

## 1. Details of Module and its structure

Module Detail	
Subject Name	Food, Nutrition for Healthy Living
Course Name	Food, Nutrition for Healthy Living
Module Name/Title	Nutrients in Food - Micronutrients
Module Id	FNHL_10106
Pre-requisites	General knowledge about Nutrients in Food - Micronutrients
Objectives	After going through this lesson, the learners will be able to understand the following : <ul style="list-style-type: none"><li>• Different type of micronutrients</li><li>• Enumerate different types of fat soluble &amp; water soluble vitamins</li><li>• Appreciate the factors enhancing the bio availability of minerals</li></ul>
Keywords	Vitamins, Minerals, Niacin, Folic acid, Cobalamin, Vitamin c, Calcium, Sodium, Potassium, Iron, Iodine, Zinc, Fluorine

## 2. Development Team

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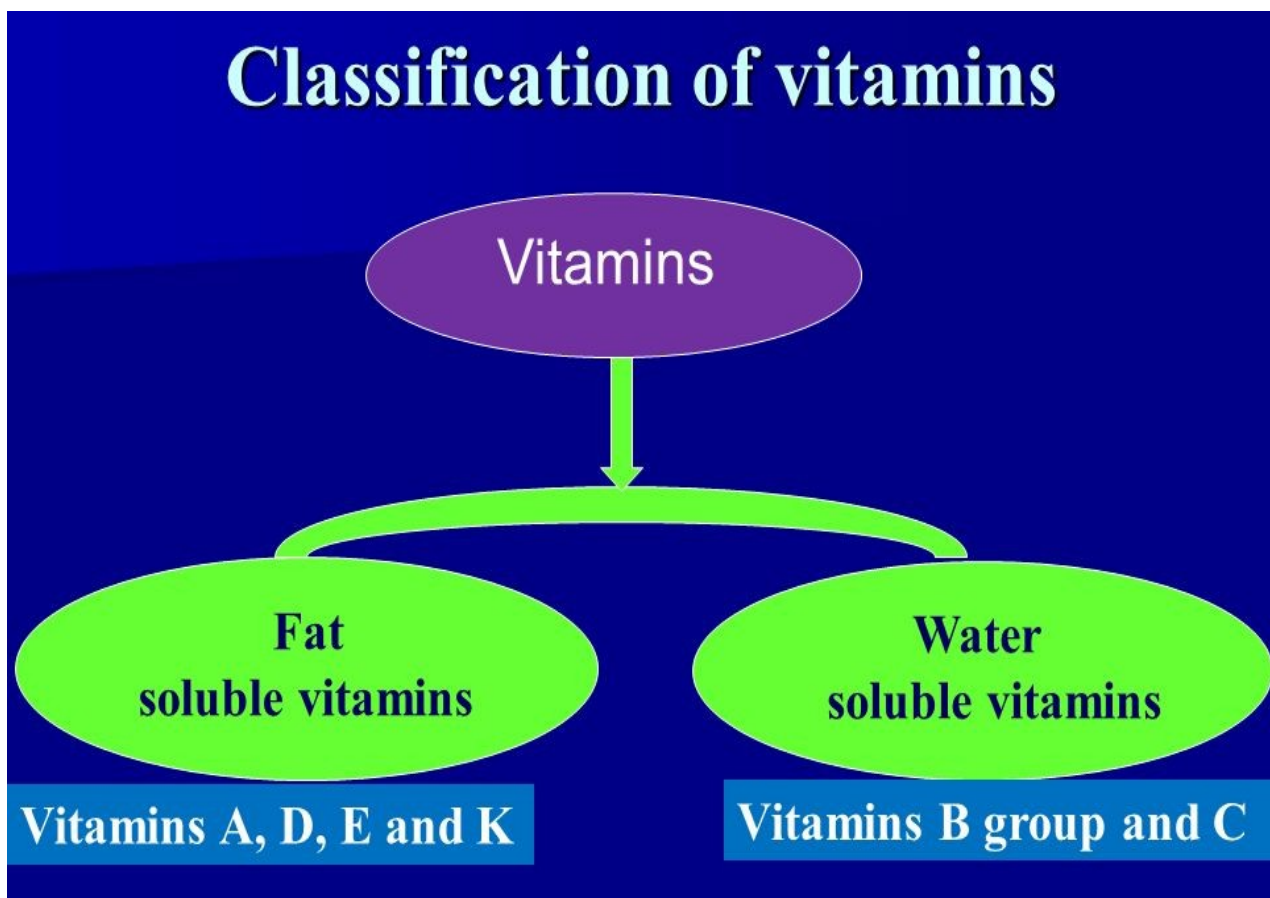
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### 1. Introduction

**Micronutrients** in the diet are as essential as the Macronutrients, primarily because they aid the various functions of the macronutrients. However, they are required in much smaller quantities as compared to the macronutrients.

