Topics to be covered -
-> Food and Nutrition
-> Cell biology
-> Health and Diseases
-> Organ System
-> Genetics and Biotechnology

Biology Class 01

Previous Class Topic

- No specific previous class topic was referenced.

Food and Nutrition

- Focuses on the essential components present in various foods.
- Emphasizes the importance of consuming a variety of nutrients for energy, growth, and overall well-being.

Nutrients

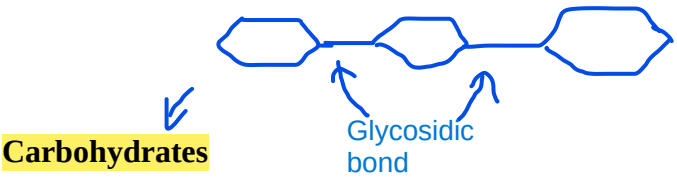
- Substances in food that provide energy or serve as building blocks. for repair and growth.
- Generally categorize into two groups: macronutrients and micronutrients.

Macronutrients and Micronutrients

and forms major part of our diet

- **Macronutrients**: Needed in larger quantities. Include carbohydrates, proteins, and fats.
- **Micronutrients**: Required in smaller amounts but are equally vital. Mainly consist of vitamins and minerals.

and they form lesser part of our diet



Carbohydrates

- **Definition and Role**
- Organic compounds made of carbon, hydrogen, and oxygen.
- Primary source of energy for the body.
- **Types**
- **Monosaccharides**: Single-unit sugars (*e.g., glucose, fructose, galactose*).
- **Oligosaccharides**: Composed of a few sugar units linked together (*e.g., sucrose, lactose, maltose*).
- **Polysaccharides**: Larger carbohydrate chains (*e.g., starch, glycogen, cellulose*).
- **Digestion and Energy**
- The body breaks down carbohydrates to obtain glucose for immediate energy.
- Excess glucose is first stored as glycogen in animals and starch in plants. Once glycogen stores fill, surplus glucose converts to fat.
- **Sources**
- Grains (rice, wheat, barley, maize), potatoes, and sugary foods.
- Natural sweeteners like honey, jaggery, and syrups containing simple sugars.
- **Weight Gain and Carbohydrates**
- Overconsumption of carbohydrate-rich foods can lead to an excess of glucose converting to fat.
- Limited glycogen storage capacity means extra carbs eventually settle in adipose tissue.

Plants → Starch

Glucose → stored → Glycogen

Animals and Human

GFG

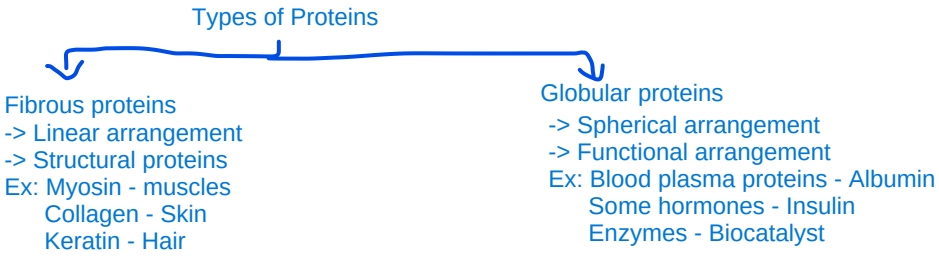
SML

CGS

they are made up of Glucose

When we eat Carbohydrate rich food then excessive Glucose is stored in the form of Glycogen and when Glucose is more than our storage capacity then is gets converted into Fat.

-> Smallest unit of Carbohydrate is Monosaccharide and they gets joined with Glycosidic bonds to form larger carbohydrates.



