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৪৯তম স্পেশাল বিসিএস (শিক্ষা) বিষয়ভিত্তিক প্রস্তুতি

বিষয়: খাদ্য ও পুষ্টি বিজ্ঞান (৬৬১)

Compendium PDF

(সিলেবাস অনুসারে সর্বাধিক গুরুত্বপূর্ণ টপিক ও এমসিকিউ-এর সমন্বয়ে রচিত)

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প্রিয় শিক্ষার্থী, ৪৯তম স্পেশাল বিসিএস (শিক্ষা)-এর বিষয়ভিত্তিক প্রস্তুতি খাদ্য ও পুষ্টি বিজ্ঞান অংশের PCS নির্ধারিত সিলেবাসের অন্তর্ভুক্ত সকল ক্লাস সম্পন্ন হয়েছে। আসন্ন চূড়ান্ত পরীক্ষায় সামনের রেখে LIVE MCQ একাডেমিক টিম আপনার প্রস্তুতিকে শাগিত করতে বিশেষ কম্পেনিডিয়াম PDF প্রদান করেছে। এই PDF-এ যা যা থাকছে।

সূচিপত্র

PSC নির্ধারিত সিলেবাস ও মানবন্টন
টপিক ভিত্তিক সাজেশন
শেষ মুহূর্তের নির্দেশনা
পড়ার টেকনিক ও গুরুত্বপূর্ণ কৌশল
সর্বাধিক গুরুত্বপূর্ণ ২০০ MCQ

PSC নির্ধারিত সিলেবাস ও মানবন্টন

Subject Code: 661

Total Marks-100

Part-I (Marks-50)	
Main Topic	Sub Topic
1. Definition of Nutrition, Health and Malnutrition	(a) Relation of nutrition and health. (b) Major nutritional problems of Bangladesh- PEM, micronutrient malnutrition. (c) Classification and functions of nutrients.
2. Carbohydrates	(a) Classification, chemical nature, source and functions of different types of carbohydrate- simple and complex carbohydrates. (b) Functions of dietary fiber.
3. Proteins	(a) Classification, chemical nature and sources of different proteins. (b) Essential amino acids
4. Fats and Fatty Acids	(a) Classification and chemical nature of different fats in the body. (b) Essential fatty acids- Omega 3 and Omega 6 fatty acids- their role in nutrition. (c) Disadvantage of excess fat intake.
5. Vitamins	(a) Classification, chemical nature and food sources. (b) Co-enzyme functions of vitamins. (c) Deficiency of vitamins in the body.

Part-I (Marks-50)	
Main Topic	Sub Topic
6. Minerals- their physiological roles- functions and food sources	(a) Major minerals (b) Minor Minerals
7. Energy intake and expenditure	(a) Measurement of energy expenditure. (b) Factors influencing energy requirement. (c) Calculation of one's energy requirement.
8. Enzyme and hormones	(a) Classification and chemical nature of different forms of enzyme and hormones. (b) Physiological role and disease states of hormones action.
9. Metabolism of carbohydrate, fats and proteins	(a) Glycolysis, TCA cycle, fatty acid oxidation, deamination and transamination. (b) Inborn errors of metabolism- Glycogen storage disease, fructosuria, phenylketonuria etc.

Part-I I (Marks-50)	
Main Topic	Sub Topic
1. Approximate Composition of Common Food stuffs	Cereals, meat, fish, eggs, milk, pulses and legumes, nuts and oil-seeds, vegetables and fruits.
2. Nutrition during normal life cycle	(a) Pregnancy and lactation- nutrition requirement, effect of malnutrition during Pregnancy. (b) Infancy and early childhood- nutritional requirement breast-feeding and weaning. (c) Elderly- health problem and nutritional modification of adult diet for old people.
3. Assessment of nutritional status of community	(a) Types of assessment- anthropometry, clinical, biochemical, dietary assessment and Surveys. (b) Advantage and disadvantages of each type.
4. Concept and importance of nutrition education	(a) Objectives of nutrition education and implementing nutrition education program in a community. (b) Use of audio-visual aids in nutrition education.

5. Community based approaches to solve nutritional problems	(a) Improving household food security. (b) Food fortifications and supplementation. (c) Promoting appropriate dietary guidelines.
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Part-I I (Marks-50)	
Main Topic	Sub Topic
6. Causes, Symptoms and Nutritional Management of Diseases	(a) Diarrhea; (b) Constipation; (c) Diabetes mellitus; (d) Hypertension; (e) Liver and kidney diseases.
7. Food additives and Food Preservation	(a) Classification of food additives and their uses in food industry. (b) Method of food preservation- heating, refrigeration, drying, use of chemicals, irradiation, pasteurization, canning, bottling, jams, pickles etc. (c) Causes of Food spoilage.
8. Antioxidant in health and nutrition	(a) Chemical nature and sources of anti-oxidants. (b) Role of anti-oxidants in detoxification of the body. (c) Free radicals and oxidative stress.
9. Micronutrient malnutrition in Bangladesh	(a) Prevalence of vitamin A deficiency, IDD and anemia. (b) Steps and measures to remove micronutrient malnutrition among the population. (c) Importance of nutritional rehabilitation for the vulnerable group.

টপিকভিত্তিক সাজেশন

মূল টপিকস	** সর্বাধিক গুরুত্বপূর্ণ	* গুরুত্বপূর্ণ
Definition of Nutrition, Health and Malnutrition	- Functions of nutrients, Micronutrient deficiency, - Kwashiorkor এবং Marasmus	Relation of nutrition and health.

		Treatment in Severe Acute Malnutrition
Carbohydrates	- Classification of Carbohydrates with Chemical Properties - Health Benefits of Dietary Fibers	Functions of Different Carbohydrates
Proteins	- Classification of Proteins (Based on Structure) and Their Function. - Essential Amino Acids and Non-Essential Amino Acids: Names and Functions - Biological Value of Protein	- Chemical Properties of Protein - Protein Denaturation - Structure of Protein
Fats and fatty acids	- Health Benefits and Sources of Omega-3 and Omega-6 Fatty Acids - Properties of Fats and Oils	- Functions of Lipids and Oils - Atherosclerosis

মূল টপিকস	** সর্বাধিক গুরুত্বপূর্ণ	* গুরুত্বপূর্ণ
Vitamins	- Functions and Deficiencies of Vitamins - Co-Enzyme function of vitamin - Sources of Vitamins	- Daily Requirement of Vitamins - Properties of Vitamins
Minerals	Functions, Sources and deficiencies of Ca, Na, P, Mg, K, Fe, Iodine	- Functions and Sources of Mg, Chloride, Cu, Zn, Selenium, Mn, Cr - Daily Requirement of Different Minerals
Energy intake and expenditure	- Components of Energy Expenditure - Calculation of Energy Requirement	Calculation of Energy from Food and calculation of gram of Carbohydrates, Protein, Lipid from Total Calorie

	Factors Affecting Energy Requirement	
Enzyme and hormones	- Classification and Functions of Enzymes - Factors Affecting Enzyme Activity - Types of Hormones - Functions of ADH, GH, Oxytocin, Prolactin, FSH, LH, T3, T4, Calcitonin	- Enzyme-Substrate Inhibition Models - Digestive Enzymes - Mechanism of Hormone Action

মূল টপিকস	** সর্বাধিক গুরুত্বপূর্ণ	* গুরুত্বপূর্ণ
Metabolism of carbohydrate, fats and proteins	- Steps and Enzymes of Glycolysis - Steps and Enzymes of TCA Cycle - Beta-Oxidation of Fatty Acids	- Deamination and Transamination - Metabolic Disorders - Urea Cycle
Approximate composition of common food stuffs	- Amount of Carbohydrates, Protein, and Fats in Rice, Wheat, Milk, Meat, Fish - Names of Proteins Present in Meat, Fish, Egg, and Cereals - Functions and Names of Vitamins, Minerals, and Phytochemicals in Fruits and Vegetables	- Bread Making and Yogurt Production - Pulses and Legumes: Composition and Function - Oilseeds: Composition and Function
. Nutrition during normal life cycle	- Nutritional Requirements During Pregnancy - Nutritional Requirements During Breastfeeding - Function of Colostrum	- Complementary and Supplementary Feeding - Nutritional Requirements for Geriatric Patients - Nutritional Requirements for Adolescents and Adults

মূল টপিকস	** সর্বাধিক গুরুত্বপূর্ণ	* গুরুত্বপূর্ণ
Assessment of nutritional status of community	- Anthropometric Methods: Advantages and Disadvantages - Clinical Methods: Features, Advantages, and Disadvantages - Biochemical Tests: Features, Advantages, and Disadvantages	Dietary Assessment Methods: Food Count, 24-Hour Recall, FFQ – Advantages and Disadvantages
Concept and importance of nutrition education	- Importance of Nutrition Education - Audio-Visual Aids in Nutrition Education	Steps in Planning Nutrition Education
. Community based approaches to solve nutritional problems	- Food Fortification - Factors Affecting Food Security - Ways of Improving Household Food Security.	- Examples of Supplementation - Supplementation Programs
Causes, symptom and nutritional management of disease	- Symptoms, Causes, and Nutritional Management of Diabetes - Symptoms, Causes, and Nutritional Management of Heart Disease - Symptoms, Causes, and Nutritional Management of Kidney Disease	- Symptoms, Causes, and Nutritional Management of Liver Disease - Causes, Symptoms Nutritional Management of Diarrhea and Constipation

মূল টপিকস	** সর্বাধিক গুরুত্বপূর্ণ	* গুরুত্বপূর্ণ
Food additives and Food Preservation	• Causes of Food Spoilage • Freezing, Pasteurization, Dehydration • Irradiation	• Curing and Smoking • Foodborne Illness
Antioxidant in health and nutrition	• Sources and Functions of Antioxidants • Health Benefits of Antioxidants	• Oxidative Stress and Free Radicals
. Micronutrient malnutrition in Bangladesh	• Causes, Symptoms, and Nutritional Treatment of Vitamin A, Iron, and Iodine Deficiencies	• Steps and Measures to Improve Micronutrient Deficiencies • Importance of Nutritional Rehabilitation

FOOD AND NUTRITION

Part-I

1. Definition of Nutrition, Health and Malnutrition

Food

Definition of Food: “According to Sumati R. Mudambi, food is any substance that nourishes the body. Only those substances which, when eaten or drunk and absorbed, provide energy, promote growth, repair tissues, and regulate body processes can be regarded as food.”

Foods are classified according to their functions into three main groups.

1. **Energy-giving foods** supply energy for physical activity, metabolic processes, and maintaining body temperature. These mainly include carbohydrates such as rice, wheat, maize, potato, sugarcane, honey, and fats like butter, ghee, oils, nuts, and seeds.
2. **Body-building foods** are essential for growth, repair, and maintenance of body tissues. Proteins such as meat, fish, egg, milk, pulses, beans, soybeans, and nuts fall under this group.
3. **Protective and regulatory foods** help regulate body processes, enhance immunity, prevent infections, and maintain overall health. This category includes vitamins and minerals found in fruits (mango, orange, banana), vegetables (spinach, carrot, tomato), milk, egg, and fish.

Nutrition

Definition of Nutrition: Nutrition বা পুষ্টি হলো এমন একটি প্রক্রিয়া, যার মাধ্যমে খাদ্য দেহের বৃদ্ধি, ক্ষয়পূরণ এবং শক্তি উৎপাদনে সহায়তা করে। এই বিষয়ের বিজ্ঞানসম্মত অধ্যয়নকে বলা হয় পুষ্টিবিজ্ঞান। “Nutrition is the science of nourishing the body” অর্থাৎ দেহের পুষ্টি সাধনের বিজ্ঞানকেই পুষ্টিবিজ্ঞান বলা হয়।

A nutrient is a chemical substance in food that is essential for an organism's growth, maintenance, and proper functioning.

