Food Constituents

I-Macronutrients

1-PROTIEN
Protein is a nitrogenous compound, made of a number of amino acids linked together. Amino acids are classified into essential (indispensable) and nonessential (dispensable), and proteins are classified into high and low biological value.

Essential amino acids: 8 in number, cannot be synthesized by the body, and so must be provided by the diet. [Leucine, isoleucine, methionin, phenylalanine, threonin, tryptophan, valine, and lysine.]

Conditional essential amino acids or nonessential amino acids:
- in childhood seven other amino acids are essential that are not essential in adult (Arginine, Histidine, Cysteine, Glycine, Tyrosine, Glutamine, Proline). These amino acids are essential in children because they are required in amounts larger than can be synthesized.
- some amino acids only become essential in circumstances when the requirement is increased e.g. Glutamine, Serine, Asparagine.

Nonessential amino acids: described so because when missing in the diet, they can be synthesized by the body. [Glutamic acid, Alanine, Aspartic acid]

High biological value protein: protein that contain all the essential amino acids in adequate amount. All animal proteins are of high biological value except gelatin.

Low biological value protein (LBV): if one or more essential amino acids are not present in a protein or of inadequate amount so can not maintain growth or support life by itself. All plants proteins are of LBV, except of soybeans.

Sources of Protein:
Animal foods:
- Milk, cheese and yoghurt.
- Eggs: yolk and white
- Meat: muscles of farm animals, poultry and fish, and organ meat [liver, kidney, spleen, brain]
Plant foods:
- Pulses [dried beans, peas, lentils].
- Cereals [grains, flour, rice] good sources.
- Nut

Function of Proteins:
- **structural**: protein is important for the structure of the body and about half of the body's protein is in structural tissues such as skin and muscle. These structural protein are collagen (25% of the body protein) actin, and myosin.
- **Formation of cells**: protein {the only nitrogen – containing nutrient} is necessary to form protoplasm {cytoplasm, which is nitrogenous compound}. Formation of cells include:
  - Building up of new cells: during growth, and pregnancy.
  - Maintenance of cells that are continually exposed to wear and tear.
  - Repair of injured cells.
- **Formation of essential biological compounds**: Hormones, enzymes, immunoglobulin {made of gamma globulin}, haemoglobin and others.
- **Transport**: proteins act as transport carriers in the blood and body fluids for many molecules and nutrients, e.g haemoglobin, lipoprotein.
- **Regulation of fluid movement** between blood and tissues: osmotic pressure is balanced by plasma proteins.
- **Buffer action**, for maintenance of tissue reaction.
- **Combustion**: provides small percent only {around 10%} of energy requirement.

Protein deficiency:
**Causes of protein deficiency**:
- protein deficiency can occur when the diet does not provide enough protein or energy or a combination of both. (if energy intake is insufficient, protein will be degraded to produce energy). protein energy malnutrition (PEM) is a major cause for concern in developing countries
- increase losses in renal disease
- increase catabolism in trauma, burns or sepsis
• malabsorption

**Protein deficiency will result in:**
- **muscle wasting, and stunted growth,** so it will lead to:
  - Protein-energy malnutrition {PEM} in infants and young children.
  - Undergrowth in school children.
  - Underweight and debility in adults, up to marasmic state in severe cases
- **Nutritional edema,** due to hypoproteinaemia:
  - In kwashiorkor: edema is a constant feature.
  - In adults.
- **Impaired immune response:** deficient formation of immunoglobulin, and more susceptibility to infection {interaction of malnutrition and infection}.
- **General weakness** and early fatigue.

**Recommended Dietary Allowance:** is **0.75 grams per kilogram** of body weight per day, which is **45 – 60 grams** for an adult.

**Recommended Protein Intake:**
- Relatively more protein is needed for vulnerable groups: growing children, and pregnant and lactating mothers. It is also recommended to give adequate proportion of animal – protein food daily, especially milk or / and cheese.
- Protein requirement is somewhat less for females than males.
- With largely plant rather than animal protein – rich diet:
  - More protein intake is required.
  - A variety of protein – rich plant foods is required daily, to upgrade biological value.

