UNIT 6: MINERALS

TABLE OF CONTENT

1.0 Introduction

You learned in Units 3, 4 and 5 about Carbohydrates, Fats and Proteins which are all organic substances. The minerals are inorganic substances drawn from the soil by plants. They are supplied by plants and animals that have already consumed plants.

Though they are inorganic substances, many of them are found as components of complex organic substances in the foods.

This unit treats mineral elements, their functions and macro elements or trace elements that are important consistituents of vital substances in the body and that are used for regulation of some body processes.

2.0 Objectives

At the end of this unit, you should be able to

- Explain the classification and body composition of mineral elements

- List the functions of Mineral elements
- Discuss some macro elements in relation to their importance to the body
- Discuss some micro elements or trace elements in relation to their importance to the body

30 Main Content

3.1 Classification and Body Composition of Mineral

Minerals in the body are grouped as

- Macro nutrient elements or Major minerals
- Micro nutrient elements or Trace elements

Macro nutrient element's are minerals that are required in relatively large amounts in the body. These are calcium, phosphorous, potassium, sulfur, sodium, chlorine and magnesium. The major electrolytes of the body water have been identified as sodium, chlorine and potassium.

Those minerals that are present in the body in amounts less than 0.005 percent of the body but are useful to the body are called micro elements or trace elements. These are iron, iodine, zinc, selenium, manganese, copper, fluorine, chromium, cobalt and mohybdenum.

The amounts of mineral that are present in the body are very small, though minerals play significant roles in the body. The mineral elements in the body constitute only about 4 percent of the bodyweight and most of the minerals are in the bones.

3.2 Functions of Minerals

There are mainly two major functions of minerals. They are:

a. Constituents of the body in hard and soft tissues
b. Regulators of some body functions

Calcium, magnesium and phosphorous are important constituents of the bones and teeth. They allow the solid structure of both the bones and teeth. Sodium, chlorine and potassium are important electrolytes in the body fluids.

Iodine in the thyroid gland and its sect et ion thryroxine, magnesium in the muscles and some in the blood, potassium in the muscles and various body organs are involved in the structure of the body.

Minerals are parts of many enzymes and hormones. There are copper and iron in c.), tochrome oxidasc and zinc in carboxypeptidase.

Iron is part of heamoglobin that transport oxygen to the cells and transports carbon dioxide away from the cells.

The minerals act as regulators and they arc necessary to some body functions. For the functioning of the nerves, minerals play important roles. An exchange of sodium and potassium ions facilitates the transmission of a nerve impulse. Altering the concentration of calcium, magnesium, sodium and potassium I the fluids of nerve cells has been found to disrupt the ability of the nerves to transmit impulses.

The neutrality of the body fluids or the acid — base balance is maintained by some minerals that can generate acid and alkali media.

Chlorine, phosphorus and sulphur that are found predominantly in protein foods like eggs, meats and in cereal products, generate acid medium.

Some of the basic — reacting minerals found largely in fruits and vegetables are calcium, iron, magnesium, potassium and sodium.

For cells to function and survive, the neutrality of the body cells must be maintained.

Minerals are involved in the osmotic pressure of the body fluids that have a lot of effects on the movements of nutrients.

Some reactions in the body require sonic levels of acidity and alkalinity. This is facilitated by minerals that generate either acid or alkali medium. Gastric juice in the stomach for digestion of carbohydrate is acidic. For digestion of fat the small intestine. some alh.dine salts are important.

The contraction of muscles depends on the presence of calcium, sodium, potassium and chlorides.

Minerals serve as catalysts in some reactions in the body. In the clotting of blood, calcium is important: in the metabolism of carbohydrates and fats, minerals are part of the catalyzing enzymes. In the synthesis of heamoglobin, mineral is involved. The production of insulin depends on the presence of

zinc. In the absorption of carbohydrate, sodium and magnesium are important. Calcium has been found to facilitate the absorption of Vitamin

B12.

3.4 Macronutrient Elements

3.4.1 Calcium

Calcium is found mostly in bones and teeth. There is more calcium in the body than any other mineral. Calcitnn gives the rigidity and hardness of both bones and teeth. Calcium ions are concerned with all cell functioning. They are involved in the clotting of blood. Calcium tends to be a kind of coordinator among inorganic elements. It plays a corrective role in conditions of excess presence of potassium, magnesium or sodium in the body. Iron is utilized to a better advantage if adequate amount of calcium is

consumed in the diet.

The deficiency of calcium and phosphorous is implicated in rickets in small children. Osteomalacia, the adult rickets, may also be due to deficiency of calcium as well as deficiency of phosphorous and vitamin D.