Classification of Nutrients

Nutrients are classified into two classes based on the amount required by the body for normal growth, maintenance, and proper functioning.

- **Macronutrients** (proteins, fats and carbohydrates) are needed in **large amounts** by the body and are typically measured in **grams (g)**.
- **Micronutrients** (vitamins and minerals) are needed in **very small amounts** and are measured in **milligrams (mg)** or **micrograms (µg)** because the body requires much less of them compared to macronutrients.

Functions of nutrients

1. Functions of Carbohydrates:

- **Energy Production:** Primary source of fuel for the body; **1 g of carbohydrate provides 4.1 kcal of energy**.
- **Energy Storage:** Stored as glycogen in liver and muscles for later use.
- **Building Macromolecules:** Serve as precursors for DNA, RNA, and glycoproteins.
- **Protein Sparing:** Prevents proteins from being used as energy.
- **Fat Metabolism:** Supports efficient lipid metabolism.

2. Functions of Proteins:

- **Structure and Support:** Form the framework of cells and provide structural support to tissues like bones, skin, hair, and nails.
- **Enzymatic Action:** Act as enzymes to speed up metabolic and other vital chemical reactions.
- **Transport and Storage:** Carry essential nutrients and molecules throughout the body.
- **Immune Response:** Form antibodies and other components to protect against disease.
- **Movement and Signaling:** Facilitate muscle contraction and enable cell communication.
- **Energy Source:** **1 g of protein provides 4.1 kcal of energy**.

3. Functions of Fats:

- **Energy Storage and Production:** Concentrated energy source; **1 g of fat provides 9.1 kcal**. Stored fat can be broken down for later use.
- **Protection and Insulation:** Cushions vital organs and insulates the body to maintain temperature.
- **Vitamin Absorption:** Essential for absorption of fat-soluble vitamins (A, D, E, K).
- **Cell Structure and Growth:** Key component of cell membranes, vital for cell growth.
- **Hormone Production and Regulation:** Precursor for hormones and helps regulate bodily functions.

4. Function of Vitamins:

Fat-Soluble Vitamins

- **Vitamin A (Retinol):** Supports vision (especially in low light), teeth, bones, skin, immune system, reproduction, and cell growth.
- **Vitamin D (Calciferol):** Regulates calcium and phosphorus absorption for strong bones and teeth; can be synthesized via sunlight.
- **Vitamin E (Tocopherol):** Antioxidant protecting cells from free radicals; supports immunity and blood vessel health.
- **Vitamin K (Phylloquinone, Menaquinones):** Essential for blood clotting and bone health.

Water-Soluble Vitamins

- **Vitamin B1 (Thiamin):** Converts carbs into energy; essential for nerve and heart function.
- **Vitamin B2 (Riboflavin):** Supports energy metabolism, red blood cell production, cell growth, and vision.
- **Vitamin B3 (Niacin):** Converts food to energy; supports nervous system, digestion, and skin health.
- **Vitamin B5 (Pantothenic Acid):** Needed for energy metabolism, hormone, and cholesterol production.
- **Vitamin B6 (Pyridoxine):** Involved in protein metabolism, brain function, red blood cell formation, and blood sugar regulation.
- **Vitamin B7 (Biotin):** Supports metabolism of fats, proteins, and glucose; promotes healthy hair, skin, and nails.
- **Vitamin B9 (Folate/Folic Acid):** Crucial for DNA synthesis, cell formation, and pregnancy (prevents neural tube defects).

- **Vitamin B12 (Cobalamin):** Works with folate for red blood cells and DNA; essential for nerve function.

5. Function of minerals

Minerals are inorganic elements required by the body for various structural, functional, and regulatory roles. Based on the **amount required by the body**, they are classified into **macrominerals** and **trace minerals**.

- **Macrominerals:** Minerals required in **large amounts (≥ 100 mg/day)**. They are essential for structural components, fluid balance, nerve function, and other major body processes.
- **Trace Minerals:** Minerals required in **small amounts (< 100 mg/day)**. They are crucial for enzyme function, hormone production, and other regulatory processes.

Functions of Macrominerals

- **Calcium (Ca):** Builds and maintains bones and teeth; aids in blood clotting, muscle contraction, and nerve function.
- **Phosphorus (P):** Works with calcium for bones and teeth; part of DNA, RNA, and cell membranes; involved in energy production and acid-base balance.
- **Magnesium (Mg):** Cofactor for 300+ enzyme reactions; supports muscle and nerve function, immune system, bone health, and protein synthesis.
- **Sodium (Na):** Maintains fluid balance and blood pressure; essential for nerve transmission and muscle contraction.
- **Potassium (K):** Works with sodium to maintain fluid balance and blood pressure; necessary for muscle contraction and nerve impulses.
- **Chloride (Cl):** Maintains fluid balance; component of stomach acid for digestion.
- **Sulfur (S):** Component of proteins and vitamins; important for skin, hair, and nail structure.

Functions of Trace Minerals

- **Iron (Fe):** Essential for hemoglobin formation, oxygen transport, energy metabolism, and immune support.
- **Zinc (Zn):** Cofactor for enzymes; supports cell growth, metabolism, immunity, wound healing, protein and DNA synthesis.
- **Iodine (I):** Needed for thyroid hormone synthesis; regulates metabolism, growth, and development.

- **Selenium (Se):** Acts as an antioxidant; supports thyroid function and maintains hair and nails.
- **Copper (Cu):** Cofactor for enzymes; aids iron metabolism, connective tissue formation, and brain/nervous system function.
- **Manganese (Mn):** Involved in carbohydrate, amino acid, and cholesterol metabolism; contributes to bone formation.
- **Fluoride (F):** Supports bone and teeth formation; prevents tooth decay.
- **Chromium (Cr):** Assists insulin in regulating blood glucose levels.
- **Molybdenum (Mo):** Component of enzymes that break down certain amino acids.

6. Major Functions of Water in the Body

- **Transport:** Carries nutrients, oxygen, and waste products throughout the body.
- **Waste Removal:** Aids kidneys, liver, and excretion via urine, sweat, and feces.
- **Temperature Regulation:** Maintains body temperature through sweating and high heat capacity.
- **Lubrication & Cushioning:** Cushions joints, tissues, and organs; keeps them moist.
- **Chemical Reactions:** Medium for metabolism, digestion, and nutrient absorption.
- **Cellular Health:** Maintains cell structure and supports cellular functions.

Health is defined by the World Health Organization (WHO) as "a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity".

Relation of nutrition and health

উপযুক্ত পুষ্টি স্বাস্থ্যের জন্য অত্যন্ত গুরুত্বপূর্ণ। এটি দেহকে শক্তি প্রদান করে, বৃদ্ধি এবং কোষ গঠনে সাহায্য করে এবং শারীরিক কার্যকারিতা ঠিক রাখে। শর্করা, চর্বি ও প্রোটিন শক্তি উৎপাদন ও টিস্যু গঠনের জন্য প্রয়োজন, আর ভিটামিন ও খনিজ লবণ দেহের বিভিন্ন প্রক্রিয়া নিয়ন্ত্রণ ও সুস্থতা বজায় রাখে। সঠিক পুষ্টিগ্রহণ খাদ্য গ্রহণ রোগ প্রতিরোধে এবং রোগ নিরাময়ে সহায়তা করে। অপরিপূর্ণ বা অপ্রতুল পুষ্টি দেহকে দুর্বল করে, কর্মক্ষমতা কমায় এবং রোগ প্রতিরোধ ক্ষমতা হ্রাস করে। মা ও শিশুর পুষ্টি শারীরিক ও মানসিক বিকাশে গুরুত্বপূর্ণ; অপুষ্টি দীর্ঘমেয়াদি স্বাস্থ্য, সামাজিক ও অর্থনৈতিক প্রভাব ফেলে। সুতরাং, পুষ্টি ও স্বাস্থ্য পরস্পরের সঙ্গে ঘনিষ্ঠভাবে সম্পর্কিত—ভালো পুষ্টি স্বাস্থ্য, কার্যক্ষমতা এবং সমাজের উন্নয়ন নিশ্চিত করে, আর অপুষ্টি এগুলোকে হ্রাস করে।

Malnutrition

Malnutrition is a broad term for deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients, which can have adverse effects on body form, function, and clinical outcomes.

Major nutritional problems in Bangladesh

- **Undernutrition.**
- **Protein-Energy Malnutrition (PEM)**
- **Micronutrient Deficiencies**
- **Double Burden of Malnutrition**

Undernutrition

This occurs when there is an inadequate intake of calories and essential nutrients, leading to being underweight.

- **Stunting:** Low height for age.
- **Wasting:** Low weight for height.
- **Underweight:** Low weight for age

বয়স অনুযায়ী ওজনের শতকরা হার (Weight for Age, W/A) – গোমেজ শ্রেণিকরণ

বয়স অনুযায়ী ওজনের শতকরা হার	শ্রেণি	ব্যাখ্যা
> 90%	স্বাভাবিক (Normal)	শিশু স্বাভাবিকভাবে বেড়ে উঠছে
75 – 89%	মৃদু অপুষ্টি (Grade I, Mild)	হালকা অপুষ্টি
60 – 74%	মধ্যম অপুষ্টি (Grade II, Moderate)	মাঝারি মাত্রার অপুষ্টি
< 60%	গুরুতর অপুষ্টি (Grade III, Severe)	প্রকট/গভীর অপুষ্টি

Protein-Energy Malnutrition (PEM)

Protein-Energy Malnutrition (PEM), now often called protein-energy under nutrition, is a condition caused by a lack of sufficient protein and energy (calories) in the diet.

Two classic forms of severe PEM are:

- **Marasmus:** Characterized by severe wasting of subcutaneous fat and muscle, marked growth retardation, and absence of edema.
- **Kwashiorkor:** Often features significant edema, hepatomegaly (enlarged liver), and fatty infiltration of the liver, with less pronounced muscle wasting compared to marasmus.

বৈশিষ্ট্য	কোয়াশিওরকর (Kwashiorkor)	ম্যারাসমাস (Marasmus)
বয়স	সাধারণত ১২-৩৮ মাস বয়সে বেশি দেখা যায়	সাধারণত ৬-১৮ মাস বয়সে বেশি দেখা যায়
পুষ্টিহীনতার ধরন	প্রোটিনের ঘাটতি	প্রোটিন ও ক্যালরি উভয়ের ঘাটতি
ওজন হ্রাস	স্বাভাবিকের তুলনায় ২০-৩০% কম	প্রকটভাবে ৬০-৭০% কম
এডিমা (পানি জমা)	থাকে (হাত, পা, মুখমণ্ডল, পেট ফুলে যায়)	থাকে না
চামড়া	পাতলা হয়ে যায়, দাগ পড়ে, ক্ষত হয়	একেবারেই পাতলা হয়ে কুঁচকে যায়
চুল	বিবর্ণ, ভঙ্গুর, কর্কশ, সহজে উঠে যায়	সাধারণত স্বাভাবিক থাকে

Treatment in Severe Acute Malnutrition

Feature	F-75	F-100
Phase	Stabilization (initial)	Rehabilitation (catch-up)
Purpose	Corrects imbalances, gentle on body	Rapid weight gain, rebuilds tissues
Nutrients	Low protein, fat, sodium	High protein & fat
Energy	75 kcal/100 mL	100 kcal/100 mL
Duration	2-7 days (until stable)	Longer, during rehab phase

Common Micronutrient Deficiencies

- Iron → Deficiency: Iron-deficiency anemia → Fatigue, weakness, poor work capacity, ↑ maternal & child mortality.
- Iodine → Deficiency: IDD → Goiter, cretinism, reduced mental capacity.
- Vitamin A → Deficiency: Exophthalmia → Night blindness, blindness, ↑ infection risk.
- Zinc → Deficiency: Stunted growth, delayed maturation, poor immunity, slow wound healing.
- Folate (B9) → Deficiency: Megaloblastic anemia, neural tube defects in pregnancy.
- Vitamin D → Deficiency: Rickets (children), osteomalacia (adults), osteoporosis.
- Vitamin B1 (Thiamine) → Deficiency: Beriberi, Wernicke-Korsakoff syndrome.
- Vitamin B12 → Deficiency: Megaloblastic anemia + neurological symptoms.
- Vitamin C → Deficiency: Scurvy (bleeding gums, joint pain, poor healing).

