VITAMINS

Vitamins are complex organic substances which are obtained by the body from food. They are made up of carbon, oxygen and hydrogen.

General characteristics of vitamins.

-Vitamins do not produce energy and hence have no caloric value.

- Most vitamins cannot be synthesized a part from small amounts of the vitamin group B. So they have to be obtained from the food eaten.

- Each vitamin is completely different from any other, has specific functions in the body and cannot be interchanged with another.

-vitamins are required by the body in minute quantities.

General functions of vitamins.

1. Vitamins help regulate the chemical reactions which release energy in the body cells from carbohydrates , proteins and fats.
2. Vitamins promote good health, affect the ageing process and help prevent diseases e.g vitamin A and C.
3. Vitamins regulate the building and repairing of body cells.
4. Vitamins act as co-enzyme.
5. Vitamins are responsible for the start and completion of certain essential chemical processes in the body.

Classification of vitamins.

Vitamins can be classified into two main groups and these are fat soluble and water soluble vitamins.

Fat soluble vitamins dissolve in fat and are insoluble in water. These are vitamin A, D, E and K.

Water soluble vitamins dissolve in water and are insoluble in fat. These are vitamin C and vitamin B complex.

WATER SOLUBLE VITAMINS

VITAMIN C- ASCORBIC ACID

Characteristics of vitamin C

-Vitamin C is the most unstable vitamin.

-It dissolves readily in water (water soluble)

-It is destroyed by light, acids, alkalis and some elements like copper and iron.

- Some of it is always lost when we cook food and all the vitamin C of vegetables can be destroyed by over cooking or by keeping the food warm.

-Vitamin C cannot be stored within the body hence both adults and children need a good supply each day.

-A white crystalline substance.

-It is a strong reducing agent that is sensitive to oxygen.

FUNCTIONS(ASCORBIC ACID) OR VITAMIN C

1. Vitamin C helps prevent infections especially cold and influenza.
2. Keeps the gums healthy

3. Necessary for healthy tissues such as the skin, bones and teeth.
4. Strengthens blood vessels thus helping to heal wounds and prevent bruising.
5. Involved in the metabolism (energy release) and in the functioning of adrenal glands.
6. Helps in blood clotting to prevent internal bleeding.
7. Necessary for iron absorption by the body.
8. Helps in growth (assists formation of connective tissue)
9. Prevents scurvy.

EFFECTS OF DEFICIENCY OF ASCORBIC ACID.

- Slow healing of wounds and fractures, excessive bruising
- Diseases of the skin occur, gums swell and even bleed, teeth become weaker
- Retarded growth in children .
- incomplete absorption of iron resulting into anaemia
- Nose bleeds
- Brittle bones
- Tiredness, irritability and a feeling of being ''run down"
- long term shortage leads to the disease called scurvy.

Xx The deficiency disease of vitamin C is **scurvy**

SCURVY

Symptoms of scurvy are;
--Swollen gums (sore and bleeding easily)
--Loose teeth
--Pains in the limbs and general tiredness
--Haemorrhages occur on the thighs above the knees. The bleeding occurs around the hair follicles.
--There is also nose bleeding and blood in urine.
--Anaemia is present by the time the disease is fully developed.
--There is delayed healing of wounds.

Treatment and prevention of scurvy

-Patients suffering from scurvy should be given adequate supplies of ascorbic acid once the disease is diagonised. It is absorbed readily into the blood, but is lost in the urine quickly.
-Eat plenty of fresh vegetables and fruits and eat them raw
-Give a good diet.
-Educate the people nutritionally , emphasing the importance or role of fresh fruits and vegetables.

Ways to avoid loss of vitamin C during the preparation and cooking of food.

1. Wash vegetables and fruits and chop quickly and avoid soaking vegetables in water as ascorbic acid is highly water-soluble.
2. Use a sharp knife and don't cut, chop or shred more than necessary when preparing vegetables. Cutting the plant cell causes the enzyme oxidase to be released.
   A blunt knife causes more cells to be disrupted.