Proteins

- **Composition and Structure**
- Contain carbon, hydrogen, oxygen, and nitrogen.
- Built from amino acids joined by peptide bonds.
- Nitrogen is a key element distinguishing proteins from carbohydrates and fats.
- **Varieties and Functions**
- **Structural (Fibrous) Proteins**: Provide support and structure (*e.g., collagen for skin, keratin for hair and nails, myosin for muscle fibers*).
- **Functional (Globular) Proteins**: Carry out various roles (*e.g., enzymes, hormones like insulin, and transport proteins such as albumin*).
- **Amino Acids and Protein Formation**
- Basic units known as amino acids.
- A chain of amino acids forms a polypeptide, which folds into a specific shape.
- Shape determines function, hence the distinction between fibrous and globular proteins.
- **Enzymes as Biocatalysts**
- Speed up chemical reactions in the body without being consumed.
- *Example*: Lactase breaks down lactose into glucose and galactose.
- Lactose intolerance arises when lactase production is insufficient.
- **Sources**
- Eggs, meat, pulses, dairy products, and certain plant-based foods.
- Milk supplies a range of nutrients, including protein, fats, vitamins, and minerals.
- **Protein Requirements**
- Typically follow the guideline of about 1 gram of protein per kilogram of body weight per day.
- Meeting these needs can be challenging if diets consist predominantly of grains.

Fats

- **Basic Composition**
- Consist of carbon, hydrogen, and oxygen.
- Characterized by being insoluble in water.
- Major storage form is triglycerides (three fatty acids + one glycerol linked by ester bonds).
- **Functions of Fats**
- Component of cell membranes, contributing to cell integrity.
- Necessary for hormone production (e.g., steroid hormones such as estrogen and testosterone).
- Provide insulation and help maintain body heat (realized in animals living in cold climates).
- Aid the absorption of fat-soluble vitamins (A, D, E, K).
- **Sources**
- Animal-based items: butter, cheese, ghee, cream, meats.
- Plant-based oils: mustard, sunflower, sesame, and olive.
- Nuts and seeds: almonds, walnuts, groundnuts.
- Avocado: popular for its unsaturated fat content.
- **Types of Fatty Acids**
- **Saturated Fatty Acids**
- All carbon-carbon single bonds.
- Often solid at room temperature (*e.g., butter, ghee, coconut oil*).
- **Unsaturated Fatty Acids**
- Contain at least one carbon-carbon double bond.
- Further subdivided into:
- *Monounsaturated (MUFA)*: One double bond (*e.g., olive oil, groundnut oil*).
- *Polyunsaturated (PUFA)*: Multiple double bonds (*e.g., fish oil, certain nut oils*). Almond oil.
- Some unsaturated fatty acids are essential (omega-3, omega-6) because they cannot be synthesized by the body.

-> When this fat gets deposited in blood vessel then there is no way to clean it up and when blocks vessel then doctors do bypass surgery.
-> There is an initiative named Global Elimination of Artificially Produced Trans Fatty Acid in which India is also part.
-> FSSAI sets less than 2% is the permissible limit of trans fatty acid in food.

- **Trans Fatty Acids**
- Created mostly through industrial processes like hydrogenation.
- Promote a longer shelf life in processed foods.
- Common in vanaspati ghee, fast foods, fried snacks, and certain baked products.
- **Health Implications**
- **Trans Fats**
- Contribute to arterial plaque deposits and pose higher health risks.
- A major factor in cardiovascular diseases (heart attacks, stroke, high blood pressure).
- **Saturated Fats**
- Generally safe if consumed in moderation.
- Excess intake may also accumulate in blood vessels but is less harmful than trans fats.
- **Unsaturated Fats**
- Considered beneficial for cardiovascular health.
- Help regulate cholesterol levels.
- **Storage and Metabolism**
- Fats yield more calories per gram than carbohydrates, making them a dense energy source.
- Excessive intake and insufficient activity lead to greater fat deposition.

Micronutrients

- Include vitamins and minerals in small quantities.
- Crucial for metabolic, enzymatic, and physiological processes.