Double Burden of Malnutrition (DBM)

এটি এমন একটি অবস্থা যেখানে একই পরিবার, সম্প্রদায়, বা এমনকি একই ব্যক্তির মধ্যেও

- **অপুষ্টি (undernutrition)** যেমন – stunting, wasting, underweight, এবং
- **অতিরিক্ত পুষ্টি (overnutrition)** যেমন – overweight, obesity ও diet-related non-communicable diseases (ডায়াবেটিস, উচ্চ রক্তচাপ ইত্যাদি) একসাথে বিদ্যমান থাকে।

2. Carbohydrates

(a) Classification, chemical nature, source and functions of different types of carbohydrate- simple and complex carbohydrates.

(b) Functions of dietary fiber.

Carbohydrates are organic compounds composed of carbon (C), hydrogen (H), and oxygen (O), typically in the ratio 1:2:1, including sugars, starches, and cellulose, which can form polymers through C–O–C bonds.

They are a major energy source, providing 55–75% of daily energy (WHO/FAO), and constitute 50–80% of plant dry weight.

কার্বোহাইড্রেটের উৎস

শ্রেণী	উদাহরণ / শর্করা	উৎস
এক-শর্করা (Monosaccharides)	গ্লুকোজ, গ্যালাক্টোজ	মিষ্টি ফল, চিনি, আঙ্গুর, মধু, দুধ (ল্যাকটোজ)
দ্বি-শর্করা (Disaccharides)	সুক্রোজ, মালটোজ, ল্যাকটোজ	মিষ্টি ফল, চিনি, গুড়, অঙ্কুরিত শস্য, দুধ
বহু-শর্করা (Polysaccharides)	সেলুলোজ, স্টার্চ, গ্লাইকোজেন	ফলের খোসা, ডাঁটা, শাক-পাতা, ছাল, শ্বেতসার, কন্দ, মূল, বীচি, কলা, প্রাণিদেহের পেশী ও যকৃত

Classification of Carbohydrates with Physical and Chemical Properties

Feature	Monosaccharide's	Oligosaccharides	Polysaccharides
Definition	Simplest form of carbohydrate; cannot be hydrolyzed further	Composed of 2–10 monosaccharide units linked by glycosides bonds	Composed of many monosaccharide units linked by glycosides bonds
Examples	Glucose, Fructose, Ribose, Galactose	Sucrose, Lactose, Maltose (Disaccharides); Raffinose (Trisaccharide)	Starch, Glycogen, Cellulose, Chitin

Molecular Weight	Low	Moderate	High
Hydrolysis	Cannot be hydrolyzed	Can be hydrolyzed by acids/enzymes to yield monosaccharide's	Can be hydrolyzed by acids/enzymes to yield simple sugars
Solubility in Water	Soluble	Soluble	Generally insoluble or slightly soluble
Taste	Sweet	Sweet	Tasteless
Form/Structure	Crystalline	Crystalline or powdery	Usually amorphous; may be linear (e.g., cellulose) or branched (e.g., glycogen)
Reducing Nature	All are reducing sugars (free carbonyl group present)	Some are reducing (e.g., maltose), some non-reducing (e.g., sucrose)	Mostly non-reducing (no free carbonyl group)

Functional Groups	Contain either aldehyde ($-CHO$) group (aldoses) or ketone ($C=O$) group (ketoses)	Functional groups become involved in glycosidic linkage	Functional groups are masked in glycosidic bonds
Chemical Reactivity	React with Tollen's or Fehling's reagent (positive for reducing sugars). Participate in oxidation, reduction, and esterification reactions	-Can undergo hydrolysis. Reducing oligosaccharides show reactions similar to monosaccharide's	Undergo acid/enzyme hydrolysis to break down into monosaccharide's. Do not react with Fehling's or Tollen's reagent

Functions of Key Monosaccharides

- **Glucose** → Primary energy source; sole fuel for brain; stored as glycogen.
- **Fructose** → Found in fruits/honey; liver metabolism; low glycemic index; part of sucrose.
- **Galactose** → From milk sugar (lactose); converted to glucose; forms glycolipids & glycoproteins.

- **Ribose** → Backbone of RNA, ATP, NADH, FADH₂ (energy transfer).
- **Deoxyribose** → Backbone of DNA (genetic material).
- **Ribulose & Xylulose** → Intermediates in pentose phosphate pathway & photosynthesis.
- **Mannose** → Builds glycoproteins; role in immunity, anti-inflammatory effects.
- **Glucosamine** → Component of cartilage & connective tissues.
- **Glyceraldehyde & Dihydroxyacetone** → Trioses; intermediates in glycolysis (energy production).

Disaccharides and Their Functions

- **Sucrose (Glucose + Fructose)**
 - Table sugar, non-reducing & stable. Quick energy after digestion.
 - Food use: sweetener, preservative, caramelization.
- **Lactose (Galactose + Glucose)**
 - Milk sugar, key infant energy source.
 - Enhances mineral absorption (Ca).
 - Prebiotic effect in gut.
- **Maltose (Glucose + Glucose)**
 - Intermediate in starch digestion.
 - Energy source (broken to glucose).
 - Brewing/fermentation (beer).

Functions of Different Polysaccharides

1. Energy Storage Polysaccharides

- Starch (plants) → Glucose storage in seeds, roots, tubers. (Amylose + Amylopectin)
- Glycogen (animals, fungi) → Glucose reserve in liver & muscle, highly branched → rapid energy release.

2. Structural Polysaccharides

- Cellulose (plants) → Cell wall strength, insoluble fiber in human diet (aids digestion).
- Chitin → Exoskeleton of insects & crustaceans, fungal cell wall, strong & flexible.

3. Functional & Communication Polysaccharides

- Hyaluronic acid → Lubrication (joints), hydration, shock absorption.
- Heparin → Anticoagulant, prevents blood clotting.

4. Food & Industrial Polysaccharides

- Pectin (fruits) → Gelling agent in jams & jellies.
- Agar (red algae) → Gelling agent in foods & microbiological culture media

কার্বোহাইড্রেট গ্রহণের পরিমাণ

"পুষ্টিবিদদের মতে, দৈনিক মোট শক্তির চাহিদার প্রায় ৬০-৭০% শর্করা থেকে সরবরাহ করা উচিত।"

Dietary fiber

Dietary fiber is the indigestible part of plant foods that cannot be broken down by human digestive enzymes. As a result, it passes through the digestive tract largely unchanged and does not provide energy to the body.

Classification of Dietary Fibers

1. **Soluble fibers** – e.g., pectins, gums, mucilages
2. **Insoluble fibers** – e.g., cellulose, hemicelluloses, lignins

Type of Fiber	Sources
Cellulose	Plant cell walls, vegetables, whole grains
Hemicelluloses	Whole grains, legumes, fruit & vegetable skins
Lignins (Non-carbohydrate)	Woody parts: fruit seeds, bran, husk, carrots, pears
Gums	Seeds
Pectins	Citrus fruits, apples, guavas, plums, gooseberries
Mucilages	Psyllium husk, seaweeds, oats, barley, legumes, eggplants

Health Benefits of Dietary Fibers

1. **Prevents constipation & hemorrhoids** – Adds bulk and softens stool, easing defecation.
2. **Prevents diarrhea** – Soluble fibers absorb excess water, solidifying loose stools.
3. **Strengthens colon muscles** – Larger, softer stools stimulate peristalsis and improve gut muscle tone.
4. **Reduces risk of heart disease** – Soluble fibers lower cholesterol absorption, promoting excretion.
5. **Prevents & manages diabetes** – Slows glucose absorption, stabilizing blood sugar levels.

6. **Enhances weight loss** – Increases satiety, slows gastric emptying, and reduces fat absorption.
7. **Prevents colon cancer** – Speeds up evacuation and dilutes carcinogens in the colon.

According to the Academy of Nutrition and Dietetics (USA), the recommended dietary fiber intake for adults is 38 grams per day for men and 25 grams per day for women. For individuals over 50 years of age, the recommended intake decreases to 30 grams per day for men and 21 grams per day for women.

3. Proteins

- (a) Classification, chemical nature and sources of different proteins.
- (b) Essential amino acids.
- (c) Functions and deficiency of proteins in the body.

Proteins are polymers of amino acids. Although around 300 different amino acids exist in nature, only 20 are considered standard and form the core structure of all proteins. These amino acids are linked together by peptide bonds.

Proteins are primarily composed of five major elements in approximate proportions: carbon (50–55%), hydrogen (6–7.3%), oxygen (19–24%), nitrogen (13–19%), and sulfur (0–4%).

প্রোটিনকে গঠন অনুযায়ী তিনটি প্রধান শ্রেণীতে ভাগ করা হয়েছে: (১) সরল প্রোটিন (Simple Proteins), (২) যৌগিক প্রোটিন (Compound Proteins), এবং (৩) উদ্ভূত প্রোটিন (Derived Proteins)।

1. Simple Proteins: কেবলমাত্র অ্যামিনো অ্যাসিড নিয়ে গঠিত। তাপে জমাট বাঁধে, পানি বা হালকা এলকোহলে দ্রবণীয়।

উদাহরণ:

১. **এলবুমিন:** রক্তের সিরাম, ডিমের সাদা অংশের ওভালবুমিন।
২. **গ্লোবুলিন:** সিরাম গ্লোবুলিন, ফাইব্রিনোজেন, পেশীর মায়োসিন।
৩. **গ্লুটেলিন:** শস্যের প্রোটিন যেমন গমের গ্লুটেলিন, চালের ওরিজেনিন, ভুট্টার জিন।
৪. **গ্ল্যাডিন (প্রোলামিন):** গমের প্রোটিন Gliadin, ভুট্টার Zein.
৫. **প্রোটামিন:** হিস্টোন, হিমোগ্লোবিন।

2. Fibrous Proteins

প্রাণীদেহে পাওয়া যায়, লম্বা আঁশবিশিষ্ট, পানিতে অদ্রবণীয়। কাঠামোগত সহায়তা ও পেশী, অস্থিসন্ধি ও সংযোজক টিস্যুতে গুরুত্বপূর্ণ।

উদাহরণ:

১. **কলাজেন:** প্রোলিন ও হাইড্রক্সি প্রোলিন সমৃদ্ধ; পানিতে সিদ্ধ করলে জেলাটিন তৈরি হয়।

২. ইলাস্টিন: টেন্ডন ও উপশিরায় স্থিতিস্থাপকতা প্রদান করে।
৩. কেরাটিন: চুল, নখ, পশম ও উলের গঠন।
৪. ফাইব্রিনোজেন: রক্ত জমাট হয়ে ফাইব্রিন তৈরি করে রক্তক্ষরণ বন্ধ করে।
৫. মায়োসিন ও অ্যাকটিন: মিলিত হয়ে অ্যাক্টোমায়োসিন তৈরি করে পেশী সংকোচনে ভূমিকা রাখে।

3. Compound Proteins

কেবল অ্যামিনো অ্যাসিড নয়, এতে অ-প্রোটিন অংশ (prosthetic group) থাকে।

উদাহরণ: নিউক্লিওপ্রোটিন (Nucleoprotein), ফসফোপ্রোটিন (Phosphoprotein), মিউকোপ্রোটিন (Mucoprotein), লাইপোপ্রোটিন (Lipoprotein), মেটালোপ্রোটিন (Metalloprotein), ক্রোমোপ্রোটিন (Chromo protein).

