

STUDY MATERIAL:- M.Sc 2nd semester

DEPARTMENT:- Home Science (CCSU, CAMPUS, MEERUT)

COURSE:- Food & Nutrition

SUBJECT:- Advanced Nutrition

NAME OF THE FACULTY:- Dr. Nidhi Chaudhary

UNIT:- 5

Topic:- Minerals (Calcium, Sodium, Chloride, Iron)

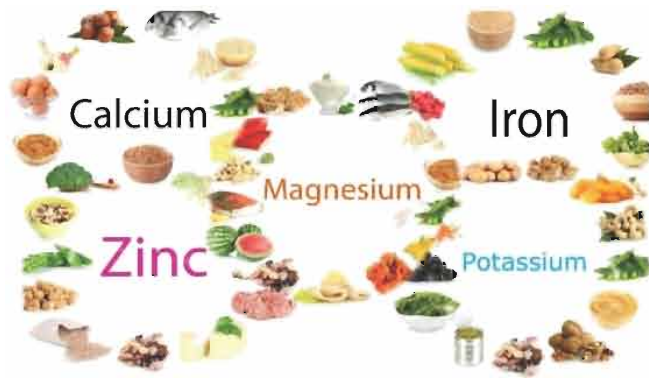
(Introduction, Sources, Absorption, Metabolism, Functions, Deficiency) Deficiency

MINERALS:-

* INTRODUCTION:-



- The minerals form only a small portion of the total body weight. They form only 7% of the composition of the human body.
- Many of these minerals are widely distributed in foods so that a well balanced diet will supply them in sufficient quantities.
- The mineral element present may be classified into 2 groups=
 - > Principle Elements (Macronutrients).
 - > Trace Elements (Micronutrients).
- These are small, naturally occurring, inorganic chemicalchemical elements.



* CLASSIFICATION:-



• Principle Elements (Macronutrients) :-

- > These elements occur in living tissues in comparatively large amounts.
- > They constitute 60-80% of all the inorganic material in the body.

• Trace Elements (Micronutrients) :-

- > These elements occur in living tissue in small amounts.
- > They are required in amount greater than 100mg/day.

MACRO MINERALS:-

Calcium
Phosphorus
Magnesium
Potassium

TRACE MINERALS:-

Copper
Manganese
Zinc
Selenium

Sulphur

Cobalt

Sodium

Iodine

Chloride

* FUNCTIONS OF MINERALS:-

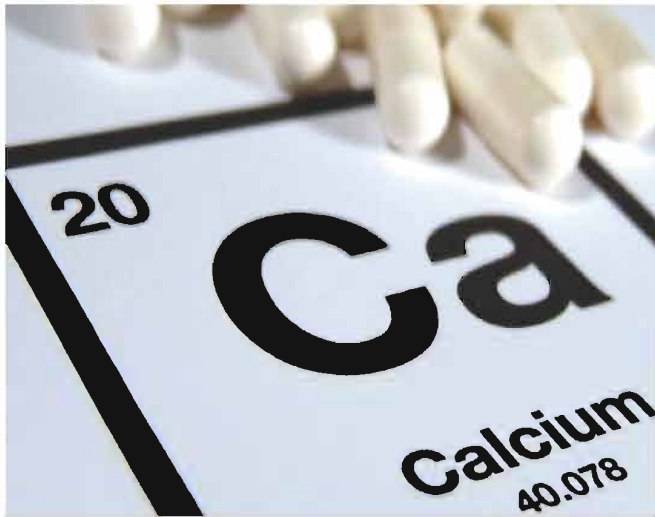
- For good bone health, eg., calcium, phosphorus & magnesium.
- As a constituent of body cells of soft tissues such as muscles, liver, etc., phosphorus.
- As soluble salts.
- Act as antioxidants.

