COMPOSITION OF FOOD AND NUTRITIONAL VALUE
COURSE - FOOD BIOCHEMISTRY (FPT-121)

DR SARVENDRA KUMAR
COLLEGE OF FISHERIES KISHANGNJ

Introduction

- Food is essential for life they are derived from plants, animals and single-cell organisms.
- Food is any nutritious substance that people eat or drink in order to maintain life.
- The food one eats provides energy for all body functions and to form new cells for the body.
- A variety of food is eaten according to taste, body requirement and availability. All living ones whether plant or animal need food for growth, repair and maintenance of body.

Functions of food

- Necessary body building material, energy yielding material and protective materials.
- Food also supplies elements and compounds **necessary for metabolism.**
- polysaccharides are only partly utilized for energy as dietary fiber **-they affect the various processes in the gastrointestinal tract.**
- In an animal body, lipids occur primarily as an energy rich store of neutral fat in the subcutaneous adipose
- Many of the minor components originally present in the raw materials are nutritionally essential, such as vitamins.
- Some of them, although not indispensable, can be utilized by the body, including most free amino acids, or impart desirable sensory properties to food products.

- Many food compound added during processing, to be used as **preservatives, antioxidants, colorants, flavorings, sweeteners**, and emulsifying agents, or to fulfill other technological purposes.
- Numerous groups, including tocopherols, carotenoids, ascorbic acid, thiols, amines, and several other non-protein nitrogenous compounds serve as endogenous muscle antioxidants, playing an essential role in postmortem changes in meat.

Classification of nutrients supplied by food

- Classes of nutrients: **water, carbohydrates, fats, proteins, minerals** and **vitamins.**
- Two groups namely **macronutrients** and **micronutrients.**
- **Macronutrients-**needed in large amounts, include carbohydrates, fats, protein and water.
- **Micronutrients-** needed in smaller quantities, are minerals and vitamins.
- other compounds present in minor quantities- Non-protein nitrogenous compounds, colorants, flavor compounds and functional additives these have significant impact on the quality of many products

SOURCES OF FOOD COMPONENTS

Water	Carbo-hydrates	Proteins	Lipid	Minerals	Vitamins
Juices	Sugars	Soybean	Oils	Vegetables	Vegetables
Fruits	Honey	Beans& peas	Lard	Fruits	Fruits
Milk	Cereals	Meat	Milk, Butter, Ghee, Vanaspathy	Meat	Fish liver
Vegetables	Chocolate& sweets	Fish	Chocolate	Fish products	Meat
Jellies	Potato	Wheat	Nuts	Dairy products	Cereals
Lean fish	Cassava	Cheese	Egg yolk	Cereals	Milk
Lean meat	Fruits & Vegetables	Eggs	Pork	Nuts	Yeast

Necessary body building material

- **Polysaccharides, proteins,** and **lipids** serve as **the building material** of different structures of the plant and animal tissues.
- The structures made of these materials are responsible for the form and tensile strength of the tissues
- Created the necessary conditions for metabolic processes to occur.
- Plays a crucial biological role in the organisms.
- Some of the main components and other constituents, are **bound to different cell structures or are distributed in soluble form in the tissue fluids.**

Energy yielding material

Carbohydrate

- The most efficient source of energy and the cheapest source of food.
- Can be readily digested, absorbs and utilized for producing energy.
- Main sources: Starch in the granular form in cereals, pulses and tubers and sugars that are present in milk, fruits and vegetables and sucrose.

Protein

- Oxidation of carbon skeletons of amino acids of proteins furnishes a minor but significant fraction of the daily energy requirement.

Fat

- Fat (Triglyceride) from plant and animal are major source of energy.
- Fat has high fuel value. It has got high capacity to be stored as energy in the body.

Protective

- Many of the minor components present food are nutritionally essential, such as vitamins and minerals

Other Function in food

- Many of the minor components originally present in the raw materials of food are nutritionally essential, such as vitamins and minerals.
- Others such as most free amino acids can be utilized by the body or impart desirable sensory properties to food products.
- Numerous groups, including tocopherols, ubiquinone, carotenoids, ascorbic acid, thiols, amines, and several other non-protein nitrogenous compounds serve as endogenous muscle antioxidants, playing an essential role in postmortem changes in meat.
- Some minor components are useless or even harmful if present in

Water

- The water content ranges from a few percent (in dried commodities-milk powder) to 90% in many fruits and vegetables.

Functions

- Indigenous water that is immobilized in the plant and animal tissues by the structural elements and various solutes contributes to the maintenance of the conformation of the polymers, serves as a solvent for different constituents, and interacts in metabolic processes.

