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Diploma in Pharmacy 2nd Year
Biochemistry & Clinical Pathology
Chapter 7 : Vitamins

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Chapter 7

Vitamins

- The word “Vitamin” comes from the Latin word “Vita” means “life”.
- Vitamins are organic component in food that is needed in very small amount for growth and for maintaining good health.
- Vitamins are chemicals found in very small amounts in many different foods.
- They required to the body through diet because they cannot be synthesized by the body.
- Water soluble vitamins cannot be stored in human’s tissues. Their excess is excreted with urine.
- Fat soluble vitamins can be stored in adipose tissue and the liver.

Function of Vitamins

- They build up the resistance of the body against disease.
- Prevent and cure various disease caused by deficiency.
- Help the Digestion and Utilization of Minerals salts and carbohydrates in the in the body.
- Stimulate and give strength to digestive & Nervous system.
- Help Maintenance of Proper Health & normal Growth.

Classification

- **Fat Soluble Vitamins** : Vitamins that dissolve in fat because fat is easily stored in our body, Fat soluble vitamins can be stored within out fat. This means they can accumulate and be saved for later use.
 - Vitamins A • Vitamins D • Vitamins E • Vitamins K
- **Water Soluble Vitamins** : Water Soluble Vitamins that dissolve in water because our body is a watery environment. These vitamins can move through our body pretty easily & they can also be flushed out by the kidneys.
 - Vitamin B Complex & Vitamin C

Scientific name of Vitamins

Fat soluble

- Vitamin A (Retinol)
- Vitamin D (Calciferol)
- Vitamin E (TocoPherol)
- Vitamin K (Phylloquinone)

Water soluble

- Vitamin B₁ (Thiamine)
- Vitamin B₂ (Riboflavin)
- Vitamin B₃ (Niacin)
- Vitamin B₅ (Pantothenic Acid)
- Vitamin B₆ (Pyridoxine)
- Vitamin B₇ (Biotin)
- Vitamin B₉ (Folic acid)
- Vitamin B₁₂ (Cobalamin , Cyanocobalamin)
- Vitamin C (Ascorbic Acid)

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Sources, chemical nature, functions, coenzyme form, recommended dietary requirements, deficiency diseases of fat-and water-soluble vitamins

Vitamin A (retinol)

→ Vitamin A is an unsaturated alcohol called retinol

Chemical Nature

- It is insoluble in Water.
- Soluble in ethanol & freely soluble in organic solvent like fats & oils.
- It is an Anti-Oxidant.
- Low sensitive light, heat, & Iodine.
- Retinoids occurs in three forms
 - Alcoholic Retinol
 - Aldehyde Retinol
 - Acid Retinoic Acid

Functions

- ✓ It is necessary for normal Vision.
- ✓ It is important for body growth.
- ✓ It helps in growth of bones and Neurological System.
- ✓ It keeps the skin , Kidneys , and other organs perfect.

Deficiency Diseases

- ◇ Night Blindness
- ◇ Xerophthalmia – (Blindness in Childhood)
- ◇ Keratomalacia (ulceration of cornea)
- ◇ Dryness of skin .etc

Coenzyme form

- The active form of vitamin A is retinal, which converted from retinol by the action of retinol dehydrogenase enzyme and finally transported throughout the body.
- Retinoic acid (hormone like substance and is involved in the cell growth and differentiation).

Dietary requirements

- ▲ For adult men : 900 micrograms (mcg).
- ▲ For adult women : 700 micrograms (mcg).
- ▲ For pregnant and lactating women have higher requirements.

Sources

- ✓ Green Vegetables , fruits , cereals , liver , milk , Butter , and egg yolk.

Vitamin D (Calciferol)

→ Vitamin D is also known as Anti-Rachitic Vitamin due to its property of curing or preventing ricket.

Chemical Nature

- It is insoluble in water Moderately soluble in fats, oils, & ethanol.
- Freely soluble in acetone, ether, & petroleum ether.
- It is sensitive to oxygen, light, & Iodine.
- Heating or mild acidity can convert it to the inactive forms.

Functions

- ✓ It increases the absorption of Calcium and Phosphorus from Intestine.
- ✓ It promotes the normal growth and development of bones.
- ✓ It keeps bones healthy.
- ✓ It promotes the normal growth of the body.

Deficiency Diseases

- ◇ Rickets in children
- ◇ Osteomalacia

Coenzyme form

- Calcitriol is an active form of vitamin D and acts as a coenzyme.

Dietary requirements

- ▲ According to the Institute of Medicine (IOM), the daily intake for adults is 600-800 international units (IU).

Sources

- ✓ Cod liver oil, fish liver oil, egg yolk, animal liver.

Vitamin E (Tocopherol)

→ Vitamin E is also known as anti-sterility vitamin or fertility vitamin due to its necessity in healthy functioning of reproductive system fertility of males and birth process in females.

Chemical Nature

- It is insoluble in water & soluble in fats & oils.
- They are anti-oxidants
- They are stable in air.
- It is acidic in nature.
- It is oil at room temperature.