4. Derived Proteins

প্রাথমিক (Simple) ও যৌগিক (Compound) প্রোটিনের ধাপে ধাপে বিশ্লেষণ, উত্তাপ, আর্দ্রবিশ্লেষণ বা বিকিরণের প্রভাবে উৎপন্ন ক্ষুদ্র আকারের প্রোটিনকে উদ্ভূত প্রোটিন বলা হয়।

- Primary Derived: Fibrinogen → Fibrin, সিদ্ধ ডিমের সাদা অংশ।
- Secondary Derived: Proteoses, Peptones, Peptides (পরিপাকে উৎপন্ন)

Nutritional Classification of Proteins

Based on nutritional significance, proteins are divided into two groups:

1. Complete Proteins:

- Contain all the essential amino acids in adequate amounts.
- Support new cell and tissue formation.
- Mostly animal proteins are complete, e.g., egg, milk, fish, meat.
- These have high quality and biological value.

2. Incomplete Proteins:

- Deficient in one or more essential amino acids.
- Cannot independently support cell growth or repair; protein synthesis is limited.
- Found mainly in plant proteins, e.g., pulses, nuts, seeds, cereals, fruits, and vegetables.
- However, combining different plant proteins (like rice and lentils, or milk with cereals) can improve amino acid balance and overall quality.

Essential amino acids cannot be produced by the human body and must be obtained from the diet, while nonessential amino acids can be synthesized by the body.

শ্রেণি	অ্যামাইনো অ্যাসিড
Essential	Methionine, Isoleucine, Leucine, Phenylalanine, Lysine, Threonine, Valine, Tryptophan
Additional Essential for Children	Histidine, Arginine
Non-essential	Glycine, Alanine, Serine, Cysteine, Aspartic acid, Glutamic acid, Tyrosine, Proline, Hydroxyproline, Cysteine

Methods for Determining Protein Quality

Method	Purpose	Use
Digestibility Coefficient	Measures the portion of dietary protein absorbed by the body.	Indicates protein digestibility.
Biological Value (BV)	Shows how much of the absorbed protein is retained in the body	Higher BV indicates better protein quality. Examples: Eggs 96–100, Fish/Meat 80–85, Rice 64–68, Wheat 58.
Net Protein Utilization (NPU)	Determines what percentage of consumed protein is retained in the body	Higher NPU reflects efficient protein use.
Protein Efficiency Ratio (PER)	Measures weight gain per gram of protein consumed.	Higher PER indicates better protein quality. Examples: Egg PER 3.8.
Amino Acid-based Methods	Evaluates presence and adequacy of essential amino acids in protein.	Amino Acid Score

Biological Functions of Proteins

- 1. Structural Functions**
 - Proteins form the body's structural framework. About 11–12 kg of protein in a 70 kg adult. Keratin – hair, nails. Collagen – bones, joints, teeth. Elastin – lungs, blood vessels
- 2. Regulatory Functions**
 - Proteins regulate biochemical processes.
 - Enzymes: All metabolic reactions (glycolysis, TCA cycle, ETC, energy production) are catalyzed by proteins (~2000 enzymes).
 - Peptide hormones: Thyroxine, Adrenaline, Growth Hormone, Insulin, Glucagon regulate growth, metabolism, and homeostasis.
- 3. Transport and Receptor Functions**
 - Transport proteins carry molecules like oxygen, lipids, ions, and nutrients across cells and blood.

Examples: Hemoglobin (O_2), Lipoproteins (lipids), Retinol-binding protein (vitamin A).

- Receptor proteins bind hormones or substrates to regulate cellular metabolism.

Examples: Adrenaline receptors, LDL receptors.

4. **Defense Functions**

- Proteins protect the body against foreign substances.
- Antibodies and immunoglobulin's destroy pathogens.

5. **Buffering Role**

- Proteins maintain pH by neutralizing excess H^+ or OH^- ions.
- Acidic amino acids (e.g., aspartic acid) and basic amino acids (e.g., histidine) contribute to this function.

6. **Water and Electrolyte Balance**

- Proteins help maintain osmotic pressure between blood, cells, and interstitial spaces, regulating water and electrolyte distribution.

7. **Blood Clotting**

- Many clotting factors are proteins (e.g., Fibrinogen, Prothrombin) that form fibrin to stop bleeding.

8. **Muscle Contraction**

- Myosin and Actin interact to produce muscle contraction for movement.

9. **Energy Source**

- Glucogenic amino acids can be converted into glucose for energy.
- During starvation or diabetes, protein catabolism increases to meet energy demands.

10. **Synthesis of Important Molecules**

- Amino acids derived from proteins are precursors for:
 - Niacin (from tryptophan)
 - Choline (from methionine)
 - Purines for nucleic acids (from glycine)

11. **Pigment Formation**

- Proteins are essential for melanin synthesis, influencing hair and skin color.

Chemical Properties of Amino Acids / Proteins

1. **Reaction with Formaldehyde**

- Amino acids react with **neutralized formaldehyde**, forming a **dimethylol amino acid complex**. The amino group is temporarily protected, and the released proton is titrated against alkali.
- **Use:** Quantitative determination of **free amino acids** in plant or food samples.

2. **Reaction with Nitrous Acid**

- Nitrous acid reacts with the amino group, producing hydroxy acids and liberating nitrogen gas (N_2).

3. Ninhydrin Reaction

Ninhydrin is a strong oxidizing agent. When it reacts with α -amino acids, it breaks them down by deamination (removing the amino group) and decarboxylation (removing the carboxyl group). As a result, three products are formed:

- Carbon dioxide (CO_2)
- Ammonia (NH_3)
- An aldehyde (with one carbon atom less than the original amino acid)

The ammonia released then reacts with another ninhydrin molecule to produce a purple-colored compound called Ruhemann's purple.

Use: This reaction is very important because it is used for the quantitative detection of amino acids. Proteins and peptides that have free amino groups also give the same purple color with ninhydrin.

4. Decarboxylation

- The carboxyl group ($-\text{COOH}$) of amino acids is removed to form amines.
- Example: Histidine $\rightarrow$ Histamine, which acts as a vasoconstrictor agent.

Protein structure is organized into four levels:

1. Primary Structure

- The linear sequence of amino acids linked by peptide bonds ($-\text{CO}-\text{NH}-$).
- If this sequence is incorrect, the protein's final shape and function will be faulty.
- Example: The amino acid chain of hemoglobin or insulin.

2. Secondary Structure

- Local folding of the amino acid chain due to hydrogen bonding.
- Main forms:
 - **α -helix** $\rightarrow$ coiled, spiral shape.
 - **β -sheet** $\rightarrow$ sheet-like layered structure.
- Provides some strength and shape to the protein.

3. Tertiary Structure

- The complete 3D structure of a single polypeptide chain.
- Stabilized by interactions such as: hydrogen bonds, ionic bonds, hydrophobic interactions, van der Waals forces, and disulfide bonds.
- This gives the protein its functional shape.

4. Quaternary Structure

- Formed when two or more polypeptide subunits combine into one functional protein.
- Example: Hemoglobin (consists of 2 α -chains and 2 β -chains).
- Proper arrangement of subunits ensures biological activity.

Protein Denaturation

Protein denaturation is the loss of a protein's natural structure due to heat, extreme pH, chemicals, mechanical agitation, or radiation. This unfolding disrupts bonds like hydrogen, ionic, hydrophobic, and disulfide linkages.

- **Causes:** Heat (e.g., frying an egg), acids/bases, mechanical agitation (whisking egg whites), chemicals (heavy metals, detergents), and radiation.
- **Effects:** Loss of biological activity, reduced stability and solubility, coagulation/aggregation, and mostly irreversible structural changes.

Protein Deficiency Diseases

1. **Kwashiorkor**
 - **Cause:** Severe deficiency of dietary protein.
 - **Characteristics:** Edema (swelling), stunted growth, skin/hair changes, enlarged fatty liver.
2. **Marasmus**
 - **Cause:** Chronic deficiency of both protein and calories (Protein-Energy Malnutrition, PEM).
 - **Characteristics:** Extreme wasting, severe weight loss, weakness, thin limbs, delayed development.

Prevention

- Adequate intake of **protein and calories** through a balanced diet.
- Nutritional rehabilitation, supplementation, and awareness to prevent long-term deficiency.

Protein Requirements

Adults (FAO): 12–15% of total daily calories should come from protein. This equals about 0.8 g per kg body weight.

4. Fats and fatty acids:

- (a) Classification and chemical nature of different fats in the body.
- (b) Essential fatty acids- Omega 3 and Omega 6 fatty acids- their role in nutrition.
- (c) Disadvantage of excess fat intake.

Fats are esters of glycerol and fatty acids (triglycerides).

Classification of Fats (Lipids)

1. Simple Lipids: Neutral fats (mainly triglycerides) made of glycerol and three fatty acids. They form 98–99% of food and body fats.
2. Compound Lipids: Contain additional components such as phosphorus, carbohydrate, or protein. Types include phospholipids, glycolipids, and lipoproteins.
3. Derived Lipids: Fat-like substances formed from fats. Key members:
 - Glycerol: Water-soluble base of triglycerides; can be converted into glucose.
 - Fatty Acids: Main energy fuel; may be saturated or unsaturated (e.g., oleic, linoleic, linolenic, arachidonic, palmitic, stearic acids).

Simple Lipids – Triglycerides (Triacylglycerol)

Definition: Most abundant lipids in the body and diet. Each molecule has three fatty acids attached to a glycerol backbone.

Types of Triglycerides:

1. Fats:

- High in saturated fatty acids
- Usually solid at room temperature
- Sources: Meat, milk, cheese, palm oil, coconut oil.

2. Oils:

- High in unsaturated fatty acids
- Usually liquid at room temperature
- Sources: Olive oil, canola oil, peanut oil.

Compound Lipids

Phospholipids (PLs)

Structure:

- Glycerol backbone.
- Fatty acids attached to the first two carbons.
- A phosphate group + nitrogenous base attached to the third carbon.

Nature:

- Amphiphilic:
 - Hydrophobic tail → fatty acid chains (water-repelling).
 - Hydrophilic head → phosphate group (water-attracting).
- Importance:
 - Because of this dual nature, phospholipids are water-soluble and play a key role in forming cell membranes (phospholipid bilayer)

Lipoproteins

- Feature: Water-soluble complexes of lipid and protein, hence called blood lipids.
- Function: Transport lipids in blood.

Lipid Profile (WHO Guidelines)

Lipids	Desirable	Borderline	Risk / High
Total Cholesterol (mg/100 mL)	< 200	200 – 239	≥ 240
LDL-Cholesterol (mg/100 mL)	< 130	130 – 159	> 160
HDL-Cholesterol (mg/100 mL)	> 60	35 – 59	< 35
Triglycerides (mg/100 mL)	< 200	200 – 400	> 400

Total cholesterol represents all blood cholesterol (LDL + HDL + VLDL), while HDL is the “good” cholesterol that removes excess cholesterol; the TC/HDL ratio (<4:1) indicates cardiovascular risk.

Derived Lipids

Fatty Acids (FAs)

Basic Structure: Carbon chain with a methyl group (CH_3) at one end and a carboxyl group (COOH) at the other.

Chain Lengths:

- SCFA: ≤ 5 carbons
- MCFA: 6–12 carbons
- LCFA: 13–21 carbons
- VLCFA: ≥ 22 carbons
- Most natural FAs = 16–18 carbons.

