

In the name of God



Selenium (Se)

Presented by:

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Introduction to Se

- Essential element for human
- There is in many selenoproteins
- Closely associated with vitamin E in it's function

Chemistry

- Non metal
- Several chemical forms
- Ingested selenium compounds:
selenate, selenite, selenocysteine and
selenomethionine

Dietary sources

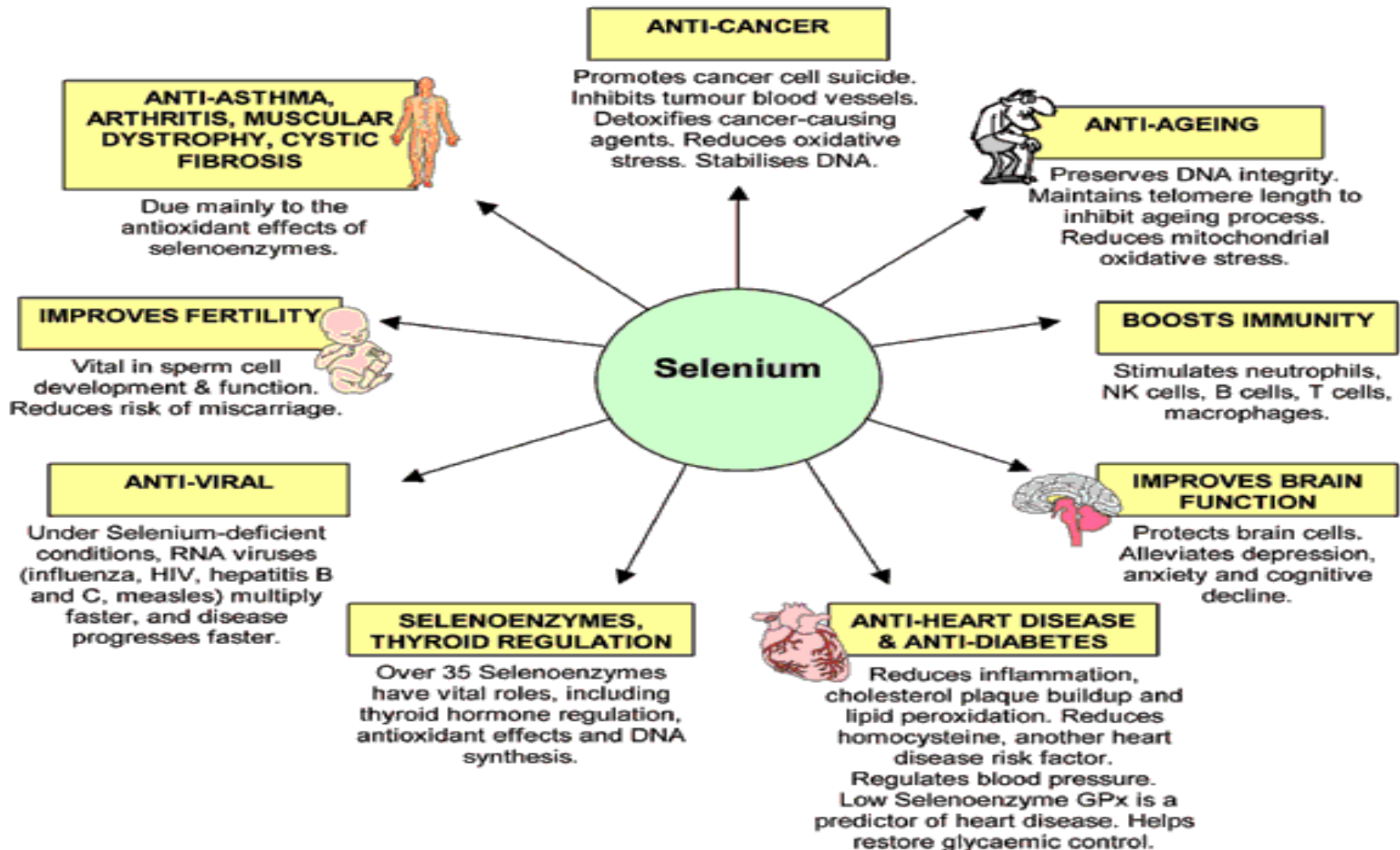
- mainly as selenomethionine from plants
- wheat and other cereal products are a good source

Absorption, Transport, Metabolism and Excretion

- Absorption is not regulated
- Accumulate in liver, kidney and lungs
- Much of them rapidly excreted in urine

Function of Se

The Health Benefits of Selenium.