Functions of Minerals

- ✧ Formation of bones and teeth — **Ca**
- ✧ **Mg** — Cofactors for metabolic enzymes
- ✧ Transportation of Oxygen — **Fe**
- ✧ **K** — Regulate heart beat, membrane potential
- ✧ Boost body immunity and heal wounds — **Zn**
- ✧ **Cl** — Produce hydrochloric-acid in stomach
- ✧ Produce thyroid hormones — **I**
- ✧ **P** — Synthesis of DNA and bones
- ✧ Regulate body fluids, maintain pH balance — **Na**
- ✧ **Cu** — Metabolism of Iron and enzymes
- ✧ Functioning of antioxidant enzymes — **Se**

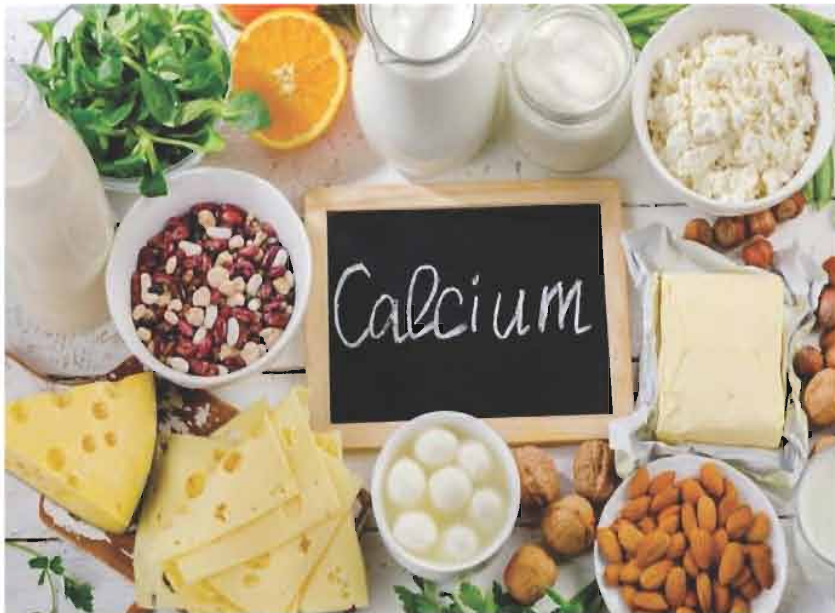
- Maintain fluid balance.
- Helps in activity of various enzymes.
- Helps in energy metabolism.

CALCIUM:-



- The name calcium is derived from the latin word "Calx" which means "Chalk".
- It occurs in highest amount in our body.
- It accounts for 1.5-2% of our total weight.
- Adequate calcium intake over one's life time is essential for healthy bones & teeth that will remain strong in old age.

* DIETARY SOURCES:-



- It is present in both animal & plant food.
- The richest source of calcium in animal food is milk & among the vegetable sources is green

leafy vegetables.

- Food fortified with calcium are also available.
- Meat & cereal grain are poor sources of calcium.
- The major sources of calcium are milk & milk products.



| Foods that contain calcium | | | | | |
|----------------------------|-------------|------------------|---------------|------------|------------------|
| Broccoli | Onion | Asparagus | Pumpkin Seeds | Cabbage | Sapote |
| Coconut Meat | Green Beans | Brazil Nuts | Bok Choy | Kohlrabi | Kale |
| Turnip Greens | Mulberry | Brussels Sprouts | Avocado | Okra | Celery |
| Sesame Seeds | Fennel | Butternut Squash | Collards | Gooseberry | Dandelion Greens |
| Swiss Chard | Almonds | Leeks | Prickly Pear | Artichokes | Spinach |

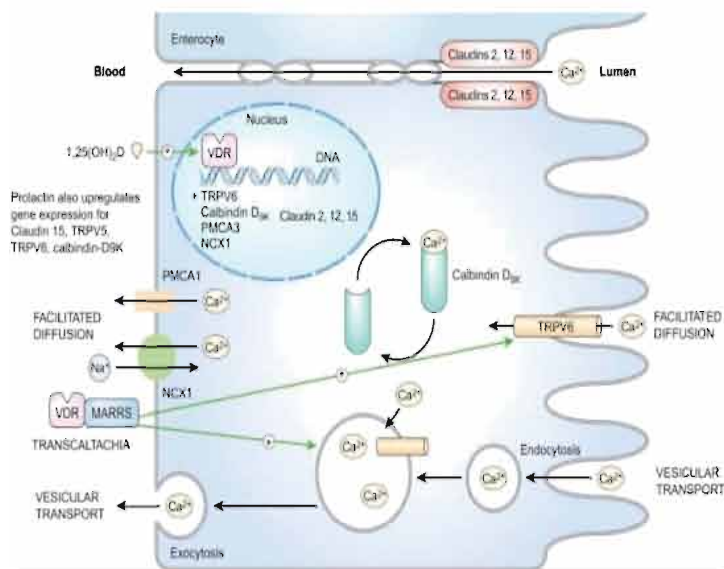
* FUNCTIONS:-

- Bone & teeth formation & maintenance= Calcium in conjunction of phosphorus, is an important constituent in bone formation during growth & maintenance.
- Growth= Calcium is necessary for normal growth.
- Catalyst for biological reaction= It plays an important role in action of many enzymes involved in metabolic process & hormone secretion.
- Maintenance & functioning of cell membrane= It occurs in cell membrane closely bound to the phospholipid lecithin.