### 2. Vitamins

These are organic substances that are required by our body for its normal functioning, growth, development & maintenance. They need to be consumed in the diet as most of them cannot be synthesised in the body. Deficiencies of vitamins over a period of time produces specific signs & symptoms.



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## **I.A. FAT SOLUBLE VITAMINS**

### **VITAMIN A**

It exists in two forms in nature :-

- a) Retinol – Animal sources
- b)  $\beta$ -Carotene – Plant sources

### **FUNCTIONS OF VITAMIN A**

1. Vitamin A is necessary in the maintenance of healthy vision especially, night vision (adaptation to the dark).
2. It is important for cell division.
3. It is essential for the maintenance of healthy skin & mucous membranes of our body.
4. Vitamin A is needed for the development & maintenance of bones.
5. Vitamin A works as an antioxidant, preventing the free radical damage.
6. It is needed for growth & reproduction.
7. This vitamin is required for strengthening immunity against infections.

### **FOOD SOURCES OF VITAMIN A**

<b>ANIMAL FOODS</b>	<b>VEGETABLES</b>	<b>FRUITS</b>
ORGAN MEATS - LIVER	SPINACH	SWEET POTATO
EGG	FENUGREEK LEAVES	PAPAYA
FISH OIL	MUSTARD LEAVES	MELON
FISH	BATHUA LEAVES	PEACHES
FORTIFIED MILK	MINT LEAVES	APRICOTS
MILK & MILK PRODUCTS	PUMPKIN	MANGO
	CARROTS	
	BROCCOLI	
	LETTUCE	
	YELLOW CAPSICUM	

### **DEFICIENCY OF VITAMIN A**

1. Low or no vision at night – Night Blindness
2. Drying of the conjunctiva – Conjunctival Xerosis
3. Bitot's Spot – dark grey or black spots in the cornea of the eye.
4. Corneal Xerosis – dryness or haziness of the cornea.
5. Keratomalacia
6. Follicular hyperkeratosis – plugging of hair follicles

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## **EXCESS OF VITAMIN A**

1. **Hypervitaminosis A** – Gastrointestinal upset, blurred vision, muscular in-coordination & headache.
2. **Hypercarotenemia** – this condition seldom occurs.
3. **Teratogenic** – which leads to spontaneous abortions & birth defects.

## **VITAMIN D**

This hormone is necessary for maintaining good health of our bones.

### **FUNCTIONS OF VITAMIN D**

1. It is needed for the absorption of dietary calcium & its deposition in the bones.
2. It is required for the growth & maintenance of bones.
3. Vitamin D helps to regulate the blood calcium.
4. Vitamin D plays an important role in cell division. Good intake of vitamin D may reduce the risk of some types of cancer.
5. It strengthens the immunity of the person.
6. It contributes to insulin secretion & may protect against diabetes.
7. It may help to control the growth & functioning of parathyroid gland.
8. Vitamin D also plays a protective role against many diseases.

### **FOOD SOURCES OF VITAMIN D**

- SKIN EXPOSURE TO SUNLIGHT
- FISH LIVER OILS
- EGG YOLK
- FISH
- LIVER
- MILK & MILK PRODUCTS
- FORTIFIED FOOD LIKE MILK & FAT/OIL

### **DEFICIENCY OF VITAMIN D**

- RICKETS – in children
- OSTEOMALACIA – in adults

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## **EXCESS OF VITAMIN D**

- NAUSEA, VOMITING, IRRITABILITY, CONSTIPATION, WEIGHT LOSS & EXCESSIVE THIRST

## **VITAMIN E**

Vit. E is essential for reproductive health and was therefore, given the name tocopherol that means “to bring forth offspring”.

## **FUNCTIONS OF VITAMIN E**

1. The major role of this vitamin is as an antioxidant. It is required for protection against the damage that can be caused by free radicals.
2. It protects Vit. A & Vit. C from oxidation & thus has a sparing effect.
3. The Vitamin prevents oxidative damage to the cells. Hence, it is also attributed as the anti-ageing vitamin.
4. By reducing oxidative damage to the DNA & cells, it has a role in protecting the body against cancer.
5. It is also crucial in reducing the risk of heart disease.
6. It is important for the metabolism of iron, immunity & maintenance of nervous tissue.

## **SOURCES OF VITAMIN E**

- Vegetable oils are the Chief source of Vitamin E – Corn, Cotton seed, Safflower, Soybean, Wheat germ & Peanut
- Almonds, Walnuts, Coconut & Olives
- Whole grains – Bajra, Wheat grain, Barley
- Fish & Cod liver oil
- Pumpkin, Spinach, Broccoli & Papaya
- Pumpkin seeds, Melon seeds

## **DEFICIENCY OF VITAMIN E**

1. There is impairment of neuromuscular function.
2. Development of a type of muscular dystrophy.
3. Breakdown of RBC's.

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## **VITAMIN K**

It is commonly known as Coagulation Vitamin, as it is essential for the coagulation of blood in case of injury or haemorrhage.