Function of Se

- More than 30 biological activity
- **Glutathione peroxidase (GSHPx):** has 4 isoforms (GSHPx-1 in RBC, GSHPx-2 in gastrointestinal mucosa, GSHPx-3 in blood plasma and GSHPx-4 in cell membrane)
- **Iodothyronine deiodinase:** has 3 isoforms and convert T4 to T3.(type I in liver, kidney and muscle and Type II, III in brain, brown adipose tissue)

Function of Se

- **Thioredoxin reductase**: has 3 isoforms (NADPH dependent)
- **Selenophosphat synthetase** (used of selenophosphat as a intermediate)
- **Selenoprotein P**: major selenoprotein in plasma, element transporter and an antioxidant
- **Selenoprotein W**: is in skeletal muscles
- Plays a role as a glutathione (GSH)-dependent antioxidant
- Its concentration decreases during selenium deficiency

Se and Pancreas

- There is evidence that patients with **chronic pancreatitis** have **enhanced** levels of **free radical** production, cytochrome P450 induction and **antioxidant deficiencies**, in particular **selenium**.
- Adequate concentrations of selenium play a key role in the **secretion** and **action** of insulin
- Two **selenoproteins** (glutathione peroxidase and selenoprotein P) are known to be involved in the **insulin signaling** pathway.

Requirements and reference nutrient intakes for Se

- Daily need is 55 μ g for adult
- Intravenous supply: less than 40 μ g/day

Se deficiency

- liver necrosis
- White muscle disease in animals
- Myopathy of cardiac
- Skeletal muscle
- Increased oxidative stress

Sever deficiency

- **Keshan disease (KD)** : low soil selenium
- Keshan disease as an endemic, highly lethal congestive **cardiomyopathy**.
- Caused by a combination of **dietary deficiency of selenium** and the presence of a mutated strain of **Coxsackievirus B**.
- Lack of selenium results in a more **virulent strain** of the coxsackievirus becoming the **dominant** viral species.
- But the **mechanism** of this selection event is **unclear**

Sever deficiency

- **Kashin disease (KBD)** : sever arthritis because low soil selenium
- The highest **incidence** rate of KBD in **China**, Southeast **Siberia** and **North Korea**.
- is a chronic, endemic type of osteochondropathy (disease of the bone)
- KBD is **multifactorial**, **selenium deficiency** being the underlying factor that **predisposes** the target cells (chondrocytes) to **oxidative stress** from free-radical carriers
- **Nutritional depletion** in hospital patient (patients accept no trace element supplementation)
- **Symptoms**: muscle weakness, cardiomyopathy, macrocytosis and pseudoalbinism

Kashin-Beck disease



Se deficiency

- Reproductive disorders:
- Necessary for Male fertility,
- Testosterone synthesis
- Sperm viability.