3. Tear the leaves of green vegetables such as lettuce other than cutting . Tearing prevents disruption of plant cells and release of oxidase enzyme.
4. Use lemon juice e.g an acid to prevent loss of vitamin C by oxidation.
5. Avoid the use of an iron knife. To reduce loss of vitamin C . Iron increases the rate of oxidation.
6. Prepare vegetables just before required.
7. Avoid cooking vegetables in a copper pan as copper speeds up the rate of oxidation.
8. While cooking use a minimum amount of water . The greater the amount of water used, the greater the loss of vitamin C.
9. Place the food to be cooked in boiling water to reduce loss of vitamin C. High temperature denature enzyme oxidase.
10. In case of green vegetables ,leave the lid off the pan for the first 2 minutes to preserve the bright green colour.
11. Cook for the minimum time. The amount of oxidation is increased by prolonged cooking.
12. Never add bi-carbonate of soda to cooking liquid as oxidation is increased by alkalis.
13. Serve at once and don't keep warm for longer than necessary to prevent vitamin C loss due to oxidation.
14. Serve cooking liquid, if possible as a soup or sauce.
15. If storage is necessary store in a cool, dry dark place oxidation of vitamin C is increased by light and heat.

Vitamin C sources

Most fruits and vegetables are good sources. Fresh ones are the best

Best fruit sources are; black currants, lemons, tomatoes, oranges, strawberries ,gooseberries grapefruits

Best vegetables are; peppers, parsley, spinach, cabbage, bean sprouts, lettuce, onions

N.B 1. Vitamin C is not widely distributed in foods so it is important to include these foods in the diet.

2. Excess of vitamin C is excreted in urine. Vitamin C content of the body is very low during infections, so it is important to boost vitamin C intake during illness.

3. In order to get adequate amounts of ascorbic acid in the body. Vegetables and fruits should be eaten raw and when they are still fresh.

The B group of vitamins-complex

Many of these have similar functions and are found in similar foods. They can't be stored in the body so an adequate supply is required daily.

Characteristics of B vitamins

-They are largely concerned with the release and utilization of energy from food.
- They are all soluble in water.
- They are not stored in the body so any excess over immediate requirements is excreted in the urine.
- The B-vitamins work together in the body.

The more important members of the B group of vitamins are;

1. Thiamine also called Vitamin B1
2. Riboflavine (vitamin B2)
3. Nicotinic acid or niacin

Other less important are;

4. Pyriodoxine or vitamin B6
5. Pantothenic acid
6. Biotin
7. Cobalamin or B12
8. Folic acids

THIAMINE OR VITAMIN B_1

This is a very complex vitamin which is likely tobe deficient in the diet because it's unstable to heat and is water soluble.

-It is destroyed by alkalis.
-It is stable in an acidic medium.
-It is not stored in the body.

FUNCTIONS OF THIAMINE

1. Thiamine stimulates growth
2. Thiamine promotes good appetite.
3. It keeps nerves healthy preventing Beri-Beri.
4. Assists in digestion of carbohydrates.
5. concerned with the release of energy from glucose, amino- acids and fatty acids.
6. Necessary for more than 20 enzymatic reactions in the body.
7. It is involved in control of the fluid balance in the body.
8. It acts as a co-enzyme(co-enzyme is a chemical substance which combine with inactive form of enzyme to produce other compounds with enzyme activity) needed for the breakdown of carbohydrates in the body.
9. It maintains muscle tone.

Deficiency of thiamine.

1. In the absence of thiamine carbohydrate metabolism is affected. Glucose is partially oxidized and a substance called pyruvic acid builds up in the body.
2. Retardation of growth in children occurs.
3. There is loss of appetite.
4. Fatigue and nervous tension in adults occurs.
5. In severe deficiency beri- beri occurs. There are two type of beri-beri and these are (i) dry and wet beri-beri

Symptoms of dry beri-beri

-There is muscle wasting
-loss of sensation of skin.
-paralysis

Symptoms of wet-beri-beri

-The main feature is oedema which may involve the legs, arms, face , trunk(fluid is retained in the tissues thus swelling occurs)

- enlargement of the heart and eventually death.

General symptoms of Beri-Beri

-Heaviness and weakness of limbs.