### **FUNCTIONS OF VITAMIN K**

1. The vitamin is essential for the formation of blood-clotting proteins.
2. It has an important part in bone metabolism & formation.

### **FOOD SOURCES OF VITAMIN K**

- VEGETABLES – Green peas, cauliflower, tomatoes, french beans & cluster beans
- GREEN LEAFY VEGETABLES – Broccoli, Spinach, Cabbage, Lettuce, Mustard leaves
- ANIMAL SOURCES - Pork, liver
- VEGETABLE OILS – Soybeans & canola

### **DEFICIENCY OF VITAMIN K**

1. Increased blood clotting time.
2. Increased tendency for haemorrhage.

## **I.B. WATER SOLUBLE VITAMINS**

This category includes the family of B – Vitamins & Vitamin C.

Amongst the B – Vitamins, the more well known ones are:-

- Thiamine
- Riboflavin
- Niacin
- Pyridoxine
- Folic acid
- Vitamin B<sub>12</sub>

### **THIAMINE (B<sub>1</sub>)**

It was found to be present in unpolished & unmilled grains especially, rice. Polishing removes the bran & germ where this vitamin is present.

### **FUNCTIONS OF THIAMINE (B<sub>1</sub>)**

1. The vitamin is important for carbohydrate metabolism.
2. It is required also for protein metabolism.

3. Thiamine plays an important role in nervous function.
4. It is needed for the synthesis of the genetic material of our body i.e. DNA & RNA.

#### **FOOD SOURCES OF THIAMINE (B<sub>1</sub>)**

<b>CEREALS</b>	<b>PULSES</b>	<b>NUTS &amp; OILSEEDS</b>	<b>OTHER SOURCES</b>
OATS	KIDNEY BEANS	PISTACHIO NUT	GREEN PEAS
WHOLE WHEAT FLOUR	COW PEAS (LOBIA)	PEANUT	FENCH BEANS
WHEAT GERM	SOY BEAN	SUNFLOWER SEEDS	GREEN BEANS
PARBOILED RICE	GREEN GRAM WHOLE	SESAME SEEDS	CABBAGE
BROWN RICE	CHICK PEAS		MUSHROOM
CORN MEAL	BENGAL GRAM		FISH
	PINK LENTIL		PORK
	RED GRAM DAL		BEEF LIVER
	BENGAL GRAM DAL		EGG
	BLACK GRAM DAL		ORANGE
			WATERMELON
			YEAST

- Excessive consumption of tea & coffee lowers the level of thiamine absorption from the diet.
- Indiscriminate use of Baking Soda in cooking hampers absorption of the vitamin.

#### **DEFICIENCY OF THIAMINE (B<sub>1</sub>)**

1. Beri-beri: It is of 2 types
  - ❖ Dry Beri-beri: In this form nervous & muscular systems are involved
  - ❖ Wet Beri-beri: Cardiovascular & Neurological systems are affected.
  - ❖ Infantile Beri-beri: breast fed infants whose mothers are deficient.
  - ❖ Cerebral Beri-beri: mainly seen in alcoholics

#### **RIBOFLAVIN (B<sub>2</sub>)**

It is the second vitamin amongst the B-Group of vitamins.

#### **FUNCTIONS OF RIBOFLAVIN (B<sub>2</sub>)**

1. It works as a coenzyme in oxidation – reduction reactions for release of energy from carbohydrates & fats.
2. Requirement of riboflavin occurs in vitamin & mineral metabolism.
3. Riboflavin performs antioxidant activity in the body.

## FOOD SOURCES OF RIBOFLAVIN (B<sub>2</sub>)

ANIMAL SOURCES	VEGETABLES & GREEN LEAFY VEGETABLES	NUTS & LEGUMES	OTHER SOURCES
WHOLE MILK	MUSHROOM	ALMONDS	WHOLE WHEAT FLOUR
CURD	BROCCOLI	SESAME SEEDS	OATS
COTTAGE CHEESE	ASPARAGUS	PEANUT	YEAST EXTRACT
PROCESSED CHEESE	SPINACH	KIDNEY BEANS	
LIVER	MUSTARD GREENS	COWPEAS	
KIDNEY	BATHUA LEAVES	GREEN GRAM WHOLE	
BEEF	FENUGREEK LEAVES (METHI)	BLACK GRAM (WHOLE)	
MUTTON	CABBAGE		
FISH	TOMATO		
CHICKEN			
EGG			

## DEFICIENCY OF RIBOFLAVIN (B<sub>2</sub>)

1. Ariboflavinosis – it can have the following symptoms:

- ❖ Inflammation of tongue
- ❖ Cracking at the corner of lips
- ❖ Inflammation & soreness of mouth
- ❖ Confusion
- ❖ Defects of eyes & nervous system
- ❖ Impaired psychomotor performance

## NIACIN

It occurs in two forms : Nicotinic acid & Nicotinamide

## FUNCTIONS OF NIACIN (B<sub>3</sub>)

1. Niacin is a component of carbohydrate, protein & fat breakdown.
2. It is essential for the synthesis of fatty acids & steroids.
3. Niacin is required for the repair of DNA & mobilisation of calcium.
4. Coenzymes of niacin are required for the metabolism of alcohol.



