcinogenic food additives e.g. nitrates, pesticides, and other chemicals and heavy metals).

- **Large doses ↓ platelet aggregation** → reduce risk of blood clots. In addition, vitamin C ↑ the strength of blood vessel walls. By these mechanisms, vitamin C can protect from coronary heart disease, thrombotic stroke, and peripheral vascular disease.

- **Protection from heavy metals**: It ↓ absorption and ↑ detoxification and ↑ excretion of heavy metals.

- **Improves healing of wounds and fractures** in burns, trauma, and surgery.

- **Iron deficiency** (by iron absorption from meals).

- **Preventing and curing Scurvy**.

Recommended Therapeutic Doses

- For scurvy, 100-250 mg once or twice daily.
- For treating the common cold, 1-3 g daily.
- During acute stress, 1 g (3 times daily)
- For preventing sunburn, 2 g of vitamin C and 1000 IU vitamin E has been used.

Toxicity and Side Effects of Vitamin C

- **Vitamin C is generally** regarded as safe in usual doses (up to 1000 mg). Dental erosion may occur from chronically chewing vitamin C tablets.
- **High doses of vitamin C** more than 2000 mg/day may induce 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.

Vitamin C- Drug Interaction

- Vitamin C ↑ chromium and aluminium absorption. Patients with renal failure who take (Al) compounds should avoid vitamin C in doses above the RDA.

- Vitamin C can destroy dietary vitamin B12 (so, it must be taken at least 2 hours after meals).

- Acidification of the urine by vitamin C could increase re-absorption of salicylates by the renal tubules, and increase plasma salicylate levels .

- High doses of vitamin C can ↓ the response to warfarin, possibly by causing diarrhea and reducing Warfarin absorption

- Aspirin increases elimination of vitamin C. It reduces tissue and leukocyte uptake of vitamin C, leaving more in the plasma to be excreted into the urine.

- Estrogens can ↓ vitamin C absorption or ↑ its breakdown.

THANX