

## THE DEFICIENCY AND EXCESS STATES OF ESSENTIAL TRACE ELEMENTS

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# ESSENTIAL TRACE ELEMENTS

- Zinc (Zn), copper (Cu), selenium (Se), chromium (Cr), cobalt (Co), iodine (I), manganese (Mn), and molybdenum (Mo) are essential trace elements for the human body.
- Even though these chemicals make up only 0.02% of the overall weight of the body, they play important roles as the active centers of enzymes
- Reduced activity of the relevant enzymes is one of the main effects of trace element deficits.
- There have also been reports of excessive trace element use as medicine, which can occasionally result in toxicity.



# 1A Elements found in the human body

1A	Elements found in the human body																8A
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg	3B	4B	5B	6B	7B	8B 8 9 10			1B	2B	Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn

The most abundant elements in the body (**red**), lesser elements (**blue**), and trace elements (**green**). Source: Dept. of Chemistry, University of Florida.



# IRON



# IRON

- Iron plays an indispensable role in delivering oxygen to the body through the bloodstream. It's also involved in several metabolic and muscular functions.
- An average daily requirement is 1-2 mg

## *Deficiency:*

- Anemia, Weakness, pale skin, susceptibility to fatigue, palpitations, headache, dizziness, and shortness of breath.

## *Excess:*

- Hemochromatosis Iron and poisoning

## *Sources:*

- Meat, poultry, beans, peas, dark green leafy vegetables, whole-grain products, and **seafood**.



ZINC



# Zinc

- Is needed for optimal growth, development, and sexual maturation. It has antioxidant properties and is vital for smell and taste sensation. It also keeps your stress levels down, boosts your immune system, and aids to regulate appetite.
- The average daily requirement is 15-20 mg/day.

## ***Deficiency:***

Loss of appetite, signs of poorly functioning immune system, impaired growth and development, poor wound healing.

## ***Excess:***

Zinc fume fever, zinc poisoning

## ***Sources:***

meat, poultry, fish, milk, wheat germ, oysters, whole-grain products, and fortified cereals.



# IODINE



## Iodine

- Is required in the production of thyroid hormones. Thyroid hormones aid in regulating your growth, development, and metabolism.

- An average daily requirement is 0.2-30mg

### *Deficiency:*

- Iodine deficiency disorders (goiter, cretinism); Pendred's syndrome

### *Excess:*

rapid heart rate, trembling, excessive sweating, lack of sleep, weight loss

### *Sources:*

Seafood, seaweeds, iodised salt, dairy products, and bread.



# SELENIUM



# Selenium

- Is essential in the production of selenoproteins that serve important roles in DNA synthesis, immune system, and reproduction.
- Recommended intake for adults 50-200 µg/day

## ***Deficiency:***

- Associated with Keshan disease (cardiomyopathy) and Kashin-Beck disease (osteoarthropathy); impaired immune function

## ***Excess:***

Selenosis (selenium toxicity) , brittle hair and nails, skin lesions

## ***Sources:***

Brazil nuts, organ meats, seafood especially tuna and halibut, cereals and other grains, and dairy products



# COPPER



# COPPER

- Is part of numerous enzymes (cofactor) and is also essential in iron metabolism.
- The daily requirement is about 2-5 mg of which 50% is absorbed from the gastrointestinal tract (GIT).

## ***Deficiency:***

- Menkes disease, hair with less pigment than normal, paleness, and brittle bones.