### FOOD SOURCES OF NIACIN (B<sub>3</sub>)

CEREALS & PULSES	NON – VEGETARIAN SOURCES	NUTS & SEEDS	OTHER SOURCES
WHOLE WHEAT FLOUR	CHICKEN	PUMPKIN SEEDS	MUSHROOM
OATS	FISH – TUNA	PEANUTS	BROCCOLI
WHEAT BRAN	MEAT	ALMONDS	TOMATO
BAJRA	EGGS	DATES	SPINACH
BARLEY			CARROTS
KIDNEY BEANS			ASPARAGUS
			POTATO
			SWEET POTATO

### DEFICIENCY OF NIACIN (B<sub>3</sub>)

1. PELLAGRA– The following symptoms are seen:
  - Weight loss
  - Weakness
  - Reduced appetite

Effects of Pellagra are known as the 4D's – Diarrhoea, Dementia, Dermatitis & Death.

2. It reduces the progression of Atherosclerosis, nausea & liver damage.

### PYRIDOXINE (B<sub>6</sub>)

It is a family of three compounds – Pyridoxal, pyridoxine & pyridoxamine.

### FUNCTIONS OFPYRIDOXINE (B<sub>6</sub>)

1. Pyridoxine is required for transamination reaction of amino acid.
2. It is essential for the synthesis of heme, the compound responsible for oxygen binding in haemoglobin.
3. It is required during the synthesis of WBC's which enhance our immunity.
4. It participates in carbohydrate metabolism.
5. Pyridoxine is required for neurotransmitter synthesis.
6. It helps to regulate gene expression.
7. It is important for interconversions such as tryptophan to niacin, homocysteine to cysteine.

## FOOD SOURCES OF PYRIDOXINE (B<sub>6</sub>)

ANIMAL SOURCES	PLANT SOURCES	
	NUTS & LEGUMES, GRAINS	VEGETABLES & FRUITS
MEAT	WALNUT	POTATO
FISH	ALMONDS	BROCCOLI
CHICKEN	SOY BEAN	SPINACH
	SUNFLOWER SEEDS	BANANA
	OATS	WATERMELON
	BUCK WHEAT	
	WHEAT BRAN	

## DEFICIENCY OF PYRIDOXINE (B<sub>6</sub>)

1. Inflammation of tongue
2. Inflammation of skin of scalp, hairline or face.
3. Protein synthesis becomes impaired which further affects overall cell metabolism.
4. Anaemia due to smaller sized & pale coloured RBC's.
5. Depression, headaches, confusion & convulsions.
6. Inflammation of peripheral nerves leading to pain & loss of function.

## FOLIC ACID (B<sub>9</sub>)

Folic acid is absolutely essential for rapid cell division.

## FUNCTIONS OF FOLIC ACID (B<sub>9</sub>)

1. It is required for the synthesis of genetic material.
2. It is needed for cell division & proliferation.
3. Amino acid metabolism.
4. Cell maturation e.g. RBC
5. It is crucial for neurotransmitter formation & can help in improvement of mental state.
6. It is heart protective as it reduces the harmful homocysteine to harmless cysteine.
7. It helps in maintaining the blood pressure normal.
8. It also lowers the risk of developing cancer.

## FOOD SOURCES OF FOLIC ACID (B<sub>9</sub>)

- DARK GREEN LEAFY VEGETABLES – Spinach, Bathua, Mustard leaves, Fenugreek leaves.
- OTHER VEGETABLES – Cabbage, Cauliflower, Broccoli, Carrot, Tomato, Peas

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- FRUITS – Orange, Orange juice, Citrus fruits, Banana, Melon
  - LEGUMES & BEANS
  - MEAT, LIVER, CHICKEN & EGG
  - WHOLE GRAINS, WHEAT GERM
  - NUTS

### **DEFICIENCY OF FOLIC ACID (B<sub>9</sub>)**

1. ANAEMIA - Large, immature RBC's which have decreased oxygen carrying capacity.
2. Defects of the Neural tube in the foetus.
3. Spina bifida i.e. bulging of spinal cord or spinal fluid through the back which can have very serious & fatal consequences.

### **COBALAMIN (B<sub>12</sub>)**

It is the only vitamin that has the mineral Cobalt in its structure.

### **FUNCTIONS OF COBALAMIN (B<sub>12</sub>)**

1. It is required for Folic Acid metabolism.
2. It is a coenzyme for amino acid conversion.
3. It is necessary for maintaining the myelin sheaths of nervous fibres.
4. It is needed for the metabolism of fatty acids.