- Regulation of muscular contraction & transmission of nerve impulses= Calcium acts to stimulate muscle contraction & to facilitate the transmission of nerve impulses.
- Calcium posses ability to be a kind of coordinator among inorganic elements= If excessive amount of potassium, magnesium are present in the body, calcium is capable of assuming a corrective role.
- Blood clotting= Calcium plays a very important role in mechanism of blood clotting.

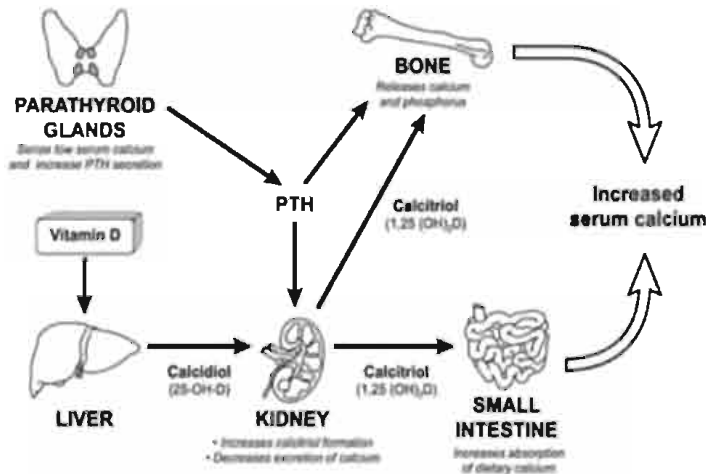
* ABSORPTION:-



- The absorption of calcium in human adults is very low varying from 30-50% of maximum absorption under optimal condition & greatest needs.
- Calcium is absorbed by two distinct mechanism passive diffusion & active transport.
- Calcium absorption is highly regulated phenomena influenced by para thyroid hormone.
- Factors favoring absorption=
 - > Vitamin D.
 - > Lactose.
 - > Protein & Phosphorus.
 - > Acidity of the digestive mass.
- Factors depressing absorption=
 - > Oxalic acid.

- > Phytic acid.
- > Emotional instability.
- > Lack of exercise.

* METABOLISM:-



- Once calcium has been absorbed, it is transported in the blood & release into the fluids bathing the tissues of the body.
- Most of the calcium present is in the bound form.
- As blood is filtered through the kidneys about 99% is excreted in urine.
- Some calcium is secreted within the digestive secretions of the stomach & intestine.
- Much of the calcium is reabsorbed.
- Most of the calcium absorbed by the body is used in the calcification of bones, a process that is facilitated by Vitamin D.

* CALCIUM DEFICIENCY:-

- Osteomalacia.
- Osteoporosis.
- Hypocalcemia.
- Hypercalcemia.

Calcium Deficiency

A CONDITION IN WHICH CALCIUM IS INSUFFICIENT OR IS NOT UTILIZED

Signs and Symptoms

99% of calcium are stored in the bones and teeth

1% circulates in the bloodstream

- mental confusion
- porous bones
- muscle cramps
- poor appetite
- dermatitis
- tingling of fingers
- skeletal malformation

Calcium Food Sources

SODIUM:-

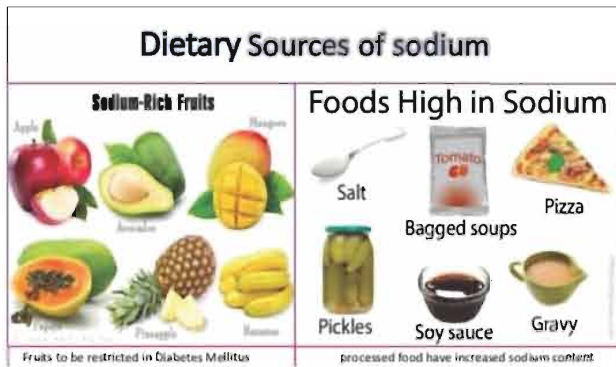
Sodium

| | | | |
|------------------------|---------------------|--------|---|
| atomic number | 11 | 22.990 | atomic weight |
| symbol | Na | | acid-base properties of higher-valence oxides |
| electron configuration | [Ne]3s ¹ | | crystal structure |
| name | sodium | | physical state at 20 °C (68 °F) |

| | | | |
|--|--------------------|--|----------------|
| | Alkali metals | | Solid |
| | Body-centred cubic | | Strongly basic |

- The adult human body contains about 100 gm of sodium ions.
- About half this quantity is found in extracellular fluid & rest in the tissue, cell & bone.

