**VITAMINS**

Vitamins exist in food as organic substances. They don’t have any caloric value for the body and only participate in the chemical and biochemical functions as regulators. They are required in very small quantities in the body for normal growth and functioning. Vitamins are divided into two main groups based on their solubility:

1. Fat soluble vitamins 2. Water soluble vitamins

**Fat Soluble vitamins (A, D, E & K):**

These vitamins are soluble in fats, stored in excess body fat and utilized when required in the body.

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| **Vitamin** | **Available Form** | **Sources** | **Functions in the Body** | **Deficiency disease** | **Heat sensitivity** |
| A (Retinol) | Pale yellow solid | Animal sources: Liver oil, butter, cheese &eggs.Plant sources: Carrots, spinach, tomatoes, cabbage& peas provide β-carotene (precursor) that converts into retinol in the body. retinol has same functions as of vitamin A in the body. | * Essential for normal growth and metabolism of body.
* Keeps the skin smooth and provide resistance against infections to the mucus lining of mouth cavity and digestive track
 | Children: Retarded growthAdults: Night blindness | Heat stable and is not lost normal cooking and processing |
| D(Cholecalciferol) | White crystalline compounds | Animal sources: Fish liver oil, eggs, butter, cheeseHuman body: Vitamin D is produced by the action of ultarviolet rays of the sun. | Helps in the absorption of calcium and phosphorus in the body. | Children: Rickets (softening of bones).Adults: Osteomalacia | Heat stable not lost during heating and processing of food. |
| E(Tocopherol) | - | Oil seeds, vegetable oils, wheat germ, eggs & milk. | * Act as antioxidants and protect fats and oils from rancidity.
* Regulate reproductive functions in humans.
* Required for healthy immune system and protects harmones from oxidation.
 | **-** | Heat sensitive and lost during auto-oxidation of lipids. |
| K(Naphthaquinone derivatives) | 3-forms:K-1(yellow viscous oil)k-2 & k-3( yellow needles) | Animal sources: Beef liverPlant sources: cabbage, cauliflower, spinach, olive & green peas.In body: Intestinal bacteria synthesize this vitamin.  | Has anti-hemorrhagic roles in the body. | * Liver damage
* Hemorrhagic condition in which blood fails to clot after an injury or accident.
 | Photo-reactive |

**Water Soluble Vitamins (B complex & C):**

These vitamins are soluble in water. These are required in small quantities are not stored in the body, hence are always needed in the body. These vitamins are present either in free form or as part of enzymes in the body as coenzyme.

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| **Vitamins** | **Available form** | **Source** | **Functions in the body** | **Deficiency disease** | **Heat sensitivity** |
| B1(Thiamine) | White solid | Cereal grains, potatoes, peas, dry beans, pulses, nuts and milk. | * Participate as coenzyme in the oxidation process of glucose.
* Promotes good appetite and digestion
 | Beriberi (muscular weakness, palpitation of heart and degeneration of nerves | Heat sensitive and lost during hating and processing. |
| B2(Riboflavin) | Yellow crystals | Milk, liver, lean meat, eggs, cheese and dark leafy vegetables  | * Participate as coenzyme in the oxidation process of glucose
* Keeps the eyes healthy and skin around mouth and nose smooth
 | Glossitis (the tongue and lips swell and scaliness at the corners of mouth). | Heat stable but lost during trimming, peeling, milling and photo-sensitive. |
| B3(Nicotinic acid) | White crystals | Lean meat, poultry, fish, leafy vegetables, groundnuts, beans, pulses. | * Participate as coenzyme in the oxidation process of glucose
* Maintain healthy skin, tongue, digestive tract and nervous system
 | Pellagra (diarrhea, scaling and discoloration of body parts exposed to sun rays, dementia(loss of memory) | Heat resistant but lost through trimming, leaching. |
| B5(Pantothenic acid) | Yellow viscous oil/ salt. | Egg and liver | * Essential for blood cell formation
* Participate as coenzyme in the oxidation process of glucose
 | Burning sensation of hands in feet, headache, tiredness restlessness, stomach pain, heart burn, nausea, vomiting and loss of appetite | Stable in the pH range of 4-7 in thermally processed foods. |
| B6(Pyridoxine) | Crystals  | Rice bran, seeds, cereals, egg yolk, meat, liver and kidney | * Involved in transamination of amino acid metabolism
 | * Seborrheic dermatitis (rash appears on skin, scalp and mouth.
* Week immune system
 | Sensitive to light |
| B7(Biotin) | Crystals/ needles | Egg yolk and liver and synthesized by intestinal bacteria | * Participate as coenzyme in carboxylation and trans-carboxylation reactions
* Biotin combines with avidin (egg protein) and make it unavailable to the body
 | - | Heat and light stable |
| B9(Folic acid) | Yellow orange needles | Liver, green vegetables, yeast and kidney | * Concerned with nucleic acid synthesis and formation of RBC’s
 | Megaloblastic anaemia (RBC’s formed are less in number or of larger size)  | Sensitive to O2 |
| B12(Cyanocobalamine) | Red crystalls | Animal tissues and fermented vegetables | * Act as coenzyme
* Role in growth and formation of RBC’s
 | Pernicious anemia Strict vegetarians suffer from this deficiency | Heat sable |
| Vitamin C(Ascorbic acid) | White crystals | Citrus fruits like orange, lime, grapefruit, guava, mango, green pepper, spinach, green peas, tomatoes and potatoes | * Essential for formation of all body tissues and blood vessels
* Aids absorption of iron from intestine
* Wound healing
* Tooth and bone formation
 | Scurvy disease characterized by bruising under skin, failure of wounds to heal, bleeding of gums and anemia | Sensitive to O2, preparatory operation and high temperatures |

**Experiment #2**

**DETERMINATION OF CRUDE FAT IN A FOOD SAMPLE**

**Purpose:**

To teach students the method of estimation of fat or oil in a food sample.

**Preparing the sample:**

Dry the product and remove moisture in order to facilitate entry of the organic solvent, because moisture restricts the entry of organic solvent. Then size reduction is done to increase the surface area of food particles of sample. After this, we go for acidic hydrolysis which helps in breaking of protein fat emulsion and increases the availability of fat for the solvent.

**Requirements:**

Weighing balance, Soxhlet apparatus, Drying oven, Thimble, Heating mantle, Glass rod, Desiccator with silica gel, Diethyl ether (Boiling temperature 60°-80°c), Cotton plugs

**Procedure:**

* Weigh 5 gram of grounded and dried sample and place it in the thimble.

Place the thimble in the soxhlet extractor.

* Take a 150ml round bottom flask and clean it and fill the flask with 75-100 ml diethyl ether.
* Place the whole apparatus on a heating mantle and allow the diethyl ether to boil.
* Continue the extraction process for 8-12 hours.
* Separate the condensing unit from extraction unit and allow the sample to cool down.
* Place the thimble with sample in the oven and after removing it place in the desiccator.
* Weight the thimble with sample.

**Calculation:**

* Empty thimble = w1
* Thimble with sample = w2
* Weight of sample = p

Crude fat (%) = Weight of thimble with sample – weight of empty thimble × 100

Weight of sample

Diagram**: Soxhlet apparatus**

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