### 2- CARBOHYDRATES

Carbohydrates form the greater bulk of average diet.  
*They are classified into:*
- **Sugars:**
  - *Monosaccharide*, e.g. glucose, fructose, galactose
  - *Disaccharides*, e.g. sucrose, (table sugar is 99% sucrose), lactose, maltose

- *Oligosaccharides* : e.g. raffinose, stachyose, they are found in legumes and seeds
• **Starches: Polysaccharides:** starch is formed of two glucose polysaccharides: amylase and amylopectin

• **Non-starch polysaccharides - fiber:** are either soluble fibers or insoluble fibers (cellulose and some hemicellulloses)

**Sources:** all carbohydrates are of plant origin, except lactose {milk sugar} and glycogen {animal starch}.

**Plant sources:**
1- Foods containing sugar or starch:
   - Cereal grains and pulses: rich sources.
   - Potatoes, sweet potatoes, rice, bananas, dates, honey, molasses, and dried fruit: good sources.

2- Refined products: sugar, flour and starch.
   - Sugar and flour: used to make bread, cakes, syrups, macaroni …
   - Starch: used for many food purposes.

**Function:** digestion of carbohydrates ends in glucose, the essential sources of fuel {one gram gives 3.75 kcal}, that provides the greater part of energy need of the body, Glucose metabolism needs insulin and thiamine.

   *Cellulose:* cellulose of food is indigestible, but gives bulk which is valuable for stimulation of intestinal peristalsis, and prevention of constipation. Dietary roughage showed to be of value in prevention of cancer colon.

**Recommended Intake:**
- No fixed dietary allowance that varies with total energy need of the individual. The minimum daily requirement for carbohydrates is **100 gm**.
- Carbohydrates of balanced diet give around **60% of energy** requirement.
- Actual carbohydrate consumption, however, differs with socioeconomic features and food habits. in developing countries up to **85%** of energy in the diet is provided by carbohydrate

**Glycaemic index (GI):** is a method of ranking foods and carbohydrates based on their immediate effect on blood glucose levels.
- The standard carbohydrate is] glucose that has a **GI 100**
- Food with a high GI are readily absorbed and raised blood glucose quickly, while low GI food are digested and absorbed slowly and raise blood glucose levels slowly.
- Foods are categorized into
  - Low GI: e.g. apples, oranges, peaches, beans, lentils
  - Medium GI: e.g. honey, jam, ice cream
  - High GI: e.g. glucose, white rice, whole and whole meal bread

**Potential disorders of dietary carbohydrates:**

Arise from excess intake, low intake or impaired metabolism.

1- **Excess Intake:**
   - Development of obesity: excess carbohydrates of diet are converted into fat which is deposited in fatty tissues of the body. The individual would thus be at-risk of the hazards of obesity.
   - Excess intake of refined sugar {usually sucrose} is a risk factor of CHD, through causing hyperlipidaemia.

2- **Low Intake:** with diet therapy, when the individual is on carbohydrate-restricted diet. He is exposed to:
   - Combustion of fat for energy, causing excess formation and accumulation of ketene bodies, and risk of ketosis.

3- **Impaired glucose utilization:** due to uncontrolled diabetes mellitus. The case is exposed to hazards of low intake.

3-**FATS**

Dietary fat is the most concentrated source of food energy. Fats are often referred to as lipids.

Over 90% of dietary fats are triglyceride, other types of fat include cholesterol, phospholipids, sterols, and carotenoids.

**Triglyceride** : have glycerol backbone to which are attached three fatty acids. The type of fatty acids determine the physical properties, nutritional function and physiological function of triglyceride

**Saturated fatty acids (SFA):** contain carbon atoms linked by single bonds and hydrogen on all available arms. They tend to be solid at room temperature.

SFA are obtained from animal storage, fats and their products, e.g. meat, fat, lard, milk, butter, cheese and cream. The plant
sources are coconut oil and palm oil. Some manufactured margarines contain significant amount of SFA. SFA tend to raise plasma cholesterol.

**Monounsaturated fatty acids (MUFA)**

Contains only one double bond and are usually liquid oil at room Temp. olive oil and rapeseed oil are the most concentrated dietary sources of MUFA. MUFA do not raise plasma cholesterol and lower LDL.

**Polyunsaturated fatty acids (PUFA)**

Contain two or more double bonds, and are liquid at room Temp. The most common PUFA are the essential fatty acids:

- linoleic acid (which present in plant seed oil), and $\alpha$-linoleic acid.
- Derivative of linoleic acid: Omega 6 (ω 6) and omega 3 (ω 3) are found in fish and fish oils. The health benefits of consumption of oily fish include improved cardiovascular risk factors.

Essential fatty acids are required in the diet because they are precursors of prostaglandin and are part of the structure of lipid membranes in all cells.