The deficiency of calcium is also implicated in the occurrence of osteoporosis, the thing of bones in old people. Low level of calcium in blood and fluids in the body may interfere with response of nerves to stimuli.

There is always a dynamic equilibrium between the calcium in the blood and that in the bones. The calcium in the bone dissolves constantly into blood under the influence of the cells called Osteoclasts Lake and Waterworth, 1980). This has been found to allow bone growth in childhood and adolescence. It also provides for maintenance and adjustment of bone shape to meet stresses on the skeleton in the action of the adults.

During growth, the amount of calcium laid down exceeds that which is withdrawn. In adults the calcium withdrawn is equal to the calcium laid

down over a short period of time.

As a result of the urinary excretion of calcium, there is the need for regular dietary intake of calcium. When the dietary intake is not adequate, the amount of calcium laid down in the bones will have problem. This does not result into serious effects in adults. In children, this deficient intake could result into serious problem if the calcification process is affected and if the

cartilages in the skeleton are replaced by bone.

The deficiency of vitamin 1) which regulated this absorption of calcium from food in the intestines into the blood can result into serious problems of

deficiency of calcium. If a pregnant woman suffers deficiency of Vitamin I), it can result into deficiency of calcium, which can later result into osteomalacia in the child after birth. The Food and Agricultural Organization of United Nations (FAO) (1961) made the following recommendations in the intake of calcium.

Age	Mg per Day
0 - 12 Months (Not breastfed)	500 - 600
1 - 9 Years	400 - 500
10 - 15 years	600 - 700
16 - 19 years	500 - 600
Pregnancy and Lactation	1000 1200

The most important sources of calcium are milk and milk products and cheese. Other sources of calcium are tinned fish, green vegetables (as a moderate source), fortified with bread.

Excessive intake of calcium can result into hypercalceamia. This occurred when fortification of baby foods was done with Vitamin D without restriction.

Student Assessment Exercise 6.1

6.1.1 Discuss the various uses of minerals in the body

6.1.2 Discuss Calcium under the Mowing headings': sources, uses absorption in the body, recommended intakes and deficiency.

3.3.2 Phosphorous

Phosphorus occurs in the body generally with calcium and they contribute to the supportive structures of the body.

Phosphorous is important in chemical reactions with protein, fats and carbohydrates so that the body may have energy.

Phosphorous exists as soluble phosphate ions in blood, lipids, proteins, carbohydrates and energy transfer enzymes.

Many of the 13 Vitamins have been found to b effective only when they combine with the phosphate in the body.

Phosphorous is an important component of nuleic acids and nucleoproteins which are responsible for cell division, reproduction and transmission of heredity traits. Phosphorous has been found to be concerned with brain and nerve metabolism.

Phosphorous combines with calcium to give rigidity to the bones and teeth. Phosphorous forms an important component of enzymes and coenzymes that are responsible for respiration in tissue.

The recommended daily allowances of phosphorous as recommended by the Food and Nutrition Board of United States of America (1974) are given here below

. Recommended Daily Allowances of Phosphorous .

Table 3.3

	Age	Weight (kg)	Height (cm)	Phosphorous (mg)
Infants	0.0 — 0.5	6	60	240
	0.5 — 1	9	71	400
Children	1 — 3	13	86	800
	4 — 6	20	110	800
	7 - 10	30	135	800
Males	11 — 14	114	158	1200
	15 — 18	61	172	1200
	19 — 22	67	172	800
	23 — 50	70	172	800
	51+	70	172	800
Female	11 — 24	114	155	1200
	15 — 18	54	162	1200
	19 — 22	58	162	800
	23 — 50	58	162	800
	51+	58	162	800
Pregnant				1200
Lactating				1200

Source: Fleck H. (1976) Introduction To Nutrition.
Third edition,Macmillan Pub. Co., Inc., New York
Page 214

Phosphorous is found in cereals and meats of all kinds, legumes, nuts, eggs, milk and diary products.

Protein rich foods are usually rich in phosphorous.

3.3.3 Potassium

It exists as a cation bound to protein in the body. With sodium potassium influences the osmotic pressure and contributes to the normal I'll equilibrium of body fluids.

Potassium has been found to be related to the other minerals in metabolism. Deficiency of potassium leads to retention of sodium. Deficiency of magnesium also results into depletion of potassium.

Dietary lack ·of potassium does not cause deficiency of potassium. Body potassium may be reduced through fasting, starvation, infectious diarrhea and vomiting, severe protein, calorie malnutrition and diabetic may result into potassium depletion.