- Numbness of legs
- ability to work is reduced.
- if not treated wet or dry beri-beri occurs

Treatment of beri-beri

1. A good diet should be provided and unprocessed cereal substituted for rice.
2. the foods should be rich in vitamin B complex and low in carbohydrates.
3. Mothers should be nutritionally educated.

Stability of thiamine

Thiamine is very soluble in water and some is destroyed by the high temperature used in cooking.

To avoid the loss of Thiamine

-Avoid steeping /soaking in water and moist methods of cooking.
-Use as little water to possible.
-Do not over-cook , keep warm or reheat.
-Boil potatoes in their skins retain 90% of the thiamine
-Cook for a short time

Food sources of thiamine.

Cereals including fortified breakfast cereals like oats
Wheat germ , yeas , milk , eggs , pork , bacon , beef , kidneys,
legumes , fruits and vegetables

RIBOFLAVIN OR VITAMIN B_2

Functions of Riboflavin

1. It is essential for metabolism of carbohydrates, proteins and fatty acids ie for energy production
2. Essential for normal growth at all ages i.e it is essential component of living cells.
3. It contributes to normal tissue maintenance i.e skin, eyes and mucous membranes .
4. It helps the cells use oxygen.
5. Prolong the span of active adult life.
6. Work together with vitamin C in the formation of materials that bind cells together.
7. It forms part of the co-enzymes needed for the breakdown of carbohydrates in the body.

Effects of deficiency of Riboflavin

- It results in poor growth in children

- Changes in the skin ,liver, eyes and nerves
- Sores at the angles of the mouth may occur and cracked lips.
- The tongue may swell and may have glossitis (colour turns to purplish red followed by pain)
- Inflammation in folds of skin between nose and
- There's nervous depression, unhealthy skin and digestive disturbances.

Food sources

Liver, kidney, egg yolk, meat , green vegetables (spinach)
Whole grain and enriched cereal products are good
**some riboflavin is manufactured by bacteria in the intestines

Properties and stability of riboflavin

-soluble in water so losses may occur in food preparation.
-destroyed by alkalis
-fairly stable to acid solutions
- not much affected by oxidizing agents

NICOTINIC ACID OR NIACIN-VITAMIN B_3

NIACIN can be manufactured in the body when the amino acid tryptophan is converted to niacin in the intestines
-it is fairly soluble in cold water and very soluble in hot water
-fairly stable to heat, alkalis and acids.

Functions of Nicotinic Acid .

1. It is involved in the release of energy from food(proteins, fatty acids and carbohydrates).
2. Essential for growth and the correct functioning and nerves and skin , tongue and digestive tract healthy.
3. It is the pellagra –preventive vitamin
4. It also helps the cells use other nutrients.

Effects of deficiency of Nicotinic Acid

-Retarded growth in children
-Diarrhea and digestive troubles
-Skin disorders i. rough red skin on the neck and hands
-Severe deficiency off nicotinic acid can cause disease known as pellagra

Symptoms and signs of Pellagra

-pellagra is characterized by **3D'**s i.e Diarrhoea, Dementia and Dermatitis
-Diarrhoea affects the digestive system. The inside of the digestive tract has a red sore and swollen appearance. The stool at times contains mucus and blood.
-Dementia affects the nervous system.
-Dermatitis appears on the skin. It resembles a severe sun burn of all parts exposed to sunlight
-mental disorders

NB. Pellagra is common in countries where maize (corn) is the staple cereal,niacin in maize is not absorbed by the body

Food sources of Nicotinic Acid

Liver, kidneys(best source), meat ,poultry, white fish, peanuts, beans, milk, bread, cheese, eggs, yeast, fortified wheat flour

Xxx it can also be manufactured by bacteria in the intestines.

PYRIDOXINE-VITAMIN B_6

Functions of Pyridoxine

1. Pyridoxine is concerned with the release of energy(breakdown carbohydrates, proteins,fats).
2. It acts as a catalyst.
3. Essential for formation of haemoglobin(red blood cells)
4. It helps nervous tissue function normally.
5. It helps to balance sex hormones hence used in menopause.
6. Vitamin B6 also plays a role in the reaction in which tryptophan is changed into niacin.