**Sources of fat**: animal and plant.

1-**Animal fat**: obtained from

- Animal food: full-cream milk, cheese and yogurt, egg yolk, and fatty meet of cattle, poultry and fish.
- Prepared fat: butter, cream, and cooking fat, they are solid at ordinary temperature.

2-**Vegetables oils**: obtained from:

- Plants food: sesame, olives, peanuts, soybeans, nuts ....
- Prepared oils: oils are extracted from some plants seeds, commonly cotton seeds, olives, corn, and sunflower seeds. They are liquid at ordinary temperature.

3-**Margarine**: manufactured by hydrogenation process of vegetable (plant) oils those become solid.

At ordinary room temperature:

- All animal fats are solid, except fish liver oil which is used for pharmaceutical purposes.
- All plant oils are liquid, except cocoa butter used for medicinal, cosmetic and food purposes, and peanut butter.
Function of fats:
• Energy source, (one gram of fat gives 9 kcal)
• Fat is a carrier for fat soluble vitamins A, D, E, and K
• Fat provides essential fatty acids
• For preparation and cooking of food, to become more palatable, by improving taste perception and appearance of food, prolong emptying time of stomach, and so give sense of satisfaction after food.
• Some fats are important constituents of cell membrane, and can be converted to biologically active compounds such as steroid hormones, interleukins, thromboxanes, and prostaglandins
• Cholesterol is converted to bile acids, which is important in digestion

Recommended Intake: balanced diet provides a suitable amount of fat that satisfies required functions. Intake, however, is not fixed, but varies with personal food habits and environmental season and atmospheric temperature factors. Most common recommendations are to limit dietary fat to 30% or less of total calories, and SFA should be less than 10% of total fat. Excess dietary fat must be avoided, while restricted – fat diet is sometimes indicated.

Dietary Fat – associated disorders:
Due to excess consumption, and metabolic disorders.
1- Excess consumption of fat: causes
• Hazards of high – cholesterol diet: cholesterol is found in animal foods, specially egg yolk, organ meat and dairy products, while plant foods are free. High – cholesterol diet contributes to cardiovascular disease, and cholelithiasis.
• Obesity.
• Digestive disturbance.

2- Metabolic disorder of dietary fat:
They arise from saturated fatty acids of animal fat and margarine, rather than plant oils, fatty acids of which are unsaturated. Fat – associated disorders are related to serum lipids, especially high level of low – density lipoprotein [LDL], and low level of high – density lipoprotein [HDL] which is:
  ☐ Risk factors of atherosclerosis.
  ☐ Contributes to cardiovascular disease [hypertension and CHD].
## Size of adult requirements for essential nutrients

<table>
<thead>
<tr>
<th>Adult daily requirement</th>
<th>Essential nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gram amount</strong></td>
<td></td>
</tr>
<tr>
<td>1 Kg [1 liter]</td>
<td>Water</td>
</tr>
<tr>
<td>50-100g</td>
<td>Available carbohydrate</td>
</tr>
<tr>
<td>50g</td>
<td>Protein [8-10 essential a. a]</td>
</tr>
<tr>
<td>1-5 g</td>
<td>Na, Cl, K, essential fatty acids</td>
</tr>
<tr>
<td>0.4-1g</td>
<td>Ca, P</td>
</tr>
<tr>
<td><strong>Milligram amounts</strong></td>
<td></td>
</tr>
<tr>
<td>300 mg</td>
<td>Mg</td>
</tr>
<tr>
<td>40 mg</td>
<td>Vit C</td>
</tr>
<tr>
<td>15 mg</td>
<td>Niacin, vit E, Fe, Zn</td>
</tr>
<tr>
<td>5 – 10 mg</td>
<td>Pantothenate, Mn</td>
</tr>
<tr>
<td>1 – 2 mg</td>
<td>Vit A, thiamin, riboflavin, vit B₆, F, Cu</td>
</tr>
<tr>
<td><strong>Microgram amounts</strong></td>
<td></td>
</tr>
<tr>
<td>200 µg</td>
<td>Folate, Mo</td>
</tr>
<tr>
<td>100 µg</td>
<td>Biotin, I, Se</td>
</tr>
<tr>
<td>2 – 10 µg</td>
<td>Vit B₁₂, vit D, vit K, Cr</td>
</tr>
</tbody>
</table>

Figures are approximate, in places rounded to fit with other on line. The range of requirements for different nutrients is about 10⁹. In addition, Sulphur is required in the form of amino acids methionine and cysteine. Cobalt is required in the form of vitamin B₁₂.