## ***Excess:***

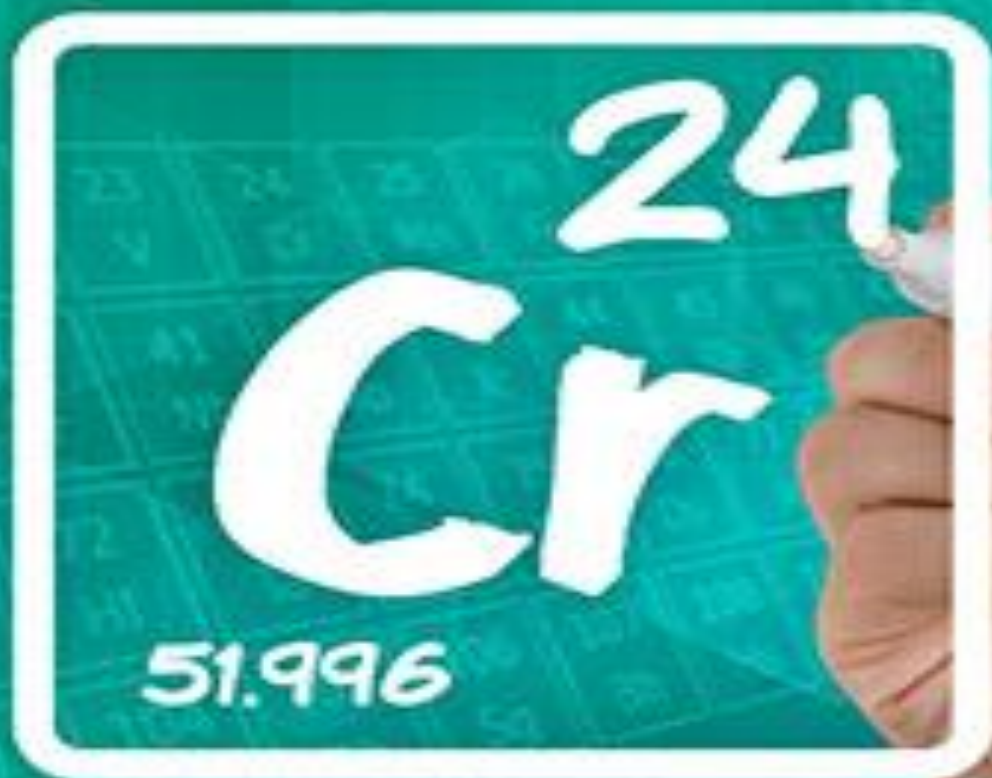
Wilson disease, Copper fume fever, copper poisoning

## ***Sources:***

Nuts and seeds, legumes, whole grains, drinking water, and organ meats.



# CHROMIUM



# Chromium

- Is one of insulin's closest friends and works with it to regulate your blood glucose levels (increase insulin sensitivity).
- The daily requirement is about 0.005 mg/day

## ***Deficiency:***

- Deficiency of chromium is very rare and is most commonly seen among diabetics.

## ***Excess:***

- Chromium poisoning, lung cancer

## ***Sources:***

Broccoli, grape juice, whole grains, nuts, cheese, beef, and poultry



# MANGANESE

25  
**Mn**  
54.938

# MANGANESE

- **Manganese** is needed by several enzyme systems in your body to function (cofactor).
- Daily requirement is about 2-5 mg/day.

## ***Deficiency:***

Manganese deficiency is very rare, and the signs and symptoms of its deficiency haven't been clearly identified

## ***Excess:***

Parkinsonian syndrome

## ***Sources:***

Seafood, especially mussels, and oysters, whole grains like brown rice, and nuts like hazelnuts



# MOLYBDENUM



# MOLYBDENUM

- **Molybdenum** is a cofactor of at least three enzymes. It's primarily involved in eliminating toxins secondary to the metabolism of sulphur containing amino acids.
- the daily requirement of 0.0001 mg/day

## *Deficiency:*

Molybdenum deficiency is extremely rare and is mostly seen among people with certain types of genetic disorders. Visual and neurological problems are possible signs of molybdenum deficiency.

## *Excess:*

Gout, molybdenum poisoning

## *Sources:*

Bread and grains, green leafy vegetables, milk, **legumes**, organ meats such as liver.



# TECHNIQUES TO DETECT TRACE ELEMENTS

Most of the trace elements are estimated with a help of colorimetric and spectrographic methods of analysis

Atomic absorption spectrometry-based on flames arcs and sparks (flame by electrothermal):

- Emission spectroscopic methods.
- Neutron activation analysis.
- Electrochemical methods.
- Isotope dilution mass spectrometry.
- Atomic X-ray fluorescence spectroscopy.

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# DIAGNOSIS OF TRACE ELEMENT DEFICIENCY

Trace element deficiency is one of the most difficult conditions to diagnose. Few valid methods are available (due to the wide overlap between the normal state and the deficiency state).

➤ Methods currently used

1) Measurement of trace element concentrations in samples:

serum, erythrocytes, leukocytes, lymphocytes, hair (for many elements); urine (for iodine)

2) Measurement of the activity of enzymes containing trace elements in their core:

alkaline phosphatase (zinc), ceruloplasmin (copper), thyroid hormone (iodine), glutathione peroxidase (selenium), etc.



THANK YOU