* DIETARY SOURCES:-



- Dietary source of sodium is the salt added during cooking.
- And from processed foods like pickles, bakery items, dry fish & nuts.

* FUNCTIONS:-

SODIUM Oregon State University Linus Pauling Institute

MAIN FUNCTIONS

- Maintains fluid and electrolyte balance
- Required for proper nerve conduction and muscle contraction
- Influences blood volume and blood pressure

GOOD SOURCES

Most dietary sodium comes from processed and restaurant food.

Processed Foods

| | |
|---|------------------------------------|
| Canned foods - lunch meat - potato chips | Table Salt (Sodium Chloride) |
| • Chicken Noodle Soup (canned), 1 cup, 789 mg | • Table Salt, 1 teaspoon, 2,325 mg |
| • Ham (minced), 3 ounces, 1,059 mg | |

DAILY RECOMMENDATION

| | | |
|-------------|-------------|-----------|
| 1,500 mg | 1,300 mg | 1,200 mg |
| 19-50 Years | 51-70 Years | 71+ Years |

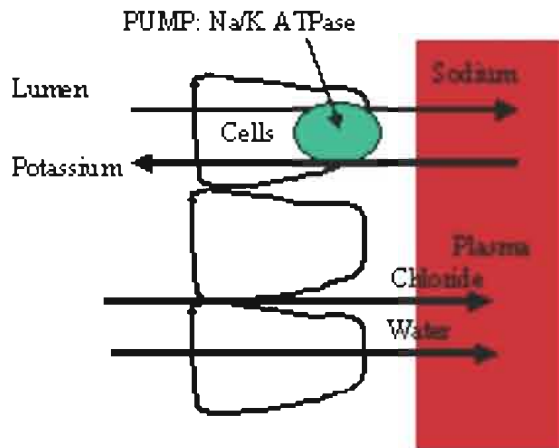
SPECIAL NOTES

- **Most people consume too much sodium.**
- Diets low in sodium and high in potassium reduce fluid retention and favorably affect blood pressure.
- Consuming $\leq 1,200$ mg of sodium/day is associated with significant blood pressure reduction.
- Fruit, vegetables, and legumes are naturally low in sodium and high in potassium.

- It help I'm maintaining fluid balance, muscle irritability, acid-base balance, nerve conduction & osmotic pressure.
- Helps in absorption of some nutrients like glucose.
- It also play vital role in functioning of heart & brain.

* ABSORPTION:-

Sodium Absorption










- It is absorbed in the jejunal region of small intestine by active transport.
- Simultaneous presence of glucose & amino acid enhances it's absorption.
- It is also actively absorbed in the ileum & in the colon except the rectum.

* SODIUM DEFICIENCY:-

HYPONATREMIA

- an imbalance between the total **body water** accumulation and the body's accumulation of **electrolytes**
- is defined as **serum sodium concentration** of less than 135 mEq/L as a result of an accumulation of total body water greater than the body's accumulation of electrolytes (**sodium + potassium**)

CAUSES: Many possible conditions and lifestyle factors can lead to hyponatremia

| | | | |
|---|--|--|--|
|  Excessive Vomiting |  Diuretics |  Drinking too much water |  Excessive Diarrhea |
|  Heart, kidney and liver problems |  Dehydration |  Inadequate Salt Intake |  Fluid shift from ICF to ECF |