Functions

- ✓ It is helpful for healthy reproductive system.
- ✓ It is an good antioxidant.
- ✓ It prevents liver cells from toxicity.
- ✓ It protect nerve fibres from demylination.
- ✓ It prevents rancidity.

Deficiency diseases

- ◇ Tooth discoloration
- ◇ Weakness of RBC
- ◇ Thrombocytosis and oedem
- ◇ Sterility in male , death of fetus in uterus in female

Coenzyme

- Tocopherols and Tocotrienols.

Dietary requirements

- ▲ According to the national institutes of health (NIH), the recommended daily intake for adult men and women is 15 milligrams per day.

Sources

- ✓ Meat , liver , fish , chicken , vegetable oils , green leafy vegetables ,egg yolk

Vitamin K (phylloquinone)

→ Vitamin K is also known as anti-haemorrhagic drugs or coagulation vitamin or vitamin for blood clotting.

Chemical Nature

- Insoluble in water, slightly soluble in ethanol, freely soluble in ether, chloroform, fats & oils.
- It is sensitive to light.

Functions

- ✓ It increases the activity of blood clotting factors.
- ✓ It helps the liver to manufacture the enzyme that catalyses the formation of prothrombin.

Deficiency diseases

- ◇ Delay in blood clotting
- ◇ Improper functioning of liver.

Coenzyme form

- Phylloquinone – Vitamin-K₁
- Menaquinone – Vitamin-K₂
- Menadione – Vitamin-K₃

Dietary requirements

- ▲ The recommended intake for the adult men and women is 120 micrograms per day

Sources

- ✓ green leafy vegetables(Spinach , Cabbage etc.) , Soya beans , wheat germ.

Vitamin B₁ (Thiamine)

→ Anti-Beri Beri Vitamin ang Anti-Neuritic Vitamin are other names for vitamin B₁.

Chemical Nature

- It is highly soluble in water, moderately soluble in methanol & glycerol, & insoluble in fats & oils.
- It is colourless crystal.

Functions

- ✓ It is necessary for maintaining good appetite.
- ✓ It helps in utilizing the carbohydrates in body.
- ✓ It is needed for brain metabolism.

Deficiency diseases

- ◇ Beri-Beri (nerve system problems , oedema , weakness , headache , Insomnia , GIT disorders.)
- ◇ Anorexia (loss of appetite)

Coenzyme form

- Thiamine pyrophosphate

Dietary requirements

- ▲ Dietary supply for adults 1-1.5 mg/day.
- ▲ For children 0.7-1.2 mg/day.
- ▲ Pregnancy and lactation 2 mg/day.

Sources

- ✓ rice bran , wheat bran , whole grains , nuts , pulses , beam , yeast , liver , eggs , fish , meat , and milk.

Vitamin B2 (Riboflavin)

→ It is essential for growth, development, & cellular function in body.

Chemical Nature

- It is moderately soluble in water, insoluble in fats & oils.
- It is light sensitive.

Functions

- ✓ It helps the regulation of some carbohydrate- metabolising hormones.
- ✓ In presence of light , it stimulate the optic nerve.

Deficiency diseases

- ◇ Injury of lips
- ◇ Cracks at the mouth' s angle)
- ◇ Eczema on face (red and dry skin and itch)
- ◇ Hair loss
- ◇ Red eye reproductive problems
- ◇ Cataract

Coenzyme form.

- Flavin mononucleotide (FMN).
- Flavin adenine dinucleotide (FAD).

Dietary requirements

- ▲ Daily requirement for adults 1.2-1.7 mg.

Sources

- ✓ Milk , liver , eggs yolk , sprouts cereals

Vitamin B₃ (Niacin)

→ Niacin is essential for cellular process & energy production.

Chemical Nature

- It is of amphoteric nature.
- It is soluble in water & insoluble in fats.
- It is stable in dry form.

Functions

- ✓ It perform metabolic function.
- ✓ It converts carbohydrates into glucose.
- ✓ It keeps nervous system working properly.

Deficiency diseases

- ◇ Dermatitis (Itchy inflammation of skin)
- ◇ Diarrhoea
- ◇ Demantia (memory loss , neuronal disorder)

Coenzyme form.

- Nicotinamide adenine dinucleotide (NAD⁺).
- Nicotinamide adenine dinucleotide phosphate (NADP⁺).

Dietary requirements

- ▲ Daily requirements for adults is 15-20 mg.

Sources

- ✓ Liver , fish , bean , and peanuts.

Vitamin B₅ (Pantothenic Acid)

→ Pantothenic acid is involved in energy production, hormone formulation & metabolism of dietary fats, protein, and carbohydrates.

Chemical Nature

- It is yellow viscous oil.
- It is soluble in water & ether, & insoluble in organic solvents like fats.

Functions

- ✓ It is essential for growth of infants and children.
- ✓ It is required for Breakdown of fats and carbohydrates for energy.
- ✓ It is required for formation of RBCs.