### **FOOD SOURCES OF COBALAMIN (B<sub>12</sub>)**

- SEAFOOD – SHRIMP, OYSTERS, FISH, MOLLUSCS
- MEAT, CHICKEN, BEEF, HAM, ORGAN MEATS – LIVER, HEART, KIDNEY
- MILK – CHEESE, CURD
- EGG

### **DEFICIENCY OF COBALAMIN (B<sub>12</sub>)**

1. PERNICIOUS ANAEMIA – nervous degeneration causing paralysis & eventually death.
2. Abnormal formation of blood cells.
3. Other symptoms are :-
  - Weakness
  - Weight loss

- Loss of appetite
- Painful red tongue
- Walking difficulties & loss of balance
- Diarrhoea
- Mental slowness
- Memory loss & loss of concentration

### **VITAMIN C (ASCORBIC ACID)**

This vitamin was used to cure bleeding gums in sailors who set off on long sea journies.

### **FUNCTIONS OF VITAMIN C**

1. It is needed for the synthesis of collagen that is the cementing substance of our tissues.
2. It is crucial in the absorption of Iron.
3. It plays the role of antioxidant in collaboration with Vit. E.
4. It is needed for strengthening immunity.
5. It is required for the production of vital substances for the transport of fatty acids, tyrosine, thyroxin etc.

### **FOOD SOURCES OF VITAMIN C**

<b>FRUITS</b>	<b>VEGETABLES</b>
MELON	TOMATO
LEMON	GREEN CHILLIES
ORANGE	CABBAGE
SWEET LIME	CAULIFLOWER
GRAPEFRUIT	CAPSICUM
INDIAN GOOSEBERRY (AMLA)	POTATO
CHERRY	BROCCOLI
STRAWBERRY	LETTUCE
KIWI	SPINACH
MANGO	MUSTARD LEAVES
PAPAYA	FENUGREEK LEAVES
WATERMELON	BATHUA
GUAVA	RADISH LEAVES

### **DEFICIENCY OF VITAMIN C**

1. SCURVY – swollen bleeding gums, delayed wound healing, fatigue etc.

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2. INFANTILE SCURVY – bone pain & resultant difficulty in movement.

### EXCESS OF VITAMIN C

1. Diarrhoea
2. Stomach inflammation
3. Kidney stones

## 2. MINERALS

These are elements which perform several indispensable functions in the human body. They are considered important for health even though they are required in much lesser quantities as compared to Carbohydrates, Lipids, Proteins, Water & Fiber.

Amongst the minerals, some are required in greater quantities than others. So, they are classified into:

- Major Minerals
- Trace Minerals

MAJOR MINERALS	TRACE MINERALS
Calcium	Iron
Phosphorus	Zinc
Magnesium	Iodine
Sodium	Fluorine
Potassium	

### II.A MAJOR MINERALS

#### CALCIUM

Calcium is listed first among the minerals because it is present in the greatest amount in our body. Nearly all the calcium in the body is concentrated in the bones & teeth which amount to roughly 1000-1200g. Also it is an important part of various metabolic reactions e.g. blood clotting. It provides strength to the skeletal system as it is an integral part of the bones.

#### FUNCTIONS OF CALCIUM

1. Calcium is important for the **formation & maintenance of bones** and **mineralisation of teeth**. It provides rigidity & strength to the framework of our body.
2. It is essential for the **maintenance of normal blood pressure** & could also protect against hypertension.
3. **Blood clotting** cannot occur in the absence of calcium.

4. Calcium concentration increases & decreases with the muscle cell which leads to **muscle contraction & relaxation**.
5. **Transmission of nerve impulses** requires calcium.
6. Calcium is needed for **cell metabolism**.

#### FOOD SOURCES OF CALCIUM

MILK & MILK PRODUCTS	CEREALS & MILLETS + NUTS & OIL SEEDS	PULSES & LEGUMES	GREEN LEAFY VEGETABLES/OTHER VEGETABLES	NON-VEGETARIAN SOURCES
MILK	RAGI	SOYABEAN	MUSTARD GREENS	OYSTERS
PROCESSED CHEESE	JOWAR	KIDNEY BEANS	BROCCOLI	
KHOYA	BAJRA	WHITE CHICK PEAS (KABULI CHANA)	RADISH LEAVES	SHELL FISH
CURD	WHEAT	COW PEA (LOBIYA)	SPINACH LEAVES	SARDINES
TOFU	RICE	BENGAL GRAM WHOLE (KALA CHANA)	FENUGREEK LEAVES	
SWEET LASSI	ALMONDS	BENGAL GRAM (CHANA DAL)	BATHUA	
SALTY LASSI		BLACK GRAM WHOLE (URAD SABUT)	FRESH GREEN PEAS	
COTTAGE CHEESE	SESAME SEEDS	BENGAL GRAM FLOUR (BESAN)	RAW BANANA	
	COCONUT (FRESH & DRIED)	DRIED GREEN PEAS		
		DRIED WHITE PEAS		

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## SIGNIFICANCE OF CALCIUM

Blood calcium levels need to be maintained within certain limits (about 9-11 mg/dl). If not maintained within these limits, there can be serious health consequences. **Above normal**, blood calcium can lead to **muscle stiffness**. On the other hand, blood calcium **below normal** can cause **uncontrolled muscular contractions**. Blood calcium being low is generally because of Vit. D deficiency or due to abnormal levels of regulatory hormones (parathyroid hormone).