Important roles of Se

- Thyroid function:
- Thyroid deiodinase enzymes are selenoprotein

Important roles of Se

- Immune function:
- Se is important for immunocompetence, defense against AIDS

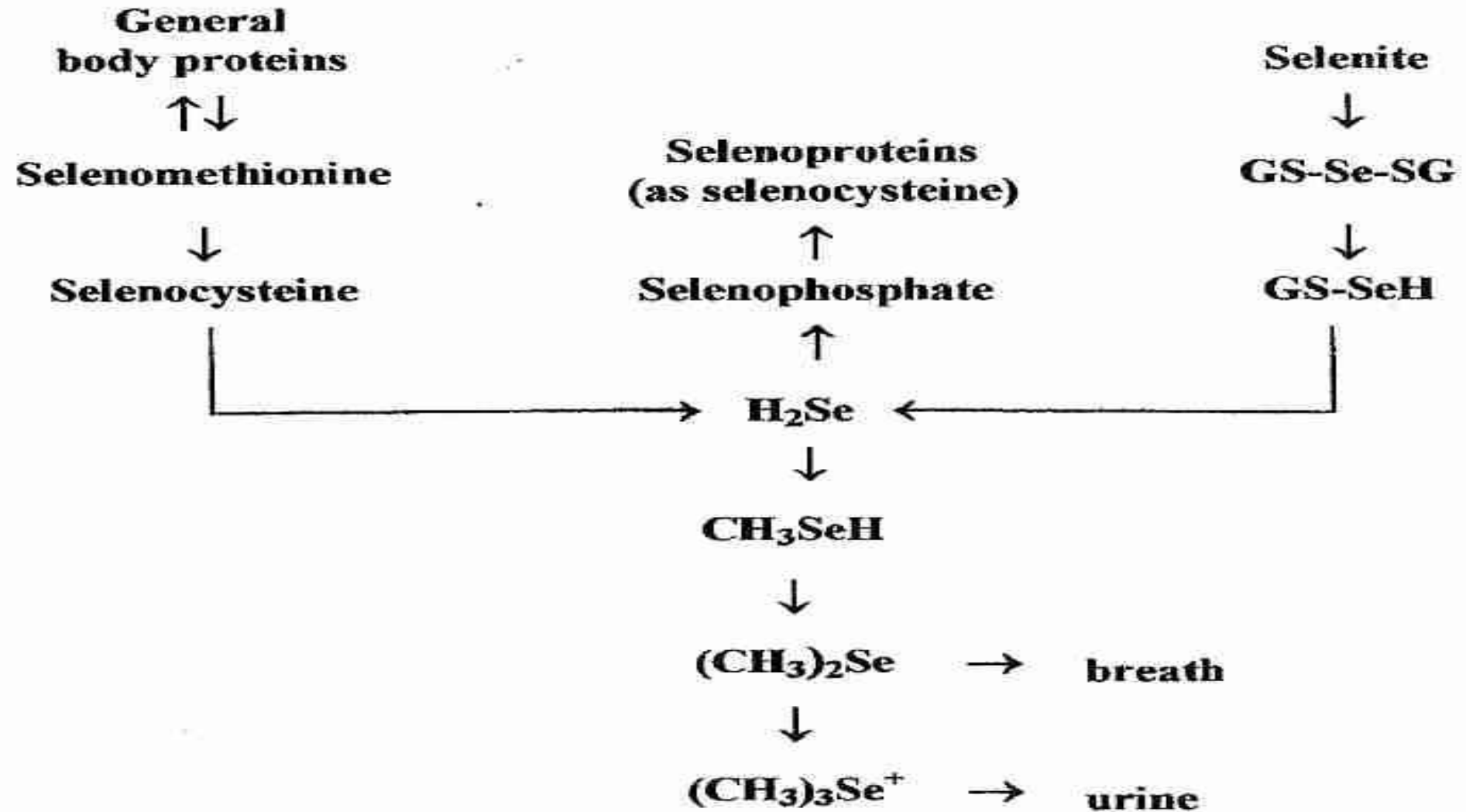
Important roles of Se

- **Inflammatory condition:**
- It's supplementation has positive effect in arthritis, pancreatities and asthma
- **Cardiovascular disease**
- **Viral virulance** (virulent strain of the coxsakie virus)
- **Cancer chemoprevention:**
- Such as liver cancer with hepatitis B, prostate cancer

Toxicity of Se

- Upper selenium called selenosis
- **characteristics:**
- Garlic odor in the breath (by dimethyl selenide), hair loss, nail damage, diarrhea
- **Note:**
- Halogenated aromatic hydrocarbons is useful in cure (caused faster methylation of selenid)

Metabolism of Se



Laboratory assessment of status

- **Whole blood** as a main indicator of selenium status
- Determined after **acid digestion** using a fluorometric method, atomic absorption spectroscopy.
- Red cell GSHPx-1 and plasma GSHPx-3 are assayed by **enzymatic methods**
- **Selenoprotein P** in plasma determined by immunological methods or monoclonal antibodies by affinity chromatography
- **Hair and nail selenium** are useful as a measure of long-term dietary selenium intake