Food sources of pyridoxine

Liver, kidneys, fish, yeast, and yeast products, eggs, whole grain cereals, some vegetables.

FOLIC ACID/FOLATE

Functions of folic acid

1. Required for the release of energy from food especially amino acids.
2. Essential for formation of normal red blood and helps to prevent anemia.
3. Important for the production of nucleic acids RNA and DNA. DNA controls heredity as well as tissues, growth and cell function.

Main sources of folic acid

Offals(liver, kidneys), dark green vegetables, whole grain cereals, pulses (i.e beans, peas, lentils), oranges, eggs, meat, poultry

Deficiency of folate/ folic acid -This may be caused by a poor diet

1. Failure to grow properly
2. In mild form the following occur; stomach pains, cracked lips, anxiety, depression, tiredness Diarrhoea
3. serious deficiency results in megaloblastic anaemia where the red blood cells become enlarged (megalo) and cannot give up their oxygen properly to the body cells.
4. Lack of folate in early pregnancy may lead to a condition called spina bitida in the baby which cause permanent disability. Women are advised to eat foods with a good folate content.

COBALAMIN(B12)

Functions of cobalamin

1. Prevents development of pernicious anaemia a disease caused by malfunctioning of red blood cells.
2. Essential for formation of red blood cells.
3. Controls the genetic make up of cells.

4. Acts as a co-enzyme hence helps to release energy from fats, carbohydrates and proteins.
5. Promotes normal growth.
6. It is essential for the nervous system.

Food sources of cobalamin.

It is found in animal protein foods such as Liver, kidneys, meat, eggs, milk, cheese,

N.B

Vitamin B12 is not present in vegetables and sometimes lacking in the diet of vegetarians.

Vitamin losses

- By oxidation
- Extraction in cooking water
- Sensitive to sunlight

Characteristics of cobalamin

-soluble in water
- stable to 100^0 C
- affected by strong acids and alkalis
- affected by light

Deficiency of vitamin B_{12}

- Results in lack of energy
- Pale skin, poor hair condition.
- Serious deficiency results in insufficient red blood cells leading to pernicious anaemia(a chronic disease characterized by abnormally large , red blood cells and neurological disturbances such as depression and drowsiness.

BIOTIN OR VITAMIN H

Functions of Biotin

1. Biotin is used as a co-enzyme for a number of reactions involved in protein synthesis.
2. It is involved in energy production and it controls fat metabolism hence aiding body weight loss.
3. Essential for the proper functioning of the brain and nerves.
4. It helps the body to use essential fats hence helping to promote health hair.
5. Widely used to treat dry skin condition.

Food sources

Biotin is found in both animal and plant foods. Yeast, liver , kidneys, egg yolk, milk, bananas, chicken, fresh fruits and vegetables.

PANTOTHENIC ACID

Functions

1. It is constituent of co-enzyme A. Co-enzyme A is one of the most important substances in metabolism (the chemical changes which nutrients undergo after digestion).
2. Is needed in the production of antibodies.
3. It is needed for the metabolism of energy nutrients and production of cholesterol.

Food sources

Best sources – liver, kidneys, yeast, egg yolk, legumes, wheat and rice germ

FAT SOLUBLE VITAMINS

VITAMIN A- RETINOL

The chemical name is retinol because its function is to protect the retina of the eye. Sometimes it is known as the antixeropthalmic vitamin. A secondary source of vitamin A is carotene. Carotene can be converted to vitamin A in the small intestine. Carotene comes mainly from vegetables sources.

Properties and stability of Vitamin A

-It is a yellow , fat soluble alcohol.

-It is heat stable at normal temperature so cooking and various forms of preserving by heat have little on it.

- However is destroyed by prolonged heating or exposure to warm air in methods of preserving such as sun-drying.

- As vitamin A is insoluble in water, moist cooking methods have no effect on it.

Functions of vitamin A

1. Vitamin A is necessary for healthy skin, and the moist lining membranes of the body including the bronchial tubes and the cornea.
2. Helps in normal vision especially in dim light or adjustment of vision from bright light to darkness. (Retinol contributes to the formation of the pigment Rhodopsin in the retina of the eye. The pigment aids people to see in dim light and it is sensitive to light).
3. It regulates growth especially in children.
4. It takes part in the development of bones and teeth and normal skeletal growth.
5. Vitamin A helps to develop resistance to diseases.
6. Prolongs the span of active adult life.
7. It is essential for the development for the metabolic reactions in the body.
8. It is also required for reproduction and breast feeding.