Water content of important food is

Water	%
Milk	86.8
Fresh Fruits	80-90
Fresh Vegetables	80-90
Fish	70-80
Pork	68-70
Beef	70-73
Chicken	73-75
honey	20.0
grains	15.0
Cereals	12-14
Pulses, seeds	10-50
Nuts	3-5

Carbohydrate

- Carbohydrates are widely distributed in plant and animal tissues.
- Carbohydrates commonly occurs in foods - Starch, glucose, fructose, sucrose and lactose.

Functions:

- used as the main source of energy in the body.
- About 50-70 % of energy value in the average diet is provided by carbohydrates. Glucose derived by digestion of carbohydrates is stored as glycogen in liver and muscle
- They also serve as a source of carbon skeletons for synthesis of various organic compounds.
- Some carbohydrates are dissolved in tissue fluids or perform different biological functions, such as in free nucleotides or as components of nucleic acids, or in being bound to proteins and lipids.
- Some plant polysaccharides are only partly utilized for energy. However, as dietary fiber they affect, in different ways, various processes in the gastrointestinal tract.

Carbohydrate content of some important foods

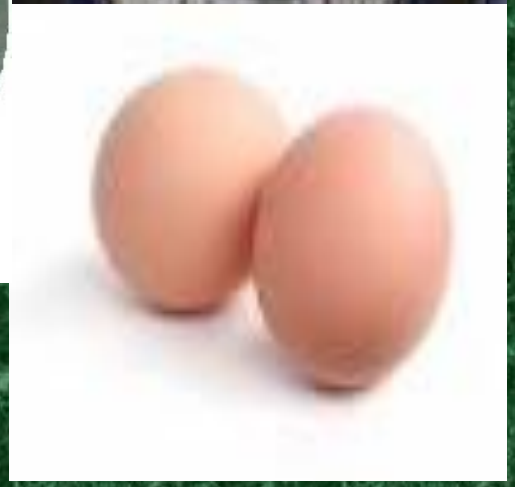
Name of food	Carbohydrate %
Jaggery	94 – 95
Cane sugar	99.0
Sago	87 – 89
Arrow root flour	85 – 87
Honey	79 – 80
Dried fruits (Raisin, dates, etc.)	67 – 77
Cereals and millets (rice, jowar, etc.)	63 – 79
Pulses (Bengal gram, red gram, etc.)	56 – 60
Roots and tubers (Potato, tapioca, sweet potato, etc.)	22 – 39
Nuts and oilseeds	10 - 25
Fresh fruits	10 - 25
Fresh vegetables	2 - 20
Milk (fluid)	4 - 5

Protein

- Protein content in foods is present mainly as crude protein - N x 6.25
- The nitrogen-to-protein conversion factor (N:P) of 6.25 has been recommended for most plant and animal food products under the assumption that the N content in their proteins is 16%
- The N content in the proteins in various food, however, is different because it depends on the amino acid component of protein compounds, such as free peptides and amino acids, nucleic acids
- The non-protein N may constitute up to 30% of total N.
- Food proteins are of two types

Animal origin - meat, milk and eggs ; Vegetable proteins- pea, bean, pulses

Important source of protein



Lipids

- A group of naturally occurring substances characterized by their insolubility in water and solubility in organic solvents.
- They occur in plant and animal tissues.
- They include simple lipids, compound lipids and derived lipids.

Function

- Oils and fats serve as the main source of energy.
- They also provide the essential fatty acids. They are good source of fat soluble vitamins.
- Fat serve as an insulating material in the subcutaneous tissues and around vital organs
- It provide materials for the synthesis of cholesterol and certain hormones.
- Lipoproteins and glycoproteins are essential for maintaining cellular integrity.
- Fat is essential for maintaining good health

Fat contents of different foods

Food groups	Fat content (%)	Food groups	Fat content (%)
Butter	85	Lamb	5.7
Peanut	50	Pork	5
Soybean	21	Chicken(white meat)	1
Sunflower seed	45	Milk (fresh)	3.5-4.0
Egg yolk	32	Wheat	2
Cotton seed	30	Rice	2
Beef Meat	6	Corn	6.5
Lean fish muscle	<1	Fruits, vegetables	<1

Fats from different sources have different types of fatty acids.