3.3.4 Sodium

Sodium exists as cations in intracellular fluids. These cations help to maintain osmotic pressure equilibrium of the fluids and the PH of body fluid volume. Sodium is used for tissue formation, nerve transmission and muscle contraction. Sodium and potassium cations together with anions of phosphates, carbonates and citrates are responsible for alkalinity of the bile and pancreatic juice and they help to stabilize the PH of the blood.

Deficiency of sodium results in "heat fatigue" — muscular weakness, drowsiness and mental confusion. When there is deficiency of sodium, physical exercise can result into muscular cramps.

Sodium is consumed in the food as sodium chloride. 6 to 8gms of sodium chloride is recommended as daily intake of sodium.

Sodium losses may occur during vomiting, renal disease, adrenal insufficiency, diarrhea and profuse sweating (Fleck, 1976). Muscle cramps and low Blood Pressure occur if this loss of sodium is accompanied by loss of water.

3.4 Trace Elements

3.4.2 **Iron**

Unlike those other materials discussed before, it is difficult to absorb iron from food and to *excrete* it through urine. This is to say that the little ion absorbed from food is retained. The iron in the body is in form of haemoglobin and inyoglobin. Therefore, ion is important in the oxidation of food stuffs and release of energy. This is because haemoglobin and

myoglobin are oxygen carrying agents in the body. Iron is also involved in the transfer of electrons.

Some irons, about 1/4 of the iron in the body is stored as ferriten. As only very small proportion of iron is absorbed into the blood stream so also, only very little ion is lost in the body except during injury and menstruation. During the manufacture of new red blood cells in the bone marrow of growing children and pregnant women more iron is absorbed to respond to this increase in need.

The incidence of Anaemia that is, the condition of inadequate haemoglobin which jeopardizes oxygen supply in the cells is as a result of deficiency of iron.

Those who are at the risk of the deficiency of iron are children and adolescents during the period of increase in blood volume, girls and women due to menstruation, women undergoing a succession of pregnancies.

Ascorbic acid favours the absorption of iron. Products of protein digestion are also known to favour the absorption of iron. These are especially those containing sulphydry groups.

The formation of insoluble salts from the reaction of oxyalate and phaytate ions with the free fatty acids present in the intestines reduce the absorption of iron.

A recommendation of 10mg per day of iron for adult men and 12mg for women in child bearing years has been made. The recommendations of iron during adolescent, pregnancy and lactation have been given respectively as 12 and 13mg per day.

Food containing iron stores and haemoglobin of mammalian carcasses are good sources of iron. That is, liver and black sausages are good sources of iron. All flesh foods and eggs also contain useful amount of irons.

3.4.3 Iodine

Iodine is found in the thyroid gland of the body where it is bound as an essential component of thyroxine. A lack of iodine in the body results to Goitre, this leads to low thyroxine level of the blood. The thyroid gland in an attempt to compensate for this deficiency of iodine becomes over stimulated and this leads to the enlargement of the gland. Women and girls are more susceptible to goiter than boys and men.

Cretinism occurs when there is acute deficiency of iron in thyroid secretion in childhood. This leads to retardation of growth in children and development of ape-like appearance.

Iodine is also very important for normal production and lactation. Pigs with lack of iodine have been found to produce young ones without hair.

A sufficient intake of the diet is assured by the use of iodine salt.

Student Assessment Exercise 6.2

Discuss iron on the basis of source, importance and requirement.

4.0 Conclusion

In this unit, you learn the two classes of minerals — macro nutrients and micro nutrient elements. You also learn about the importance of these minerals and their sources.

Macro nutrient elements such as calcium, phosphorus, potassium and sodium and micro nutrient elements such as iron and iodine are discussed.

5.0 Summary

In this unit minerals were discussed under macro nutrient and micro nutrient elements. Minerals have been found to be important constituents of the body's hard and soft tissues and regulator of some body functions.

Macroelements have been found to be those consumed in more than 0.005% of the body weight. The microelements are those present in less than 0.005% of the body weight. Though, minerals are consumed in relatively small amount, their deficiencies could lead to serious health problems.

6.0 Tutor Marked Assignment

Discuss the problems associated with the deficiencies of calcium, phosphorous and ion.

Answers to Student Assessment Exercise

6.1.1 *See* answers in Section 3.2 of this Unit

6.1.2 Answers in Section 3.3.1 of this unit

6.2 Sec answers in Section 3.4.1 of this unit.

7.0 References and Other Sources

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