## DEFICIENCY OF CALCIUM

1. Low intake of calcium during childhood – **Incomplete bone mineralisation**, distorted/**brittle teeth**.
2. Increased risk of **Osteoporosis** in adults, loss of teeth.
3. **Tetany** – low blood calcium levels leading to muscular spasms.

## EXCESS OF CALCIUM

1. Greater risk of **kidney stone** formation.
2. **Inhibitor in the absorption of other minerals** such as Iron & Zinc.
3. **Excess Calcium may deposit in the arteries** leading to higher risk of heart attacks.

## SODIUM

Common salt is the major source of Sodium for our body. Salt/sodium chloride is made from sea water.

## FUNCTIONS OF SODIUM

1. Sodium is the chief regulator of **extracellular fluid volume**.
2. It is the most important factor for **retaining body water**.
3. Sodium contributes to the **maintenance of fluid balance** throughout the body.
4. Sodium is important for **regulating the acid-base balance&osmotic pressure**.
5. It is essential for **absorption of various nutrients**.
6. It participates in the **conduction of nerve impulses&** muscular contraction.

## FOOD SOURCES OF SODIUM

- COMMON SALT/SODIUM CHLORIDE
- FOOD ADDITIVES like preservative, baking powder
- BACON & HAM
- GREEN LEAFY VEGETABLES such as Fenugreek leaves, Mustard leaves, Bathua, Coriander, Radish leaves

- SALT WATER FISHES
- CONVENIENCE FOODS & PACKAGED FOODS – soups, pickles, chutneys, vegetables in brine/canned foods, ketchups & sauces, chips, biscuits, namkeens, crackers, noodles, pasta etc.
- MILK, PROCESSED CHEESE, COTTAGE CHEESE

### DEFICIENCY OF SODIUM

1. Continued vomiting & diarrhoea alongwith low sodium intake & excessive sweating – can cause leach the body of salt. These factors can lead to **dizziness, nausea, muscular cramps**& if untreated, the patient can land up into shock & coma.
2. Athletes & diarrhoea patients need to compensate for the electrolyte losses otherwise severe sodium loss can be fatal.

### EXCESS OF SODIUM

1. **High blood pressure**& its associated problems.
2. **Fluid retention** in the body.
3. Increased urinary calcium output & subsequent **kidney stones**.

### POTASSIUM

It performs many of the cellular functions inside the cell that sodium performs outside.

### FUNCTIONS OF POTASSIUM

1. Potassium helps to **maintain cell integrity**. Potassium distribution affects homeostasis & maintains constant heartbeat.
2. It is important for maintaing **Na-K pump** across the cell membrane.
3. It aids in the functioning of various enzymes.
4. It helps regulate the osmotic pressure & acid-base balance across the membranes.
5. Potassium supports the transmission of nerve impulses.
6. Potassium helps in the contraction of muscles & in maintaining regular cardiac rhythm.
7. It helps to maintain the blood pressure normal.

### FOOD SOURCES OF POTASSIUM

MILK & MILK PRODUCTS	FRUITS	VEGETABLES	OTHER SOURCES
MILK	BANANA	SPINACH	BROWN RICE
CURD	MELON	LETTUCE	WHOLE GRAINS like Bajra



BUTTERMILK	SWEET LIME	BEETROOT	PORRIDGE
	ORANGE	CABBAGE	LENTILS
	APRICOT	TOMATO	SOYBEAN
	RAW BANANA	POTATO	DRIED GREEN PEAS
	PEACH	SWEET POTATO	DRIED WHITE PEAS
	KIWI	CARROT	ALMONDS
	GRAPE FRUIT	BEET LEAVES	PEANUTS
			WALNUTS
			MEAT
			PORK

### **DEFICIENCY OF POTASSIUM**

1. Development of High Blood Pressure
2. Diarrhoea can deplete body potassium & create deficiency, hence it should be replenished through fluids, juices, ORS.
3. Diuretic medicines used to treat hypertension can also make the body deficient in potassium.
4. Depletion in the levels of blood potassium can be fatal, as in case of athletes, alcoholic, people with eating disorders or those consuming diets deficient in calories.