Effects of deficiency of vitamin A

The deficiencies are caused when the body doesn't receive enough vitamin A from the diet or when absorption of vitamin A doesn't take place properly. When the body receives less vitamin A the following may result;

-Growth is retarded in children.

- night blindness or inability to see in dim light.
- reproductive failure
- lowered resistance to infection
- dryness of the skin and lining membranes, leading eventually to xeropthalamia
- in the absence of retinol the pigment rhodopsin is not formed. This results in impaired vision in dimlight.
- mouth ulcers and acne
- diarrhea

Excess of vitamin A

Hypervitaminosis A occurs when too much vitamin A is taken. This sis because vitamin A is not soluble in water and cannot be broken down by the body into a form in which it can be excreted and therefore any excessive amount consumed remains in the tissue.

Symptoms of Hypervitaminosis A

-Pain in the bones of arms and legs.
-loss of appetite
- headaches
- Drowsiness
- vomiting
-dry itching skin and lining membranes, leading eventually to xeropthalmia
- loss of hair
- and enlargement of the liver

The body is able to store supplies of vitamin A in the liver so that reserves built up at one time can be used up at another time when foods containing less vitamin A are available. This accounts for part of the very high food value of the liver.

Absorption of vitamin A takes place through the lacteals of the villi along of fatty acids and glycerol.

Bile salts are essential for vitamin A absorption.

Xeropthalamia –it affects the cornea of the eye and causes blindness

Symptoms of xeropthalmia

Vitamin A losses

- By oxidation
- Rancidity
- Un affected by normal cooking process, but losses occur at higher temperatures e.g frying and with prolonged heating

Food sources of Vitamin A

Animal foods-for example Liver, fish, milk, cheese, butter, egg yolk, cod liver oil . Carotene is found in plants which are pawpaws, tangerines , mangoes, apricots, peaches, carrots, tomatoes, pumpkins, spinach, peas, cabbages, broccoli, celery, green pepper, sukumawiki,

All yellow, dark green vegetables, orange fruits contain carotene

Vitamin a is found in plants (vegetables and fruits) in the form of carotene.

VITAMIN D– also known as Cholecalciferol

It can be manufactured by the action of sunlight upon fats under the human skin as ergesterel and is therefore known as the "sunshine vitamin "at times.

It may also be got from the animal products particularly fish liver oils, liver, egg York, oily fish, cheese, dairy produce,margarine, foods processed and fortified with vitamin D(infant milk powders, margarine and breakfast cereals).

Functions of Vitamin D

1. Vitamin D together with calcium and phosphorus is essential in the formation of bones and teeth.
2. It assists the body use calcium and phosphorus
3. It promotes quick healing of bone structures.

4. it is of vital importance during pregnancy and early childhood as it controls the calcification or laying down of calcium in children.

Characteristics of vitamin D

- Fat soluble
- Can be stored in the body
- Fairly stable to heat, oxidation, acids, alkalis
- A white crystalline

Effects of deficiency of vitamin D

1. if the diet does not contain enough vitamin D , the body will not be able to use calcium and phosphorus.
2. In severe cases, rickets occur in children where the bones are deformed and not strong enough to support the weight of the young child.
3. Oestomalacia, a disease similar to rickets occurs in adults. Whereby the bones gradually lose calcium and calcium is not replaced. It is sometimes found in elderly people and in women after successive pregnancies.
4. Dental carries
5. backache
6. muscle cramps

RICKETS

This is a disease which causes malformation of bones in children. It is directly due to lack of vitamin D.

Symptoms of rickets

- The child is restless, fretful(cries all the time), pale, flabby muscles and limbs assume un natural posture.
- Excessive swelling on the forehead.
- Abdomen is distended because of weak abdominal muscles.
- Diarrhea is common and the child is prone to respiratory infection.
- Development of the body is delayed so there in teething.
- Changes in the bones i.e legs are bow-shaped and in rare occasion knock-kneed. This is because the legs can't support the weight of the child since they are not strong.