Percentage compositions of fatty acids in common fats and oils

Fat	Saturated				Unsaturated		
	C_4-C_{12}	C_{14}	C_{16}	C_{18}	C18:1	C18:2	C18:3
Butter fat	11	8	26	11	33	4	-
Coconut oil	63	18	9	2	8	2	-
Cotton seed oil	-	1	17	2	30	56	-
Egg fat	-	-	25	8	52	22	2.9
Groundnut oil	-	-	9	3	65	17	-
Lard	-	1	28	15	47	4	0.5
Rapeseed oil	-	-	6	2	28	15	3.5
Safflower seed oil	-	-	6	4	38	51	-
Sesame oil	-	-	10	2	29	51	8.1
Sunflower oil	-	-	6	5	14	73	-
Sardine oil	-	6.6	15.5	3.7	17.3	3	1.3

Minerals

- Minerals are needed in small amounts but are important for the body's basic growth and structure.
- Minerals are naturally occurring inorganic element in the soil which is transformed into an organic compound for use and assimilation by the human body.
- There are about 25 minerals that are essential to life and are present in the body
- Nutritionally important minerals are classified into major and minor minerals
- Major minerals- calcium, phosphorus, magnesium, sodium, potassium, and chloride. And trace elements - iron, iodine, zinc, selenium, chromium and copper.

source of minerals- Egg, meat, milk, nuts, fruits, vegetables, and cereals are the chief sources of mineral in diet and Milk products supply the majority of calcium and phosphorus

Minerals

- There are 16 minerals that the human body needs in order to function properly.
- Some minerals perform important functions like **formation of bones** and **teeth**, **haemoglobin of blood cells**, **thyroid hormone**, **components of hair**, **nail** and **cell integrity etc.**

Mineral content of edible portion of fish

- Fish is a good source of minerals particularly small fish which are eaten with bones are good source of calcium, phosphorus, iron and copper.
- The only rich source of iodine commonly included in the human diet is fish.
- Most shellfish especially oysters are rich in calcium, magnesium, copper, zip, and iodine.

Mineral content of edible portion of fish

Mineral	Average content (mg%)	Mineral	Average content (mg%)
Potassium	300	Iron	1.5
Chloride	200	Manganese	1.0
Phosphorus	200	Zinc	1.0
Sulphur	200	Fluorine	0.5
Sodium	63	Arsenic	0.4
Magnesium	25	Copper	0.1
Calcium	15	Iodine	0.1

Vitamin

- Vitamins are organic micronutrients, required in only milligram or microgram quantities per day. They are required vital functions of the body and many of them are involved in the utilization of major nutrients like proteins, fats and carbohydrates.
- Although they are needed in small amounts, they are essential for the health and well being of the body.
- **Classification;** They are classified into water-soluble and fat-soluble.

  fat soluble vitamins A, D, E and K

  water soluble vitamins comprise vitamin C and eight B vitamins namely thiamine, riboflavin, niacin, pyridoxine, cobalamin, folate, pantothenic acid and biotin.

Functions:

- Most of the vitamins B are essential components of specific coenzymes for enzymes participating in energy metabolism and other specialized activities.
- Vitamins regulate body processes such as energy production
- blood clotting and calcium balance.
- Vitamins help to maintain organs and tissues healthy.

Sources:

Vitamins are found in fruits, vegetables, grains, legumes, meat, fish and dairy products.

Fish as a sources of vitamins: Fishes are good sources of fat soluble vitamins A,D and E and of water soluble vitamins of B group.

- Fish liver oils are known as the richest source of vitamin A and D.
- Vitamin A content up to 30,000 IU/g and vitamin D upto 250,000 IU/g of liver has been found in some species.
- Fish liver oils are very often used for medicinal purposes because of these vitamins fish oils are also rich in vitamin E than any other animal fat.

Vitamin	Average content (µg %)
Vitamin A	25
Vitamin D	15
Vitamin E	12

Vitamin B	Average content (µg %)
Thiamin	20
Riboflavin	120
Nicotinic acid	3000
Vitamin B_{12}	1
Pantothenic acid	500
Pyridoxine	500
Boitin	5
Folic acid	80
Vitamin C	3000

Factor affecting food composition

Raw material

- The content of different components in **food raw materials** depends on the **species and variety of the animal or plant crop;**
- The conditions of life and age of the farm harvesting of the plants
- On the feeding, conditions of life, and age of the farm animals or the fishing season for fish and marine invertebrates

Processed foods:

- The composition of processed foods depends on and on changes taking place due to processing and storage.
- These changes are mainly brought about by endogenous and microbial enzymes, active forms of oxygen, heating, chemical treatment, and processing at low or high pH.

Changes occurring in food due to processing

- Leaching of soluble, desirable and undesirable components, such as vitamins, minerals and toxins occurs during washing, cooking.
- These are lost in dripping after thawing or due to cooking.
- Loss of moisture and volatiles occur due to evaporation and sublimation
- During salting, frying or smoking there is leaching of nutrients and absorption of desirable or harmful compounds.
- Due to enzyme activity, desirable or harmful compounds are formed.
- There is also development of typical flavour in cheese or decarboxylation of amino acids in fish
- There is a loss of nutrients and deterioration of dried fish due to attacks by flies, mites and beetles.