Hypernatremia Signs and "FRIED SALT" Symptoms

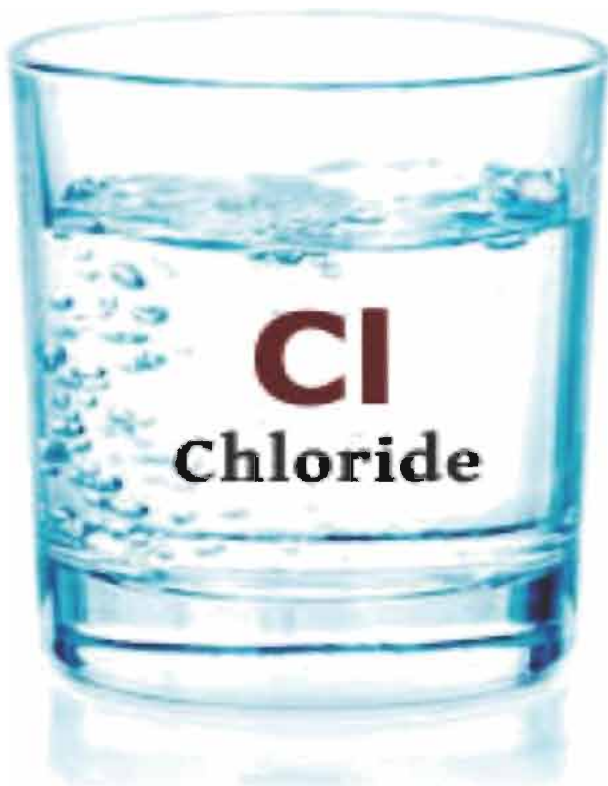
F Flushed skin and fever (low-grade)
R Restless, irritable, anxious, confused
I Increased blood pressure and fluid retention
E Edema: peripheral and pitting
D Decreased urine output and dry mouth



Skin flushed
Agitation
Low-grade fever
Thirst

www.nursebuff.com

CHLORIDE:-



- It is a negatively charged atom that people commonly eat as a component of table salt.

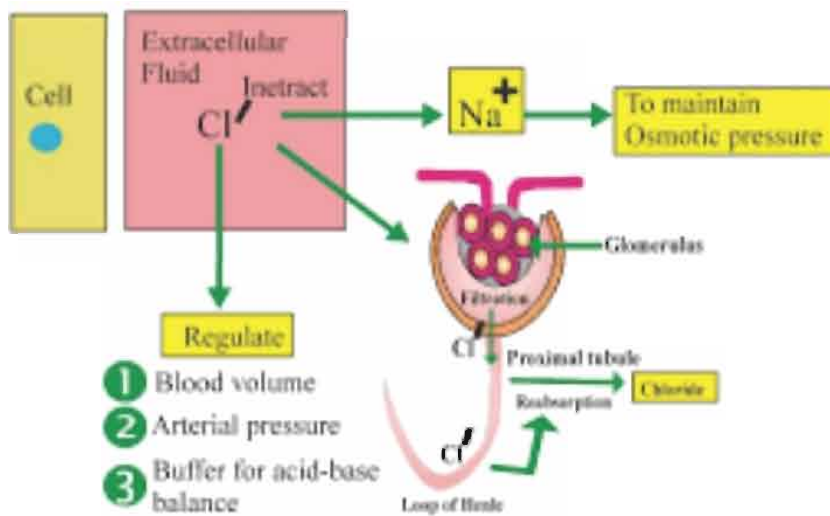
* DIETARY SOURCES:-

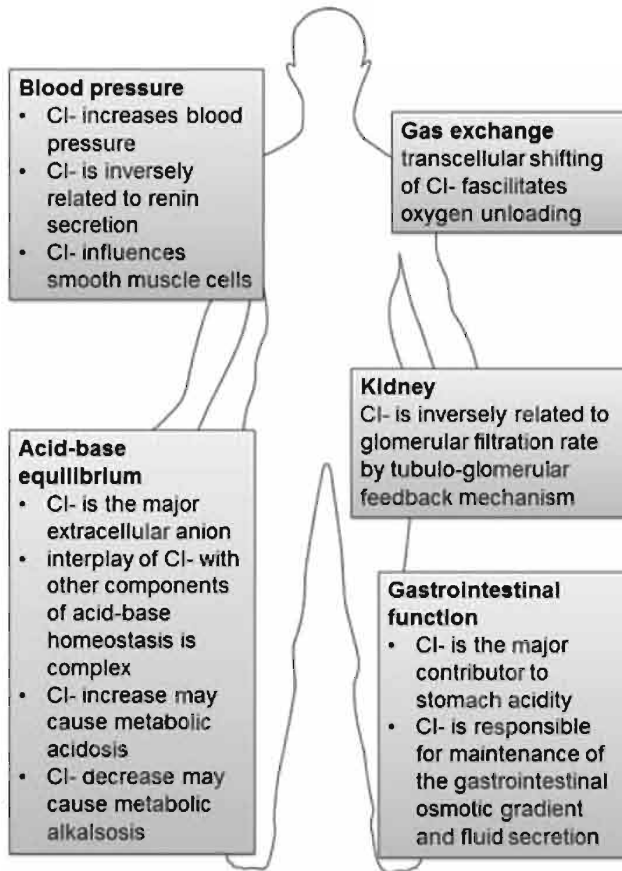


- Although some fruits & vegetables naturally contain chloride.
- But most of it's intake comes from table salt.