Prevention of rickets.

- Intake of adequate intake of foods rich in vitamin D and calcium.
- Mothers should be educated in the need to keep children in the sunshine once in a while.
- Intake of foods rich in ascorbic acid, iron and vitamin A.
- Provide a well-balanced diet.

Treatment of rickets

- Give milk at least 500ml daily. Milk is the best source of calcium.
- An adequate intake of iron and ascorbic acid(vitamin C) should also be ensured.
- Vitamin D can also be got from co-liver oil, margarine and eggs.
- sun bathing should be encouraged; do not lock children indoors.

OSTEOMALACIA

This an equivalent to rickets but found in adults where there is lack of calcium in the bones. Common in women especially those of the child bearing age who have depleted their calcium store through many pregnancies and periods of lactation.

It is found in those who are confined indoors and eat diets low in vitamin D and calcium.

Symptoms of osteomalacia

- Pains are present (from dull aches to severe pains). Bone tenderness on pressure are common.
- Patient walks with legs wide apart appearing to waddle
- Tetany is common. Involuntary twitching of the muscles.
- Spontaneous fractures may occur.

Treatment and prevention of osteomalacia

- A good diet should be given including milk, eggs, butter and margarine.
- Adequate sunlight and consumption of calcium and vitamin D especially for pregnant and lactating mothers.
- Nutrition education should be given.

Excess of vitamin D

Hypervitaminosis D occurs because vitamin D is insoluble in water and any excess cannot be readily disposed of in urine. Large amounts of vitamin D can be poisonous.

Symptoms of hypervitaminosis D.

- Loss o appetite
- Intense thirst
- Constipation and diarrhoea
- Loss of weght
- Irritability ,coma
-

VITAMIN E (TOCOPHEROL)

Functions of vitamin E

1. Essential for normal metabolism of the body.
2. A very useful anti-oxidant as it delays normal oxidation and rancidity in food and in the body.
3. Helps in elasticity of arteries and veins.
4. In some animals, vitamin E is essential for reproduction .

Characteristics of vitamin E

- Soluble in fat and oils
- Stable to heat and acids
- A powerful anti-oxidant
- Unstable to alkalis and Utra-violet light
- Does not leach into water

Food sources

It is widely distributed throughout the food supply in food that are not highly processed.

Leafy vegetables, vegetable oils, milk, eggs, liver, muscle meat, fish, butter, margarine ,nuts

VITAMIN K (KOAGULATION VITAMIN)
Koagulation is a Danish word for clotting and England it is coagulation.

Characteristics of vitamin K
-Fat soluble
-heat stable
-Affected by irradiation

Functions of vitamin K
1. It assists in the formation of the prothrombin a protein essential for normal **blood clotting** in the liver.
2. bone development
3. It assists in maintaining strong bones in the elderly

Deficiency of vitamin K
-If the deficiency is mild, the blood takes longer to clot (prolonged clotting)
-In severe cases the blood fails to clot altogether and has no treatment leads to death.
-it is common in new-born babies because breast milk and cows milk contain little. The digestive tract in new-born are sterile.
-It is not common in adults as it is well distributed in foods. It is also made by bacteria in the intestines.

Sources of vitamin K
Liver(pig's liver), eggs, milk, fish, green vegetables, cauliflower, some fruits
It is manufactured by bacteria present in intestines.

Questions
1. Insufficient and excessive intake of various nutrients cause some disorders.
   Name nutritional disorders caused by both insufficient and excessive intake of the following nutrients.
   (i) iron (ii) fluorine (iii) vitamin A, (iv) vitamin D (v) carbohydrates
2. Give the symptoms and treatment for the following nutritional disorders .
   (i) Goitre
   (ii) Rickets and osteomalaciA
   (iii) Pellagra
   (iv) Beri-beri
   (v) Anaemia
3. (a) What are the functions of the following in the body?
      (i) Calcium
      (ii) Phosphorus
      (iii) Iron
      (iv) Ascorbic acid
   (b) Give food sources for each of the above nutrients