The following symptoms can be observed :-

- Glucose intolerance
- Confused Mental state
- Irregular Heartbeats
- Lack of appetite
- Muscle weakness
- Reduced Blood Pumping capacity of the heart

### **EXCESS OF POTASSIUM**

1. High level of potassium in the blood interferes with heart functioning, reduction in heart beat which can lead to heart attack.

### **II.B. TRACE MINERALS**

These minerals although required in minute quantities fulfil some indispensable functions in our body. Therefore, they are highly important for us.

### **IRON**

The amount of Iron in our body is only 5g. However, it performs some very crucial functions in the body.

## FUNCTIONS OF IRON

1. Iron is a component of Haemoglobin in the blood. It helps in the transport of oxygen from the lungs to the various organs & carbon dioxide from the organs to the lungs.
2. Iron is present in the muscles in the form of Myoglobin for the storage & use of oxygen.
3. It is involved in the formation of ATP for energy utilisation in the cells.
4. Iron has a role as a co-factor for many other enzymes e.g. those involved in generation/synthesis.
5. Iron is imperative/ vital for the detoxification of liver from the residues of various drugs.
6. It plays a very important role in strengthening the immunity of the body.
7. Iron has an integral role to play in the formation of a few neurotransmitters.

## FOOD SOURCES OF IRON

NON-VEGETARIAN SOURCES	VEGETABLES	FRUITS & DRYFRUITS	CEREALS & PULSES	OTHER SOURCES
ORGAN MEATS e.g. LIVER	AMARANTH LEAVES	DATES	WHOLE GRAINS	FORTIFIED CEREALS
OYSTERS	LOTUS STEM	SESAME SEEDS	OATS	MUESLI
FISH	SPINACH	FIGS	BAJRA	WHOLE MEAL BREAD
BEEF	FENUGREEK LEAVES	COCONUT	RAGI	WHEAT BRAN
CHICKEN	MUSTARD LEAVES	ALMONDS	WHOLE WHEAT FLOUR	WHOLE WHEAT PASTA
			RICE FLAKES (CHIRWA)	
			PUFFED RICE (MURMURA)	
MUTTON	MINT LEAVES	DRIED APRICOTS	SOYABEANS	SPROUTS/ GERMINATED SEEDS
EGG YOLK	CORIANDER LEAVES	CASHEWNUTS	FRESH GREEN PEAS	FERMENTED FOODS
	POTATO	WALNUTS	GREEN BEANS	JAGGERY
	SWEET POTATO	PEANUTS	CHICK PEAS	
	CURRY LEAVES	PUMPKIN SEEDS	BLACK EYED BEANS	
	SPRING ONIONS	RAISINS & CURRANTS	RED KIDNEY BEANS	
	BATHUA LEAVES	WATER MELON	GREEN GRAM WHOLE	
	RAW BANANA	APRICOT	GREEN, BROWN & RED LENTILS	

		PLUM	CHOLIA	
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**SIGNIFICANCE OF IRON**

The absorption & excretion of iron should be in balance. Certain factors influence both increase & decrease in iron absorption respectively. Iron absorption is enhanced when there is acidity in the environment. Therefore it is suggested that while consuming meals one should accompany it with fresh juice or lemonade or salty chhach. However, excessive dietary fibre & consumption of tea or coffee (in any form; immediately after meals) can greatly hamper the absorption of iron from the diet.

**DEFICIENCY OF IRON**

1. Anaemia is the major public health problem across the world. The age groups most impacted by it are:-
  - Preschool children
  - School children
  - Adolescent girls
  - Pregnant women

Nearly two-third individuals in each of the above categories are affected by it. It can occur due to various reasons:-

- Dietary deficiency during stages of rapid growth
- Increased blood loss due to various reasons e.g. worm infestation, haemorrhage, child birth etc.
- Absorption of iron from the diet can also be inadequate because of several issues.

Anaemia can affect the optimal growth, stamina, achievement of complete potential, academic performance, work efficiency, physical activity & output amongst others.

**EXCESS OF IRON** – Although it is uncommon in India, excessive consumption of iron can lead to Liver damage, Increased risk of heart disease & Gastrointestinal disorders.

**IODINE**

It is one of the most important trace minerals required by our body to perform most metabolic activities successfully. Iodine is a constituent of the thyroid hormones – T<sub>4</sub>(thyroxine) &

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T<sub>3</sub>(triiodothyronine). These hormones are crucial for the promotion of our physical & mental growth, development & regulation of metabolic functions of the body.

### **FUNCTIONS OF IODINE**

1. Iodine influences the growth, development & functioning of the brain.
2. It regulates the speed of oxidation within the cells & tissues.
3. Iodine is essential for the metabolism of all nutrients especially, energy.
4. Iodine is important for the development of muscle & nervous tissue.
5. It helps to maintain the circulatory system.