* FUNCTIONS:-

Chloride Function





* CHLORIDE DEFICIENCY:-

What is Hyperchloremia?

Hyperchloremia is a condition in the body, when the volume of chlorine ion elevates remarkably causing some other physical disorders, including decreased volume of oxygen content in the blood.

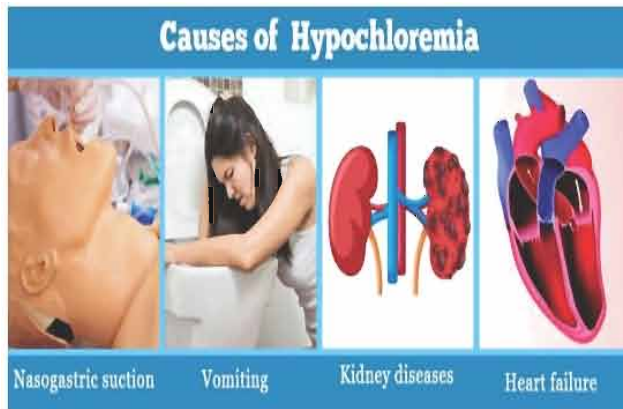
Symptoms of Hyperchloremia

- Loss of fluid leading to dehydration
- Diarrhea, and vomiting
- Breathing problem
- Kussmaul breathing
- Reduced cognitive functioning
- Intense thirst
- Pitting edema in different parts of the body
- Fever and sweating.

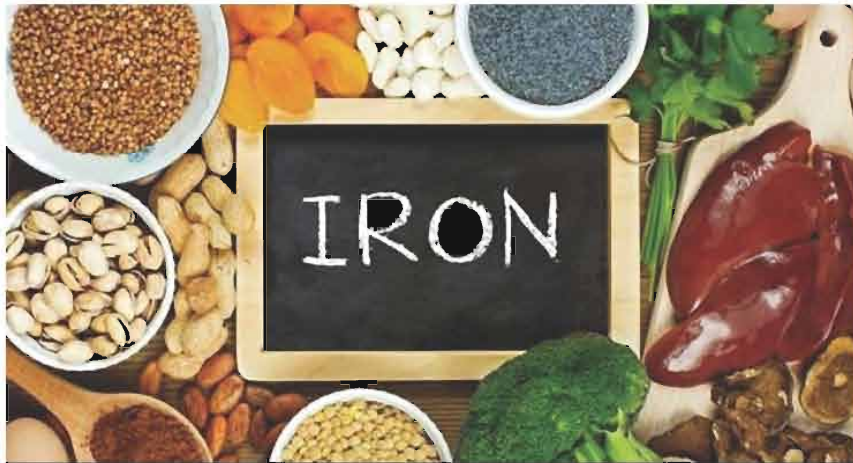
For More Information:
Visit: www.epainassist.com

ePainAssist.com

• Hypochloremia= It occurs when chloride level increases in our body. It may lead to retention of water in the cells & can also lead to oedema.



IRON :-



- The total iron content of the normal adult man is estimated to 4-5 g.
- A greater part of iron in the body is present as haemoglobin.
- Most of the body iron exist in complex form bound to protein either as heam compounds or as ferritin & transferrin.
- Free inorganic iron occurs in the body only in very small amounts.
- The heam protein & flavo protein enzymes also contain iron.