Classification of fatty acid by Saturation

1. Saturated Fatty Acids (SFAs):

- No double bonds (all carbons saturated with hydrogen).
- Solid at room temperature.
- Sources: Meat, milk, cheese, palm oil, coconut oil.
- Example: Stearic acid (in butter).

2. Unsaturated Fatty Acids (USFAs):

- Have one or more double bonds ($\text{C}=\text{C}$), causing a kink.

- Generally liquid at room temperature.

Types:

- Monounsaturated (MUFA): One double bond. Sources: Olive, peanut, canola oil. Example: Oleic acid.
- Polyunsaturated (PUFA): Multiple double bonds. Sources: Corn, soybean, safflower oils. Example: α -linolenic acid.

Cis and Trans Forms of fatty acid

- **Cis-Fatty Acids:** Hydrogen's on same side of double bond $\rightarrow$ bent structure. Mostly natural (plant foods). Example: Cis-oleic acid.
- **Trans-Fatty Acids:** Hydrogen's on opposite sides $\rightarrow$ straight structure (resembles saturated fat).

Sources: Small amounts in milk & meat (ruminants), large amounts in partially hydrogenated oils (margarine, reused frying oil, fast foods, snacks).

Health Risk: ~5 g/day increases risk of heart disease, type 2 diabetes, and cancer by ~23%.

Essential and Nonessential Fatty Acids

1. Nonessential Fatty Acids (NEFAs):
 - Can be synthesized in the body.
 - Do not need to be supplied through diet.
2. Essential Fatty Acids (EFAs):
 - Cannot be synthesized by the body.
 - Must be obtained from diet/supplements.
 - Examples:
 - Linoleic acid (ω -6)
 - α -linolenic acid (ω -3)
3. Conditionally Essential Fatty Acids:
 - Long-chain PUFAs (C-20) derived from ω -3 and ω -6 families.
 - Become essential when the body cannot produce enough from parent EFAs (e.g., in disease or special developmental stages).
 - Examples:
 - EPA (Eicosapentaenoic acid)
 - DHA (Docosahexaenoic acid)
 - ARA (Arachidonic acid)

Sources of Fatty Acids

Fatty Acid Type	Fatty Acid Name	Carbon / Double Bonds	Food Sources
Short Chain (সংক্ষিপ্ত শিকল)	Butyric Acid	C ₄ :0	মাখন
	Caproic Acid	C ₆ :0	মাখন, নারকেল তেল
	Caprylic Acid	C ₈ :0	মাখন, নারকেল তেল
Medium Chain (মধ্যম শিকল)	Lauric Acid	C ₁₂ :0	মাখন, নারকেল তেল
	Myristic Acid	C ₁₄ :0	মাখন, কিছু উদ্ভিদ
Long Chain (লম্বা শিকল)	Palmitic Acid	C ₁₆ :0	প্রাণিজ ও উদ্ভিদ স্নেহ
	Stearic Acid	C ₁₈ :0	প্রাণিজ ও উদ্ভিদ স্নেহ
	Arachidic Acid	C ₂₀ :0	মাখন, প্রাণিজ চর্বি, বাদাম তেল
	Palmitoleic Acid	C ₁₆ :1	জলপাই তেল, মাছের তেল, গরুর চর্বি
Monounsaturated (১টি দ্বিবন্ধনী)	Oleic Acid	C ₁₈ :1	জলপাই তেল
	Linoleic Acid	C ₁₈ :2 (ω-6)	বীজ তেল, সয়াবিন
Polyunsaturated (বহু দ্বিবন্ধনী)	α-Linolenic Acid	C ₁₈ :3 (ω-3)	বীজ তেল, সয়াবিন
	Arachidonic Acid	C ₂₀ :4 (ω-6)	প্রাণিজ পেশী, মাংস
	Eicosapentaenoic Acid (EPA)	C ₂₀ :5 (ω-3)	মাছের তেল, ঠান্ডা পানির মাছের তেল
	Docosahexaenoic Acid (DHA)	C ₂₂ :6 (ω-3)	Shellfish, সামুদ্রিক মাছ

Essential fatty acids- Omega 3 and Omega 6 fatty acids- their role in nutrition

- **Cardiovascular Health**
- **Omega-3 (EPA & DHA):** Reduce LDL cholesterol & triglycerides → lower heart disease and stroke risk.
- **Omega-6:** Replacing saturated fats with Omega-6 also lowers LDL cholesterol.
- **Anti-inflammatory Effects**

- **Omega-3:** Reduce pro-inflammatory eicosanoids, cytokines, ROS → relieve rheumatoid arthritis symptoms.
- **Omega-6 (ARA):** Precursor to inflammatory eicosanoids; balance with Omega-3 is crucial.
- **Brain & Nervous System**
 - **Omega-3 (DHA):** Supports neurodevelopment, learning, memory, cognition; reduces ADHD symptoms.
 - **Omega-6 (ARA):** Contributes to brain growth and development.
- **Pregnancy & Fetal Development**
 - **Omega-3:** Essential for fetal brain, retina, and nerve development; maternal intake supports both mother and fetus.
 - **Recommended:** 0.6–1.2% of total energy during pregnancy.
- **Oxidative Stress & Skin/Eye Health**
 - **Omega-3:** Acts as antioxidant → maintains healthy skin, hair, and eyes.
- **Cell Membrane Integrity**
 - Both **Omega-3** and **Omega-6** maintain membrane fluidity, flexibility, and nutrient transport.
- **Eicosanoid Precursor**
 - **Omega-6 (ARA):** Produces prostaglandins, thromboxanes, leukotrienes → regulate inflammation, clotting, blood vessels.
 - **Omega-3:** Produces less inflammatory eicosanoids → balances inflammatory response.
- **Growth and Development**
 - EFAs support **normal growth, skin health, and nervous system maturation.**
 - **Omega-3:** Enhances neuronal communication and cognition.
 - **Omega-6:** Ensures proper cellular and tissue growth.
- **Energy Source**
 - Both provide **9 kcal/g**; Omega-6 also used for signaling and structural functions.

Properties of Fats

1. Hydrolysis: Fats react with water to break ester bonds → produces **glycerol + fatty acids**.

2. Saponification Value

- Amount of alkali (mg KOH) needed to hydrolyze 1 g of fat.
- Significance: Indicates average molecular weight of fatty acids in a fat sample.

3. Acid Value / Free Fatty Acid Content

- Measures free fatty acids in fats.
- Significance: High acid value → hydrolysis or spoilage of fat.

4. Rancidity

- Unpleasant odor/taste in fats during storage.
- Prevention: Antioxidants (vitamin E, BHT, BHA), cool/dark storage.

5. Iodine Value

- Definition: Measures degree of unsaturation in fats.
- Significance: Higher iodine value → more unsaturation → more prone to oxidative rancidity.

6. Hydrogenation

Addition of hydrogen to unsaturated fats → converts to saturated fats.

Disadvantages of Excess Fat Intake

Major Health Risks

1. Weight Gain & Obesity
 - Fat provides 9 kcal/g, more than proteins or carbs.
 - Excess calories → stored as body fat → overweight/obesity.
 - Obesity increases risk of chronic diseases.
2. Cardiovascular Disease
 - High LDL / Low HDL cholesterol → atherosclerosis.
 - High blood pressure → heart works harder, kidney damage.
 - Increases risk of heart attack and stroke.
3. Type 2 Diabetes

Excess saturated & trans fats → insulin resistance → high blood sugar.
4. Liver & Gallbladder Diseases
 - Fat accumulation → nonalcoholic fatty liver disease (NAFLD) → cirrhosis/liver failure.
 - High cholesterol → gallstones.
5. Certain Cancers

High-fat diets (especially saturated fats) linked to colorectal, pancreatic, breast cancer.

5. Vitamins

Vitamins:

- (a) Classification, chemical nature and food sources.
- (b) Co-enzyme functions of vitamins.
- (c) Deficiency of vitamins in the body

Vitamin is a vital substance. It is needed in a very small quantity for growth and good health. Vitamins are vital body regulators.

Classification of Vitamins

Vitamins are classified according to their solubility in fat and water.

1. Fat-soluble vitamins are A, D, E and K
2. Water-soluble vitamins are B group vitamins and vitamin C

Chemical characteristics of fat-soluble vitamins (A, D, E, and K):

1. They are not easily destroyed by ordinary cooking methods (more stable than water-soluble vitamins).
2. They are stored in the liver and adipose tissue, and excess intake may lead to toxicity (hypervitaminosis).
3. They are fat-associated compounds and may be destroyed by rancidity of fats.
4. Their absorption depends on the presence of dietary fat and bile salts; they are not absorbed if mineral oil is present in the intestine (because mineral oil interferes with fat absorption).

Fat soluble vitamins (A, D, E, and K)

ভিটামিন	বিপাকীয় কাজ	উৎস	অভাবজনিত রোগ / উপসর্গ
ভিটামিন A	১। চোখের রেটিনার রড কোষে 11-cis retinol স্বল্প আলোতে দেখতে সাহায্য করে। অভাবে রাতকানা হয়। ২। Epithelial কোষ ও mucus membrane এর সুস্থতা রক্ষা করে। ৩। দেহের বর্ধন ত্বরান্বিত করে	মাছের যকৃৎ তেল, ডিমের কুসুম, যকৃত, গাজর ও অন্যান্য রঙিন শাকসব্জি ও ফল, পাকা পেঁপে, কাঁঠাল, আম, ধনে পাতা, সবুজ শাক, লাল শাক।	- Xerophthalmia (চোখ শুকানো) - Bitot's spot - Keratomalacia - রোগ প্রতিরোধ ক্ষমতা হ্রাস
ভিটামিন D	১। অস্ত্র হতে Ca^{++} পরিশোধন ত্বরান্বিত করে। ২। বৃদ্ধ হতে Ca^{++} এর পুনঃশোষণ বাড়ায় এবং অস্থি হতে Ca^{++} এর অপসারণ বাড়ায়।	চামড়ার নিচে আলোর প্রভাবে 7-dehydrocholesterol হতে D_3 উৎপন্ন হয়। মাছের যকৃৎ তেল, ডিমের কুসুম	- শিশুদের Rickets - প্রাপ্তবয়স্কদের Osteomalacia (হাড় নরম হওয়া, দুর্বলতা)

	৩। রক্তে Ca^{++} এর স্বাভাবিক মাত্রা বজায় রাখে। হাড় ও দাঁতের খনিজকরণে প্রভাবিত করে।		
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ভিটামিন	বিপাকীয় কাজ	উৎস	অভাবজনিত রোগ / উপসর্গ
ভিটামিন E	১। কোষের ঝিল্লীর অসম্পূর্ণ মেম্বের জারণ প্রতিহত করে, কোষের কার্যক্ষমতা রক্ষা করে। ২। দেহে উৎপন্ন মুক্ত র্যাডিকেলের ক্ষতিকর প্রভাব হতে কোষীয় ঝিল্লীকে রক্ষা করে।	উদ্ভিজ্জ তেল, লেটুস পাতা, তৈল বীজ, বীচি।	পেশীর দুর্বলতা, বক্ষ্যাহত, গর্ভপাত, immune system-এ ক্ষতিসাধন।
ভিটামিন K	-রক্ত জমাটকরণের বিভিন্ন factors-এ প্রভাবকারী বিক্রিয়ায় সহায়তা করে। -রক্ত জমাটকরণে Ca^{++} -এর কাজ ত্বরান্বিত করে।	সবুজ শাকপাতা। অল্পে জীবাণু দ্বারা সংশ্লেষিত হয়।	অভাবে রক্ত জমাটকরণ প্রক্রিয়া ব্যাহত হয়।

Recommended dietary allowances of fat-soluble vitamins per day

Water-Soluble Vitamins (B-complex + C)