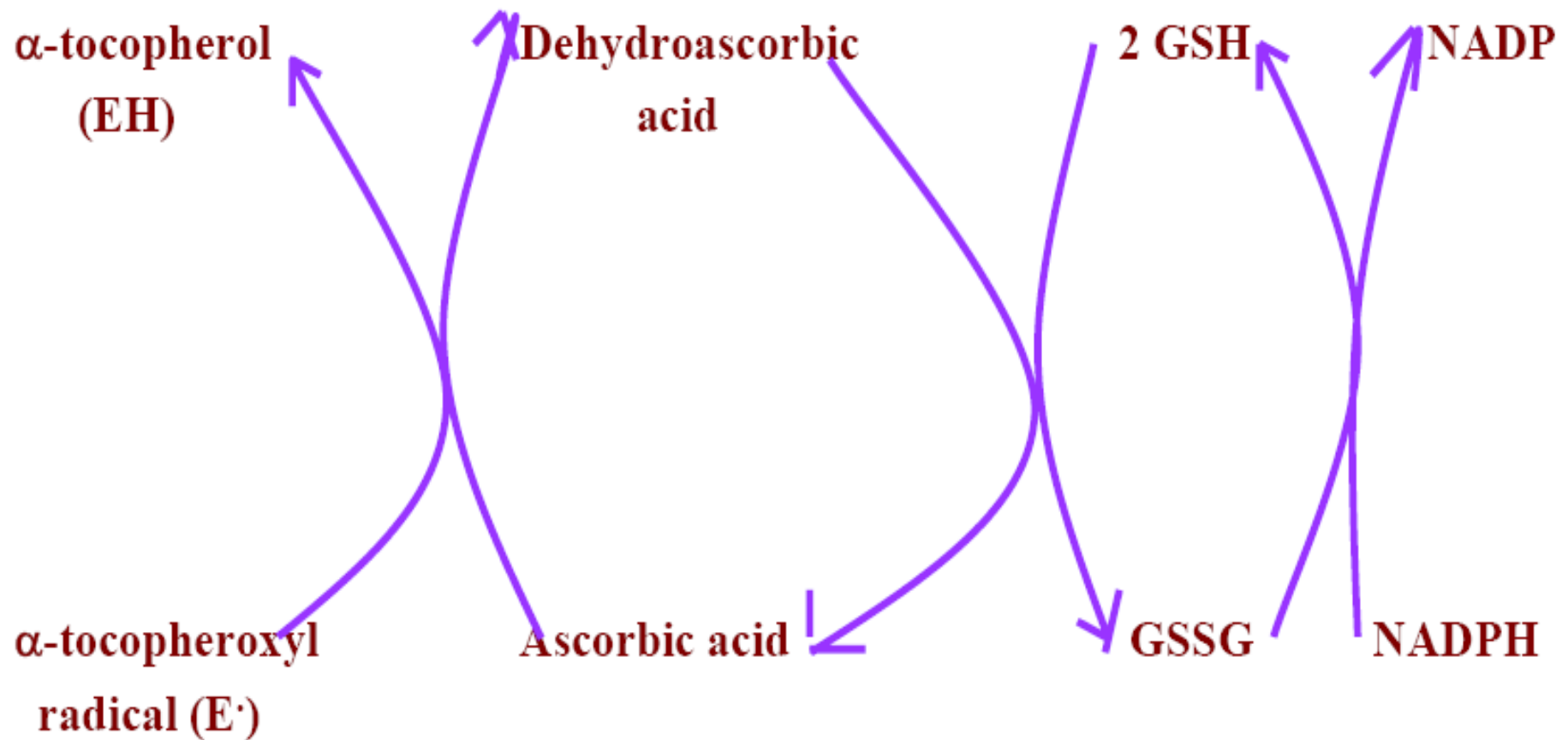
Reference intervals

- **Note:** all reference intervals for selenium should be established locally because these are affected by dietary intake
- Plasma: 63 – 160 $\mu\text{g/L}$ (0.8 – 2 $\mu\text{mol/L}$)
- Children <2 years: 16 – 71 $\mu\text{g/L}$ (0.2 – 0.9 $\mu\text{mol/L}$)
- Children 2 – 4 years: 40 – 103 $\mu\text{g/L}$ (0.5 – 1.3 $\mu\text{mol/L}$)
- Children 4 – 16 years: 55 – 134 $\mu\text{g/L}$ (0.7 – 1.7 $\mu\text{mol/L}$)
- Cu-off values are 8 $\mu\text{g/L}$ (0.1 $\mu\text{mol/L}$)

vitamin E & Selenium

- They have a synergically effect
- Se is necessary for pancreas action that is important for lipid and vitamin E absorptin
- Vitamin E decreased needs to Se because inhibit excretion of Se and cause stability of active form of Se

The Regeneration of Vitamin E



- The enzyme glutathione peroxidase which is involved with glutathione oxidation ($2 \text{ GSH} \longrightarrow \text{GSSG}$) is a selenium containing enzyme, which explains the interrelationship between α-tocopherol and Se.

The End