* DIETARY SOURCES:-

Heme- iron - easily absorbed

| | | |
|---|---|--|
|  Grass Fed Ground Beef 2mg /100g |  Chicken Liver 11mg /100g |  Dark Turkey Meat 1.4mg /100g |
|  Pork Chop 0.7mg /100g |  Canned Sardines 2.9mg /100g |  Canned Tuna 1.07mg /100g |

Non Heme- iron - not so easily absorbed

| | | |
|---|---|---|
|  Weetbix (TM) 3 mg / (2) 30g |  Lentils (cooked) 3.3 mg /100g |  Chickpeas 2.7 mg /1 cup |
|  Sweet Potato 0.6 mg /100g |  Dried Apricot 0.93mg / 30g (5) |  Tofu 2.96mg /100g |
|  Raw Spinach 1.2 mg /1 cup |  Almonds 1.1 mg /30g |  Rolled Oats 1.1mg / 30g |

Pair Iron Foods with foods rich in Vitamin C for better absorption



- Rich sources of iron are cereals, millets, pulses & green leafy vegetables.
- Among the cereal grains & millets. Bajra & ragi are very good source of iron.
- Iron from animal food is better absorbed than plant foods.
- Inclusion in our diet about 50g of green leafy vegetables which are rich in iron can meet a fair

proportion of iron needs.

- Iron content of food can be increased by cooking in iron vessels.

*FUNCTIONS:-

IRON

The word 'Iron' comes from the Anglo-Saxon word 'Iarn', which means 'metal'.

Iron can be found in the Ferrous (Fe²⁺) and Ferric (Fe³⁺) form.

Iron was thought to be discovered in 5000BC where it was used for tool and weapon making.

There are 2 types of dietary Iron: **Haem** and **Non-Haem**. Haem foods include Meat, particularly red, some poultry and fish. Whereas, non-haem sources include green leafy vegetables, nuts, legumes and cereals.

Iron's bioavailability can change greatly dependent on foods that it is eaten with. Iron is absorbed best when eaten with **Amino Acids** and **Vitamin C**. Iron is absorbed poorly when eaten with **Tannins** (Tea), **Phytates**, or **Fibre**.

Women's requirements are always higher due to iron losses in Menstruation. Adolescent women require **14.8mg** of iron per day, whereas adolescent men only require **8.7mg** per day.

Iron Deficiency is called **Anaemia**. Anaemia is characterized by extreme lethargy, breathlessness, insomnia, pale skin, irritability and girth and headaches.

It had been predicted that **8% of women** and **3% of men** suffer from iron deficiency in the UK.

Iron is an essential nutrient during pregnancy. Studies have shown that mothers deficient in iron often have low birth weight children born pre-term.

Iron plays a vital functional role in **red blood cells**. Iron is the main component of haemoglobin. Haemoglobin is used to carry oxygen to vital organs and muscles around the body.

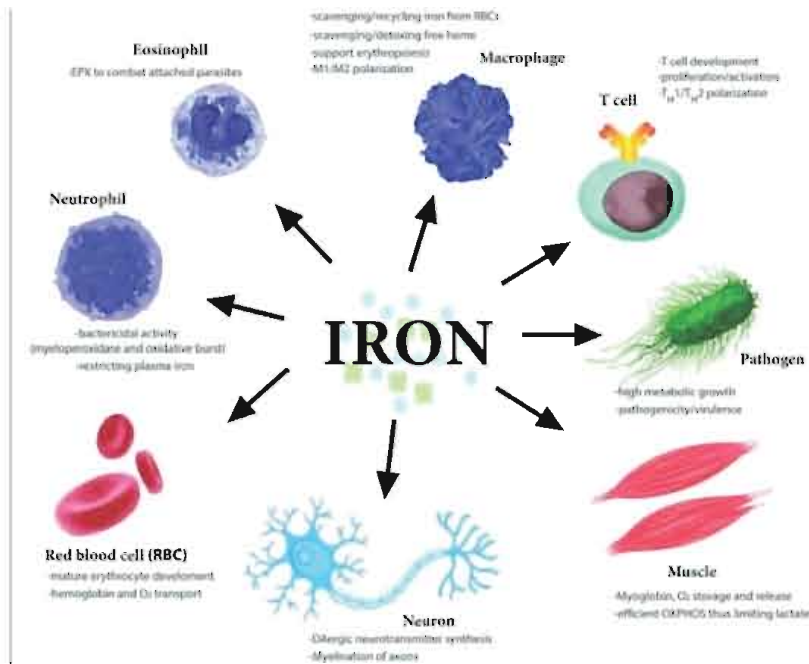
Iron is required for **good cognitive function and mental processing**. Consuming adequate iron as a young child can provide the correct stepping stones for a well developed brain as an adult.

Iron is heavily involved in the **electron transport chain (ETC)** which is used to make ATP (the body's form of energy). Iron is oxidized/reduced along the chain to provide substrate for energy production.