Vitamins: Water-Soluble and Fat-Soluble

- Vitamins differ from macronutrients in that they largely do not provide energy but help regulate multiple bodily functions.
- Two categories based on solubility:
- **Water-Soluble**: Vitamin B complex and Vitamin C.
- **Fat-Soluble**: Vitamins A, D, E, and K.

Vitamin B Complex (Water-Soluble)

- A group of vitamins with distinct chemical forms but often found together.
- Important for mouth, oral health, nerves, and many metabolic processes.
- Excess water-soluble vitamins are excreted; toxicity issues are rare with a balanced intake.
- **Vitamin B1 (Thiamine)**
- *Sources*: Peanuts, milk.
- *Deficiency*: Beriberi (impairment in growth and nerve function).
- **Vitamin B2 (Riboflavin)**
- *Sources*: Milk, bananas.
- *Deficiency*: Cheilosis (cracks in corners of the mouth).
- **Vitamin B3 (Niacin)**
- *Sources*: Mushrooms, eggs.
- *Deficiency*: Pellagra (*also called 4D disease: diarrhea, dermatitis, dementia, and possible death*).
- **Vitamin B5 (Pantothenic Acid)** TRNP PBFC
- *Sources*: Soybeans, eggs.
- *Deficiency*: Fatigue and general weakness.
- **Vitamin B6 (Pyridoxine)**
- *Sources*: Milk, grains.
- *Deficiency*: Possible nerve damage (tingling, burning sensations).
- **Vitamin B7 (Biotin)**
- *Sources*: Oranges, strawberries.
- *Deficiency*: Hair loss and nail fragility.
- **Vitamin B9 (Folic Acid)**
- *Sources*: Dates, spinach, beetroot.
- *Deficiency*: Can cause neural tube defects in early pregnancy, affecting embryo brain and nervous system development.
- **Vitamin B12 (Cyanocobalamin)**
- *Sources*: Meat, fish, dairy (limited in plant-based diets).
- *Deficiency*: Pernicious anemia, low moods, or anxiety, as B12 is vital for red blood cell formation and nervous system health.

Vitamin C (Ascorbic Acid) (Water-Soluble)

- **Sources**
- Citrus fruits like oranges and lemons.
- Other fruits and vegetables can also supply vitamin C.
- **Deficiency: Scurvy**
- Symptoms include bleeding gums, joint pain, and muscle pain.
- Sometimes referred to as “Sailor’s disease,” it historically affected sailors deprived of fresh produce.
- Clinically affects immune function and collagen formation.

Additional Notes on Lactose Intolerance and Alternative Options

- Lactose intolerance arises when the enzyme lactase is insufficient or nonfunctional.
- Undigested lactose can cause gastrointestinal discomfort.
- Alternatives include:
- **Plant-based milks**: Almond milk, soy milk, cashew milk.
- **Coconut milk**: Common in various cuisines.
- **Lactose-free dairy**: Lactose is removed enzymatically.

Additional Insights on Health and Nutrition

- **Fiber (Cellulose)**
- Found in plant cell walls.
- Humans cannot digest cellulose, so it acts as dietary fiber and aids bowel movements.
- **Importance of Moderation**
- Overuse of saturated or trans fats can lead to plaque in arteries.
- Excess carbohydrates can convert to stored fats.
- Protein deficiency affects muscle repair and various bodily functions.
- **Role of Enzymes**
- Each metabolic reaction has a specific enzyme.
- Enzyme deficiencies lead to issues digesting or synthesizing certain substances.
- **Hair and Nail Health**
- Keratin, a fibrous protein, forms hair and nails.
- Biotin (B7) supplements often recommended for breakage or hair loss.
- Collagen is key for skin firmness; used in some supplements or treatments.

Topic to be Discussed in the Next Class

- Fat-soluble vitamins (A, D, E, K) and minerals.
- Cell biology, including cell structure and related concepts.