Deficiency diseases

- ◇ Anaemia
- ◇ Growth problem
- ◇ Liver problems
- ◇ Nausea
- ◇ Vomiting
- ◇ Fatty liver

Coenzyme form

- Coenzyme A

Dietary requirements

- ▲ Daily intake for adult is 5-10 mg.

Sources

- ✓ Honey , cereals , nuts , eggs , liver ,fish , milk , meat , bran

Vitamin B6 (Pyridoxine)

→ Pyridoxine or pyridoxal or pyridoxamine is an anti-oxidant that helps in protein metabolism & production of RBCs, neurotransmitters & haemoglobin in the body.

Chemical Nature

- It is colourless crystal at room temperature.
- Highly soluble in water & insoluble in chloroform and fat.
- It is stable in solution.

Functions

- ✓ It is needed for Infant growth.
- ✓ It is required for formation of dopamine , serotonin etc.
- ✓ Formation of RBCs and WBCs.

Deficiency diseases its deficiency rarely occurs

- ◇ Depression
- ◇ Confusion
- ◇ Decrease immune function
- ◇ Anaemia

Coenzyme form

- Pyridoxal phosphate (PLP).

Dietary requirements

- ▲ Daily requirements about- 2-2.2 mg/day.
- ▲ During pregnancy/lactation 2.5 mg/day.

Sources

- ✓ Milk , liver , eggs yolk , meat , leafy vegetables etc.

Vitamin B7 (Biotin)

→ Biotin helps in metabolism of lipids, proteins, & Carbohydrates from food, & releases energy from Carbohydrates.

Chemical Nature

- It is white crystalline substance.
- It is soluble in water & insoluble in fats.
- It is soluble in air.

Functions

- ✓ It helps in metabolism of carbohydrates , lipids , proteins and produces energy.

Deficiency diseases

- ◇ Alopecia (hair loss)
- ◇ Hair graying

Coenzyme form

- Biocytin is coenzyme form.

Dietary requirements

- ▲ Daily requirement for adult is 100-300 mg.

Sources

- ✓ Honey , Milk , liver , eggs yolk , meat , fish etc.

Vitamin B₉ (Folic acid)

→ Folic acid or Folate Or Folacinm helps in protein metabolism, RBC stimulation, reduces the risk of neural tube birth defects, controls homocysteine levels, & reduces the risk of coronary heart diseases.

Chemical Nature

- It is an organic yellow crystalline substance.
- Soluble in water & insoluble in fats.
- Unstable in light.

Functions

- ✓ It help in Protein metabolism,.
- ✓ Controls Homocysteine level.
- ✓ It break Homocysteine amino acid.

Deficiency diseases

- ◇ Affect DNA Synthesis
- ◇ Megaloblastic anaemia. (abnormal large Red Blood cells).

Coenzyme form

- Tetrahydrofolate (THF or FH₄).

Dietary requirements

- ▲ Daily requirements in adults are 200 µg.
- ▲ During pregnancy 400 µg.
- ▲ During lactation 300 µg.

Sources

- ✓ leafy vegetables liver , eggs etc .

Vitamin B₁₂ (Cobalamine)

→ Cobalamin is involved in the formation of genetic material, RBC Production, & Nervous system maintenance.

Chemical Nature

- It is red, red-orange or yellow crystalline substance.
- Soluble in water & insoluble in fats.
- Stable in heat.

Functions

- ✓ It is required for formation of genetic materials.
- ✓ For formation and maturation of RBCs.
- ✓ It is needed for maintenance of nervous system.

Deficiency diseases

- ◇ Neurological disorder
- ◇ Infertility
- ◇ Demyelination
- ◇ Megaloblastic anaemia

Coenzyme form

- Methylcobalamin (MeCbl).
- Adenosylcobalamin(AdoCbl).

Dietary requirements.

- ▲ Daily requirement for adult is 3µg.
- ▲ For children 0.5-1.5 µg/day.
- ▲ During pregnancy/lactation 4µg

Sources.

- ✓ Liver, kidney, Milk., Fish., Curd, Chicken etc

Vitamin C (ascorbic acid)

- Vitamin c is also named as anti scorbutic acid because it prevents scurvy.
- It is also recognized as an anti-rabies or anti-cancer vitamin.

Chemical Nature

- It is soluble in water, & in soluble in fats.
- In aqueous solution, dehydroascorbic acid is unstable.

Functions

- ✓ It is necessary for Iron absorption.
- ✓ It provides immunity against viruses and cold.
- ✓ It keeps gums and capillaries healthy.
- ✓ It helps in wound Healing.

Deficiency diseases

- ◇ Scurvy disease
 - Bleeding from gums and decaying teeth.
 - Loosing teeth.
 - Haemorrhage due to weakness of capillaries.
 - Delay in wound healing.

Coenzyme form

- Ascorbic acid.

Dietary requirements

- ▲ Daily requirements for the adult is 60-70 mg.

Sources

- ✓ Citrus fruits, Goose berry, Guava, Green vegetables, Tomatoes, Adrenal gland and gonads.

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