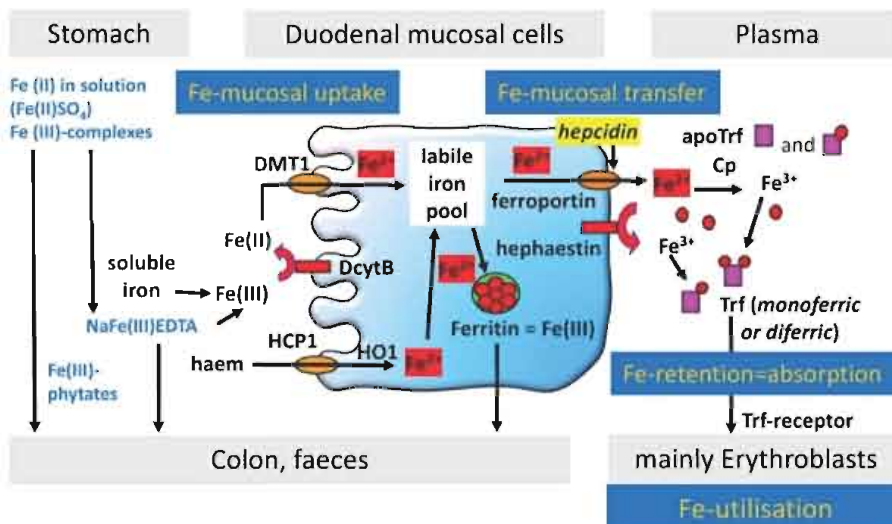
• **Transport & Storage of Oxygen**= Each gram of haemoglobin contains about 3.34 mg of iron. Iron within the metalloprotein haemoglobin & myoglobin can bind to oxygen molecules & transport them through the blood or store them within the muscles. Myoglobin is found only in muscle, where it serve as a reservoir of oxygen.

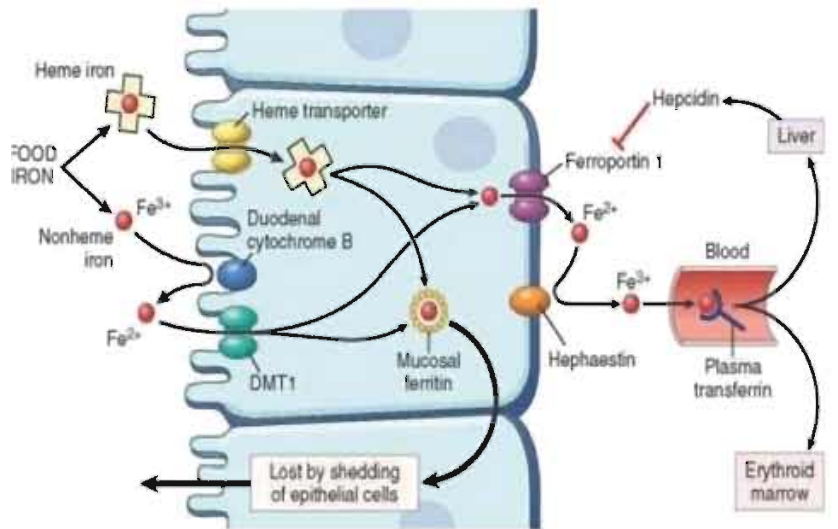
• **Co-factor of enzymes & other proteins**= The iron containing haem group is also part of several proteins involved in the release of energy during the oxidation of nutrients & the trapping of that energy within ATP.

- Formation of RBC= Bone marrow produces immature cells known as erythroblasts. As erythroblasts mature in the bone marrow, many synthesise the iron containing haeme group in a process requiring the help of vitamin B6 & copper.



* ABSORPTION & METABOLISM:-





DUODENAL EPITHELIAL CELL UPTAKE OF HEME AND NONHEME IRON.

- Dietary iron exist in two chemical forms. Haeme iron is found in haemoglobin, myoglobin & some enzymes, & non-haeme iron is found predominantly in plant foods but also in some animal foods, as in non-haeme enzymes & ferritin.
- Haem is absorbed intact by the intestinal mucosal cells.
- Iron absorption is enhanced by the co-ingestion of Vitamin C because ascorbic acid reduces ferric to ferrous iron.
- Factors affecting absorption=
 - > Increased acidity.
 - > Animal tissue protein.
 - > Body need.
 - > Calcium.
- Inhibiting factors=
 - > Low gastric acidity.
 - > Phytates & oxalates.
 - > Polyphenols.
 - > Minerals.

* IRON DEFICIENCY:-