### **FOOD SOURCES OF IODINE**

- IODISED SALT
- SEA SALT
- SALT WATER FISH – COD FISH & TUNA
- SEA VEGETABLES
- POTATO
- STRAWBERRIES & CRANBERRIES
- SPINACH
- FENNEL
- ALMONDS
- OATS
- SOYBEAN
- KIDNEY BEANS
- BROCCOLI

### **DEFICIENCY OF IODINE**

1. Iodine Deficiency Disorders (IDD)
2. Goitre – Enlargement of the thyroid gland due to insufficient iodine intake in the diet.
3. Cretinism – incomplete physical development & mental retardation in newborn infants & young children.

Fortification of food items such as salt, sugar, bread, milk, wheat flour & drinking water can be one option.

Fortification of oil with iodine & supplementation of the diet with this oil can also be an aid.

4. Hypothyroidism

**EXCESS OF IODINE** – Excessive consumption of Iodine can induce hyperthyroidism, thyroid cancer & auto-immune thyroid disease.

## ZINC

Zinc is an important trace mineral for human growth although its importance has been established in the 1960's. It is a component of more than 300 enzymes. It is much needed for their optimal activity. Zinc is involved in the synthesis & degradation of the major macronutrients & also in the metabolism of micronutrients.

### FUNCTIONS OF ZINC

1. Zinc is crucial in the synthesis of DNA & RNA i.e. for genetic expression.
2. It is important for healing of our wounds, for metabolism of proteins & for cellular growth.
3. Zinc is a part of the antioxidant mechanism of our body.
4. It is highly important for production, storage & release of insulin.
5. It has been found to strengthen immunity.
6. Zinc is imperative for the structure formation & functioning of cell membranes & maintenance of cell integrity.
7. It is necessary for the synthesis of (retinal) the active form of Vit. A for the visual pigments.

### FOOD SOURCES OF ZINC

CEREALS, PULSES & LEGUMES	NUTS & OILSEEDS	MILK & MILK PRODUCTS	NON – VEGETARIAN SOURCES	VEGETABLES & FRUITS
WHOLE GRAIN FLOUR	PUMPKIN SEEDS	MILK	OYSTERS	SPINACH
WHEAT GERM	WATERMELON SEEDS	PROCESSED CHEESE	CHICKEN	MUSTARD LEAVES
RED GRAM DAL	ALMONDS	YOGHURT	LIVER	BATHUA
GREEN GRAM DAL	CASHEW NUTS		BEEF	POTATO
BLACK GRAM DAL (SPLIT)	SUNFLOWER SEEDS		MUTTON	SWEET POTATO
CHICK PEAS	PEANUT		FISH SALMON	BANANA
SOYBEANS	WALNUT		EGG	ORANGE
KIDNEY BEANS			RED MEATS	RAISINS
CLUSTER				POMEGRANATE

BEANS				
				DATES
				FIGS

### **SIGNIFICANCE OF ZINC**

Zinc supplementation has been known to reduce the severity & frequency of Diarrhoea. It has also been known to improve symptoms of pneumonia, respiratory infections & common colds. Zinc is considered highly beneficial for the growth & behavioural development of children below 1yr of age.

### **DEFICIENCY OF ZINC**

Children need zinc in sufficient quantities they are in a phase of rapid growth. Symptoms of deficiency can be as follows:-

- Retardation in growth & maturation
- Impairment of body's immunity
- Rash resembling acne
- Diarrhoea
- Hair loss
- Reduced appetite
- Poor motor development, cognitive performance & behavioural changes
- Delayed wound healing may be defective

### **EXCESS OF ZINC**

- Unrestricted & excessive intake of zinc can cause copper deficiency which can lead to vomiting, diarrhoea, nausea, cramps & reduced immune function

### **FLUORINE**

This mineral is required in very minute quantity by our body. It occurs as a calcium salt & helps to make the bones & teeth larger in size & more perfectly formed. Even a slight excess of Fluorine can cause disturbances in health.

### **FUNCTIONS OF FLUORINE**

1. Fluoride is necessary for strengthening of teeth. It makes them more resistant to erosion & damage.
2. It fights the bacteria of the mouth for the maintenance & safety of teeth.

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3. Fluorine helps to make the tooth enamel more resistant to the action of acids produced by the bacteria present in the mouth.

#### **SOURCES OF FLUORINE**

- ✓ FLUORINATED WATER
- ✓ ALL KINDS OF SEA FOOD
- ✓ SALT WATER FISHES
- ✓ TEA
- ✓ FOODS GROWING IN SOILS THAT GET FLUORINE THROUGH WATER, FERTILISERS & PESTICIDES

#### **EXCESS OF FLUORINE**

1. Brittleness & staining of teeth/dental mottling which if not cured or arrested at the right stage can lead to dental fluorosis.
2. Skeletal fluorosis – can be seen through symptoms such as: stiffness of spine, excessive curvature of spine, arthritis, abnormal hardening of bones, sometimes paralysis, calcification of ligaments, tendons & cartilage.
3. Knock knee syndrome.