ভিটামিন	সক্রিয় রূপ / কো-এনজাইম	প্রধান কাজ	প্রধান উৎস	অভাবজনিত রোগ
B ₁ (থায়ামিন)	Thiamine pyrophosphate (TPP)	১। শর্করা, ফ্যাট ও প্রোটিন হতে উৎপন্ন ৫-কিটো এসিডের ডিকার্বোক্সিলেশনে প্রভাবিত করে। ২। স্নায়ুতন্ত্র, অস্ত্রের সুস্থতা রক্ষা করে	যকৃত, বৃক্ক, গোটা শস্য, ডাল, বাদাম।	অভাবে বেরিবেরি রোগ হয়।
B ₂ (রিবোফ্লাভিন)	FMN, FAD	১। হাইড্রোজেন অপসারণে জারণ-বিজারণ বিক্রিয়ায় অংশ নেয়। ২। কোষের সুস্থতা রক্ষা করে	যকৃত, বৃক্ক, গোটা শস্য, ডাল, বাদাম, দুধ ও দুধজাতীয় খাদ্য।	অভাবে জিহ্বায় ও মুখে ঘা হয়।

B ₃ (নায়াসিন)	NAD ⁺ , NADP ⁺	১। জারণ-বিজারণ বিক্রিয়ায় অংশগ্রহণকারী এনজাইমের কো-এনজাইম রূপে অংশ নেয়। ২। শর্করা, প্রোটিন ও ফ্যাট হতে শক্তি উৎপাদনে প্রভাবিত করে। ৩। ফ্যাটি এসিড সংশ্লেষণে প্রয়োজন হয়	যকৃত, গোটা শস্য, বীচি, মাছ, মাংস।	অভাবে পেলেগ্রা রোগ হয়
B ₅ (প্যানটোথেনিক এসিড)	Coenzyme A (CoA)	CHO, প্রোটিন ও ফ্যাটের বিপাকে pyruvic acid Acetyl CoA a KG→Succinyl CoA F.A. oxidation জৈবিক সংশ্লেষণ cholst. সংশ্লেষণ।	যকৃত, বৃক্ক, ডিম, মাংস, দুধ, বাধাকপি, ফুলকপি, বাদাম, সীম।	Fatigue, headaches, muscle cramps, digestive issues, numbness, and irritability

ভিটামিন	সক্রিয় রূপ / কো-এনজাইম	প্রধান কাজ	প্রধান উৎস	অভাবজনিত রোগ
B ₆ (Pyridoxine)	Pyridoxal phosphate (PLP)	অ্যামাইনো এসিডের বিপাকে অংশগ্রহণকারী এনজাইমের কো-এনজাইম রূপে PLP কাজ করে Transamination, decarboxylation, ছাড়াও B ₆ হিম সংশ্লেষণে প্রভাবিত করে।	যকৃত, বৃক্ক, ডিম, দানা	এক ধরনের রক্তস্ফলতা হয়।
B ₇ (বায়োটিন)	N-carboxybiotin	CoA fixation এবং carboxylation যেমন- pyruvate→OAA Acetyl CoA→melonyl CoA	ডিমের কুসুম, দুধ, গুঁড়, চকোলেট, বাদাম।	Neurological problems and skin issues
B ₉ (ফোলিক এসিড)	Tetrahydrofolate (THF)	১। ১-কার্বন স্থানান্তরে প্রভাবিত করে। ২। পিউরিন, পিরিমিডিন, মেথিওনিন সংশ্লেষণে প্রভাবিত করে।	যকৃত, গোটা শস্য, গাঢ় সবুজ পাতা।	অভাবে macrocytic anaemia হয়।

B ₁₂ (কোবালামিন)	Methylcobalamin	১। মিথাইল বর্গ স্থানান্তর করে। ২। Methyl malonyl Co-A-কে Succinyl Co-A-তে পরিণত করে। ৩। পিউরিন, পিরিডিন সংশ্লেষণে ফলিক এসিডের সাথে কাজ করে	প্রাণিজ খাদ্যে পাওয়া যায়। যকৃতে জমা থাকে।	অভাবে pernicious anaemia হয়।
C (অ্যাসকরবিক এসিড)	L-Ascorbic Acid	অ্যামাইনো এসিডের বিপাকে অংশগ্রহণকারী এনজাইমের কো-এনজাইম রূপে PLP কাজ করে Transamination, decarboxylation, ছাড়াও B6 হিম সংশ্লেষণে প্রভাবিত করে।	তাজা ফল ও সব্জি, লেবুজাতীয় ফল, কাঁচামরিচ, আমলকি, পেঁয়াজ, বাতাবি, আমড়া,	অভাবজনিত রোগ হচ্ছে স্কার্ভি।

Characteristics of Water-Soluble Vitamins

1. Instability:
 - Compared to fat-soluble vitamins, they are less stable.
 - Easily destroyed by heat, light, oxidation, radiation, and contamination with metals (like copper, iron).
2. Water Solubility:
 - They dissolve in water and may leach out into cooking water.
 - If the cooking water is discarded, a significant amount of vitamins is lost.
3. Absorption & Excretion:
 - They are absorbed directly into the bloodstream.
 - Excess intake is excreted through urine; hence, toxicity is rare (except in very high doses of Niacin, Pyridoxine, Vitamin C).
4. Storage:
 - They are not stored in large amounts in the body (except Vitamin B12 in the liver).
 - Daily or regular intake from food is necessary.

Recommended dietary allowances of water-soluble vitamins per day

6. Minerals- their physiological roles- functions and food sources:

(a) Major minerals

(b) Minor Minerals

Minerals are inorganic elements from the earth's crust that the body uses in ionic (electrolyte) form, as they carry electrical charges. They cannot be synthesized by humans, plants, or animals, and must be obtained from water, plants, or animal foods.

Classification:

1. **Major minerals** (≥ 100 mg/day): Calcium, Phosphorus, Magnesium, Sulfur, Sodium, Potassium, Chloride.
2. **Trace minerals** (< 100 mg/day): Iron, Iodine, Copper, Selenium, Zinc, Fluoride, Manganese, Chromium.

খনিজ উপাদানের উৎস, ভূমিকা, অভাব ও দৈনিক চাহিদা

খনিজ উপাদান	উৎস	ভূমিকা	অভাবের লক্ষণ	প্রতিদিনের চাহিদা
ক্যালসিয়াম (Ca^{2+})	দুধ ও দুধজাতীয় খাদ্য, ডিম, সবুজ শাক, কাঁটা সমেত ছোট মাছ, সয়াবিন, বাদাম	হাড় ও দাঁতের গঠন ও মজবুতকরণ; রক্ত জমাটকরণ; পেশীর সংকোচন; এনজাইম সক্রিয়করণ; নার্ভীয় প্রতিবেদন	শিশুদের রিকেট, বড়দের অস্টিওম্যালেশিয়া, হাড় দুর্বলতা	শিশু: 500 mg; কিশোর: 600 mg; বড়রা: 400 mg; গর্ভাবস্থা: 1000 mg
ফসফরাস (P)	দুধ, মাছ, মাংস, ডাল, বাদাম, শসা	১। ক্যালসিয়ামের সাথে হাড় ও দাঁতের গঠন ও মজবুতকরণ। ২। শক্তির ধারক ATP. GTP রূপে উচ্চ শক্তিসম্পন্ন যৌগ তৈরি। ৩। কোষীয় উপাদান যেমন নিউক্লিক এসিড, প্রোটিন, এনজাইম, ফসফোলিপিড হিসেবে কোষীয় বিপাকে সাহায্য করে।	পেশীর দুর্বলতা, ক্যালসিয়ামের সাথে হাড়ের গঠন ব্যাহত হয়।	ক্যালসিয়ামের মত
ম্যাগনেসিয়াম (Mg^{2+})	বাদাম, গোটা শস্য, সয়াবিন, গাঢ় সবুজ পাতা, ডাল	হাড়-দাঁত গঠন; এনজাইম সক্রিয়করণ, পেশীর কাজ ও স্নায়ু-পেশী সমন্বয়।	অভাবে খিচুনি ও পেশীর টান।	বড়দের: 300–350 mg

সোডিয়াম (Na ⁺)	খাওয়ার লবণ, দুধ, মাখন, মাংস, আচার, পনির	কোষ বহির্ভূত প্রধান ধনাত্মক আয়ন; অম্ল-ক্ষার সমতা; পানির ভারসাম্য; নার্ভ ও পেশীর উদ্দীপনা; sodium pump	অতিরিক্ত ঘাম, ডায়রিয়া, বমিতে অভাব দেখা দেয়। পেশীর খিঁচুনি, দুর্বলতা, রক্তচাপ হ্রাস দেখা দেয়	বড়দের: 1.5–2.0 g
পটাসিয়াম (K ⁺)	দুধ, মাছ, মাংস, শস্য, ফল, ডাবের পানি, শাকসবজি, ডাল, বাদাম, বীচি	কোষের ভেতরের প্রধান ধনাত্মক আয়ন; পানির সমতা; Na-K-Ca এর সাথে পেশী ও নার্ভ কার্যক্রম; হৃদস্পন্দন নিয়ন্ত্রণ; গ্লাইকোজেন ও প্রোটিন সংশ্লেষণ	দুর্বল পেশী, অনিয়মিত হৃদস্পন্দন, বমিভাব	বড়দের: 2–4 g; mg
লৌহ (Fe)	যকৃত, প্লীহা, বৃক্ক, মাংস, ডিম, গোটা শস্য, সবুজ শাক, কলমী শাক, কালো কচুশাক, শুকনো ফল, গুড়	হিমোগ্লোবিন গঠন; অক্সিজেন পরিবহন; শক্তি উৎপাদনে সহায়তা	Hypochromic microcytic anemia, দুর্বলতা, ক্ষুধামান্দ্য	শিশু: 12–18 mg; বড়দের: 20–25 mg

আয়োডিন (I)	সামুদ্রিক লবণ, সামুদ্রিক মাছ, শেওলা	থাইরয়েড হরমোন (থাইরক্সিন) গঠন	গলগণ্ড; শিশুদের মানসিক ও শারীরিক প্রতিবন্ধকতা; বড়দের বুদ্ধিহীনতা	বড়দের: 0.15 mg; শিশু: 0.07–0.09 mg
তামা (Cu ²⁺)	যকৃত, বৃক্ক, মাংস, মাছ, বাদাম, শস্য দানা, সবুজ শাক, ডিম	-তামা Hb তৈরিতে আবশ্যিক। -প্রোটিনের অথবা কো বিপাকজনিত রক্তস্বল্পতা -জারণ-বিজারণকারী এনজাইমের অংশবিশেষে এদের ভূমিকায় প্রভাবিত করে।	রক্তস্বল্পতা; প্রোটিন অপুষ্টি	1.5–2.5 mg
দস্তা (Zn ²⁺)	ডিম, মাছ, মাংস, শস্য দানা, সামুদ্রিক মাছ	অনেক এনজাইমের অংশ; বৃদ্ধি; ইনসুলিন উৎপাদন; RNA বিপাক	ক্ষুধামান্দ্য; বৃদ্ধি ব্যাহত; মানসিক দুর্বলতা; ক্ষত নিরাময়ে দেরি	10–15 mg

7. Energy intake and expenditure:

- Measurement of energy expenditure.
- Factors influencing energy requirement.
- Calculation of ones energy requirement.

শক্তি খাদ্যের শর্করা, প্রোটিন ও স্নেহজাতীয় উপাদান জারিত হয়ে উৎপন্ন হয়। শক্তি ক্যালরি বা জুলে মাপা হয়।

- ১ কিলোক্যালরি = ৪.১৮৪ কিলোজুল
- ১ গ্রাম শর্করা → ৪ কিলোক্যালরি
- ১ গ্রাম প্রোটিন → ৪ কিলোক্যালরি
- ১ গ্রাম স্নেহ → ৯ কিলোক্যালরি

Components of Energy Expenditure:

1. Basal Energy Expenditure (BEE/BMR):

- Minimum energy required at complete rest to maintain vital functions (breathing, heart, metabolism, protein synthesis, repair).
- Measured 10–12 hrs after a meal, in rest.
- Adult male $\approx$ 1 kcal/kg/hr, female $\approx$ 0.9 kcal/kg/hr.
- Influenced by age, gender, body size, hormones, health condition.

2. Energy for Physical Activity:

- **Light:** 150–250 kcal/hr (walking, reading, driving, chores).
- **Moderate:** 300–400 kcal/hr (sports, brisk walking, cycling, gardening).
- **Heavy:** 450–590 kcal/hr (swimming, digging, football, hill climbing).
- More activity → higher oxygen use, muscle contraction, metabolic rate.

3. Thermic Effect of Food (TEF):

- Energy used for digestion, absorption, metabolism of food.
- $\approx$ 8–10% of total calorie intake.

Total Energy Expenditure (TEE) = **BMR + Physical Activity + TEF.**

Measurement of Energy Expenditure

1. Direct Calorimetry:

- Person kept in respiration chamber.
- Heat from body warms circulating water.
- Difference in water temperature $\times$ volume = total heat loss (energy expenditure).

2. Indirect Calorimetry:

- Based on O_2 consumption & CO_2 production.
- Uses Benedict-Roth Apparatus at rest, fasting.
- 1 liter O_2 = ~4.82 kcal.

3. Doubly Labeled Water (DLW) Method:

- Person drinks water with isotopes (^2H for hydrogen, ^{18}O for oxygen).
- Measures total energy expenditure over several days.

4. Respiratory Quotient (RQ)

Ratio of CO_2 produced / O_2 consumed during metabolism.

- Carbohydrate → $RQ \approx 1$
- Fat → $RQ \approx 0.7$
- Protein → $RQ \approx 0.8$

Factors Influencing Energy Requirement

1. **Age:** Higher in children/adolescents (growth); lower in adults and elderly (reduced BMR & activity).
2. **Body Size & Weight:** Larger body/lean mass → higher BMR & energy needs.
3. **Sex:** Men need more (more muscle, higher BMR); women need less (more fat mass).
4. **Physical Activity:** Light: 150–250 kcal/hr (walking, chores). Moderate: 300–400 kcal/hr (cycling, gardening, brisk walking). Heavy: 450–590 kcal/hr (running, swimming, labor)
5. **Physiological State:** Growth → higher needs. Pregnancy → +300 kcal/day (2nd trimester onward). Lactation → +500 kcal/day (milk production). Illness/Recovery → higher needs (fever, infection, healing).

শক্তি চাহিদা নির্ণয় (উদাহরণ – ৫২ কেজি ওজনের মাঝারি শ্রমে লিঙ্গ মহিলা):

1. মৌলিক বিপাক (BMR):

→ $52 \times 0.9 \times 24 = 1123.2$ কিলোক্যালরি (Adult male ≈ 1 kcal/kg/hr, female ≈ 0.9 kcal/kg/hr.)

2. শ্রমের জন্য শক্তি:

মাঝারি শ্রম = BMR এর ৭৫%

$\rightarrow 1120 \times 0.75 = 840$ কিলোক্যালরি
 $\rightarrow \text{মোট} = 1120 + 840 = 1960$ কিলোক্যালরি

3. খাদ্যের বিশেষ চলক্রিয়া (TEF):

মোট শক্তির 10%
 $\rightarrow 1960 \times 0.10 = 196.0$ কিলোক্যালরি

4. মোট দৈনিক শক্তি চাহিদা:

$1960 + 196.0 = 2156$ কিলোক্যালরি

অর্থাৎ, ৫২ কেজি ওজনের মাঝারি শ্রমে লিঙ্গ মহিলার দৈনিক শক্তি চাহিদা ≈ 2156 কিলোক্যালরি।

মোট দৈনিক শক্তি = 2530 কিলোক্যালরি; (অনুপাত: কার্বোহাইড্রেট 70%, প্রোটিন 20%, স্নেহ 10%) :

1. কার্বোহাইড্রেট (Carbohydrate)

- শতকরা = 70% $\rightarrow 0.70 \times 2530 = 1771$ কিলোক্যালরি.
- গ্রামে রূপান্তর: 1 গ্রাম কার্বোহাইড্রেট = 4 কিলোক্যালরি $\rightarrow 1771 \div 4 = 442.75 \approx 443$ গ্রাম.

2. প্রোটিন (Protein)

- শতকরা = 20% $\rightarrow 0.20 \times 2530 = 506$ কিলোক্যালরি.
- গ্রামে রূপান্তর: 1 গ্রাম প্রোটিন = 4 কিলোক্যালরি $\rightarrow 506 \div 4 = 126.5 \approx 127$ গ্রাম.

3. স্নেহ / চর্বি (Fat)

- শতকরা = 10% $\rightarrow 0.10 \times 2530 = 253$ কিলোক্যালরি.
- গ্রামে রূপান্তর: 1 গ্রাম স্নেহ = 9 কিলোক্যালরি $\rightarrow 253 \div 9 = 28.11 \approx 28$ গ্রাম.

8. Enzyme and hormones:

(a) Classification and chemical nature of different forms of enzyme and hormones.

(b) Physiological role and disease states of hormones action.

An **enzyme** is a biological catalyst (usually a protein) that speeds up a specific chemical reaction in living organisms without being consumed or permanently altered.

Classification and Functions of Enzymes

Class	Sub-class / Example	Type of Reaction Catalyzed
Oxidoreductases	Dehydrogenases, Oxidases, Reductases, Peroxidases, Catalases, Hydroxylases	Transfer electrons (often as H ⁺ or hydride ions); oxidation-reduction reactions
Transferases	Kinases, Transaldolases, Methyltransferases, Acyltransferases	Transfer of functional groups (e.g., phosphorylation of glucose by hexokinase)
Hydrolases	Esterases, Glycosidases, Peptidases, Phosphatases, Thiolases, Phospholipases, Amidases	Cleavage of bonds via hydrolysis (adding water)
Lyases	Decarboxylases, Aldolases, Hydratases, Dehydratases	Removal of groups without hydrolysis
Isomerases	Racemases, Epimerases, Mutases	Rearrangement of atoms within a molecule (isomerization)
Ligases (Synthetases / Carboxylases)	Glutamine synthetase	Formation of new bonds (C-C, C-S, C-O, C-N) via condensation, coupled with ATP hydrolysis (e.g., Glutamic acid + NH ₃ → Glutamine)

Chemical Nature of Enzymes

- Protein Nature:
 - Most enzymes are proteins with primary, secondary, tertiary structures.
 - Some RNA molecules act as enzymes → ribozymes.
- Solubility:
 - Soluble in polar solvents (e.g., water)
 - Insoluble in non-polar organic solvents
- Acid-Base Nature:
 - Acidic or basic depending on amino acid composition
 - Base:Acid ratio >1 → basic enzyme; <1 → acidic enzyme
- Zwitterionic Behavior:
 - At isoelectric point (pI), enzymes exist as zwitterions (both + and – charges)
- Tertiary Structure:
 - Specific 3D structure essential for function

Holoenzyme

Holoenzyme = Apoenzyme (protein) + Coenzyme/Prosthetic group (non-protein)

Coenzymes

- Loosely bound to apoenzyme; removable by dialysis
- Often vitamin-derived, act as second substrate or assist reaction

Enzyme-Substrate Interaction Models

1. Lock-and-Key Model

- Active site and substrate shapes are perfectly complementary.
- No change in enzyme structure upon binding.
- Active site = pre-shaped template; only specific substrate fits.

2. Induced Fit Model

- Active site changes shape to fit substrate after binding.
- Amino acids at active site help correct substrate binding.
- Explains flexibility of enzyme structure and specificity.

3. Substrate Strain Model

- Substrate is strained when binding to enzyme's active site.
- Strain facilitates conversion to product.
- Often combined with Induced Fit Model to explain enzyme mechanism.

Factors Affecting Enzyme Activity

1. **Enzyme Concentration:** ↑ Enzyme → ↑ Reaction rate (if substrate is sufficient).

2. **Substrate Concentration:**

- ↑ Substrate → ↑ Reaction rate until **saturation**.
- Graph: **rectangular hyperbola**.

3. **Temperature:**

- ↑ Temperature → ↑ Reaction rate up to **optimum (40–45°C)**.
- Beyond ~50°C → **denaturation**, activity lost.
- Graph: **bell-shaped curve**.
- **Q₁₀ (temperature coefficient):** Reaction rate increase per 10°C rise.

4. **pH:**

- Each enzyme has **optimum pH** (usually 6–8).
- Extreme pH → alters ionic charges → ↓ activity or inactivation.
- Exceptions: Pepsin (pH 1–2), Acid phosphatase (pH 4–5), Alkaline phosphatase (pH 10–11).

5. **Product Concentration:**

- ↑ Product → ↓ Reaction rate (feedback inhibition).

Enzymes for Digestion of Carbohydrates, Proteins, and Fats

Nutrient	Digestive Enzyme	Source / Site	Function
Carbohydrates	Salivary amylase	Salivary glands / Mouth	Breaks starch → maltose
	Pancreatic amylase	Pancreas / Small intestine	Starch → maltose
	Maltase, Sucrase, Lactase	Small intestine (brush border)	Disaccharides → monosaccharides (glucose, fructose, galactose)
Proteins	Pepsin	Stomach (chief cells)	Proteins → peptides
	Trypsin, Chymotrypsin	Pancreas / Small intestine	Proteins → smaller peptides
	Peptidases (aminopeptidase, dipeptidase)	Small intestine	Peptides → amino acids
Fats (Lipids)	Lipase	Pancreas / Small intestine	Triglycerides → glycerol + fatty acids
	Bile (emulsifier, not enzyme)	Liver / Gallbladder	Emulsifies fats → ↑ surface area for lipase action

হরমোন (Hormone)

- হরমোন হলো রক্তের মাধ্যমে সারা শরীরে বার্তা পৌঁছে দেওয়া রাসায়নিক পদার্থ, যা সাধারণত **নালিবিহীন (endocrine) গ্রন্থি** থেকে নিঃসৃত হয়।
- **অন্য নাম:** প্রাণরস
- **কার্য:** প্রতিটি হরমোন শরীরে **নির্দিষ্ট কাজ** সম্পাদন করে; কাজ শেষে অনেক সময় নিঃশেষ হয় বা ধ্বংস হয়।

কাজের পদ্ধতি:

1. হরমোনের **টার্গেট সেল** থাকে।
2. টার্গেট সেলের **রিসেপ্টর**-এর সাথে সংযুক্ত হয়।
3. সংযোগের মাধ্যমে বিভিন্ন **বায়োকেমিক্যাল বিক্রিয়া** শুরু হয়।
4. হরমোন কোনো কোষের কাজ **সক্রিয় বা নিষ্ক্রিয়** করতে পারে।

হরমোনের প্রকারভেদ (Types of Hormones)

হরমোনকে গঠন অনুযায়ী প্রধানত ৩ ধাপে ভাগ করা হয়:

1. **পেপটাইড হরমোন (Peptide Hormone)**
 - গঠিত প্রোটিন বা পেপটাইড দিয়ে।
 - উদাহরণ: **ইনসুলিন, গ্লুকাগন, অক্সিটোসিন, গ্রোথ হরমোন**
2. **স্টেরয়েড জাত হরমোন (Steroid Hormone)**
 - কোলেস্টেরল থেকে তৈরি।
 - উদাহরণ: **টেস্টোস্টেরন, কর্টিসল, ইস্ট্রোজেন**

3. এমাইনো অ্যাসিড জাত হরমোন (Amino Acid Derived Hormone)

- ট্রিপটোফেন বা টাইরোসিন থেকে তৈরি।
- উদাহরণ: এপিনেফ্রিন, নরএপিনেফ্রিন

ফ্যাটি অ্যাসিড ডেরাইভড হরমোন (Fatty acid derived hormone)

- ইকোসানয়েডস (Eicosanoids)
- নিউরোহরমোন (Neurohormone)
- গ্রোথ হরমোন সম্পর্কিত বিশেষ শ্রেণী

হরমোন ও তাদের কাজ

গ্রন্থি	হরমোন	কাজ
হাইপোথ্যালামাস	ADH	কিডনিতে পানি পুনঃশোষণ বৃদ্ধি, জলীয় ভারসাম্য রক্ষা
	(Vasopressin)	
	Oxytocin	প্রসবের সময় জরায়ুর সংকোচন; স্তন্যস্রাব সহজ করা
পিটুইটারি (Master Gland)		
Anterior Lobe (অগ্র পিটুইটারি)	GH / STH	শরীরের বৃদ্ধি, হাড় ও পেশীর বৃদ্ধি
	TSH	থাইরয়েডকে উদ্দীপিত করে T3 ও T4 নিঃসরণ
	FSH	নারী: ডিম্বাণু উৎপাদন; পুরুষ: শুক্রাণু উৎপাদন
	LH	নারী: ডিম্বাণুর পরিপক্বতা ও ওভুলেশন; পুরুষ: টেস্টোস্টেরন নিঃসরণ
	ACTH	অ্যাড্রিনাল কর্টেক্স উদ্দীপিত করে কর্টিসল নিঃসরণ
	MSH	ত্বকে মেলানিন উৎপাদন বৃদ্ধি
	Prolactin	স্তন্যস্রাব বৃদ্ধি (দুধ উৎপাদন)
Posterior Lobe (পশ্চাৎ পিটুইটারি)	ADH, Oxytocin	হাইপোথ্যালামাসে তৈরি, এখানে সংরক্ষিত হয় এবং নিঃসৃত হয়
থাইরয়েড গ্রন্থি	T3 (Triiodothyronine)	বিপাকক্রিয়া নিয়ন্ত্রণ, শক্তি উৎপাদন বৃদ্ধি
	T4 (Thyroxine)	বৃদ্ধি ও বিকাশে সাহায্য করে, স্নায়ুতন্ত্র সক্রিয় রাখে
	Calcitonin	রক্তে ক্যালসিয়াম কমায়, হাড়ে ক্যালসিয়াম জমা করে
প্যারাথাইরয়েড গ্রন্থি	Parathormone (PTH)	রক্তে ক্যালসিয়াম বাড়ায় ও ফসফেট কমায়
অ্যাড্রিনাল কর্টেক্স	Cortisol	প্রোটিন ও ফ্যাট ভাঙে, রক্তে গ্লুকোজ বাড়ায়, প্রদাহ কমায়

গ্রন্থি/অঙ্গ	হরমোন	কাজ
মেডুলা	Adrenaline	হৃদস্পন্দন, রক্তচাপ, শ্বাসক্রিয়া ও রক্তে গ্লুকোজ বাড়ায় ("Fight or Flight")
	Noradrenaline	রক্তনালী সংকুচিত করে রক্তচাপ বাড়ায়
	Insulin	রক্তে গ্লুকোজ কমায় (গ্লুকোজ → গ্লাইকোজেন)

অগ্ন্যাশয় (Pancreas – Islets of Langerhans)	Glucagon	রক্তে গ্লুকোজ বাড়ায় (গ্লাইকোজেন → গ্লুকোজ)
পাইনিয়াল গ্রন্থি	Melatonin	ঘুম, জৈব-ঘড়ি ও দৈহিক রিদম নিয়ন্ত্রণ
ডিম্বাশয় (Ovary)	Estrogen	নারী যৌন বৈশিষ্ট্য প্রকাশ, জরায়ুর আন্তর্য্য বৃদ্ধি
	Progesterone	ঋতুচক্র নিয়ন্ত্রণ, গর্ভধারণ রক্ষা
অণ্ডকোষ (Testis)	Testosterone	পুরুষ যৌন বৈশিষ্ট্য প্রকাশ, শুক্রাণু উৎপাদন বৃদ্ধি

9. Metabolism of carbohydrate, fats and proteins:

(a) Glycolysis, TCA cycle, fatty acid oxidation, deamination and transamination.

(b) Inborn errors of metabolism- Glycogen storage disease, fructosuria, phenylketonuria etc

Metabolism is the sum of all the chemical reactions in the body's cells, divided into anabolism and catabolism. Anabolism uses energy to build larger molecules from smaller ones, such as building muscle tissue. Catabolism releases energy by breaking down complex molecules into simpler ones, like digesting food.

Carbohydrate Metabolism

Major Pathways of Carbohydrate Metabolism

- Glycolysis :**
Glucose is broken down into pyruvate or lactate, releasing energy (ATP).
- Citric Acid Cycle (Krebs cycle / TCA cycle):**
Acetyl-CoA is oxidized to carbon dioxide (CO₂). This is the final common pathway for carbohydrate, fat, and amino acid oxidation, producing energy-rich molecules (NADH, FADH₂, ATP).
- Gluconeogenesis:**
Glucose is synthesized from non-carbohydrate sources such as amino acids and glycerol.
- Glycogenesis:**
Glucose is stored in the form of glycogen in the liver and muscles.
- Glycogenolysis:**
Glycogen is broken down to release glucose for energy.

Glycolysis

Occurs in all cells – Glycolysis takes place in almost every cell, and the required enzymes are present in the **cytosol**.

Takes place with or without oxygen –

- **Anaerobic condition:** End product is **lactate**.
- **Aerobic condition:** End product is **pyruvate**, which is further oxidized to **CO₂ and H₂O**.

Key Points of Glycolysis

- Occurs in the cytoplasm of both plants and animals.
- Involves 10 enzymes.
- End products: 2 Pyruvate, 2 ATP, 2 NADH (per glucose)

Irreversible Steps in Glycolysis (Step Names & Enzymes):

Step	Reaction	Enzyme
1	Glucose → Glucose-6-phosphate	Hexokinase / Glucokinase
3	Fructose-6-phosphate → Fructose-1,6-bisphosphate	Phosphofructokinase-1 (PFK-1)
10	Phosphoenolpyruvate (PEP) → Pyruvate	Pyruvate kinase

ATP and NADH Production in Glycolysis

- Used: 2 ATP
- Produced: 4 ATP
- Net Gain: 2 ATP
- NADH Yield: 2 NADH → 5–6 ATP (via ETC).
- Total Energy Yield (per glucose): 7–8 ATP (2 ATP + 5–6 ATP).

Pyruvate Oxidation

- Takes place in the **mitochondria** when **oxygen is available** (aerobic conditions).
- Each **glucose molecule** produces **2 pyruvate molecules** in glycolysis, which are converted to **2 Acetyl-CoA molecules**.
- During this conversion, **2 NADH molecules** are generated (1 per pyruvate).
- These **2 NADH** can produce approximately **5 ATP** through the electron transport chain (2 × 2.5 ATP).

This step links **glycolysis** to the **Krebs cycle**, preparing pyruvate for further energy production.

TCA Cycle (Krebs Cycle)

- Main energy-producing pathway, generating **65–70% of ATP**. Occurs in the **mitochondrial matrix**
- **Acetyl-CoA** is oxidized to **CO₂ and H₂O**, using about **two-thirds of body's oxygen**.
- Also called **Tricarboxylic Acid Cycle** because citric acid (3 carboxyl groups) is the first product.

ATP Generation in Glucose Metabolism

Cofactors (Vitamins) and Inhibitors of Krebs Cycle

Vitamins (Cofactors):

- Thiamine (Vitamin B₁)
- Riboflavin (Vitamin B₂)
- Niacin (Vitamin B₃)
- Pantothenic acid (Vitamin B₅)

Inhibitors:

- Fluoroacetate
- Arsenite
- Malonate

Fatty Acid Oxidation (β-Oxidation)

Fatty acid oxidation is the process of breaking down fatty acids to produce energy. It occurs in the **mitochondrial matrix**, mainly converting long-chain fatty acids into **Acetyl-CoA**.

Major Steps

1. **Activation of Fatty Acids:** In the cytoplasm, fatty acids are converted into Acyl-CoA by **Acyl-CoA synthetase**, consuming 2 ATP equivalents.
2. **Transport into Mitochondria:** Acyl-CoA is transported via the **Carnitine Shuttle** into the mitochondrial matrix, where β-oxidation occurs.
3. **β-Oxidation Proper:** Repetitive 4-step cycle in the mitochondrial matrix:
 - **First Oxidation:** Forms a double bond; FAD → FADH₂.
 - **Hydration:** Water added across the double bond.
 - **Second Oxidation:** NAD⁺ → NADH.

- **Thiolysis:** Cleaves a 2-carbon **Acetyl-CoA** unit; remaining fatty acid re-enters the cycle.

Energy Yield

- Acetyl-CoA enters the **TCA cycle** for further ATP production; NADH and FADH₂ produced feed the **ETC** for additional ATP.

Metabolic Water

Oxidation generates metabolic water, important for animals like camels and kangaroos.

Regulation

1. **Major Inhibitor:** Malonyl-CoA blocks the Carnitine Shuttle, preventing simultaneous fatty acid synthesis and oxidation.
2. **Allosteric Regulation:** Excess NADH, FADH₂, or Acetyl-CoA inhibits β -oxidation enzymes.
3. **Hormonal Control:**
 - **Insulin:** Inhibits β -oxidation, promotes fatty acid synthesis.
 - **Glucagon & Adrenaline:** Stimulate β -oxidation during fasting or energy demand.

Amino Acid Metabolism

Transamination in Amino Acid Metabolism

Transamination is a chemical process where an **amino group (-NH₂)** from one amino acid is transferred to a **keto acid**, forming a new amino acid and a new keto acid.

Enzyme:

- Catalyzed by **aminotransferases (transaminases)**.
- Requires the coenzyme **Pyridoxal Phosphate (PLP)** from Vitamin B₆, which temporarily holds the amino group.

Mechanism:

- **Amino group acceptance:** Amino acid transfers its -NH₂ to PLP → forms PMP (Pyridoxamine Phosphate), leaving a keto acid.
- **Amino group donation:** PMP transfers -NH₂ to a new keto acid → forms a new amino acid, regenerating PLP for the next cycle.

Deamination

Deamination is the process in which the amino group ($-NH_2$) of an amino acid is completely removed.

Differences from Transamination:

- Transamination: Amino group is transferred from one molecule to another; no free ammonia is produced.
- Deamination: Amino group is removed as free ammonia (NH_3), which is toxic and must be safely eliminated.

Purpose of Deamination

1. Nitrogen elimination: Removes excess nitrogen safely via the urea cycle.
2. Energy production: The remaining carbon skeleton (keto acid) can be used for ATP generation through the TCA cycle.
3. Occurs mainly in: Liver and kidneys, as these organs handle amino acid metabolism and ammonia detoxification.

Mechanism of Deamination

- **Amino group removal:**
 - Amino acid (e.g., glutamate) loses its amino group $\rightarrow$ forms a **keto acid**.
- **Electron acceptor:**
 - NAD^+ or $NADP^+$ accepts electrons $\rightarrow$ produces NADH or NADPH.
- **Ammonia release:**
 - NH_3 is produced, which is highly toxic.
- **Urea formation:**
 - NH_3 enters the **urea cycle**, becomes urea, and is excreted safely.

Important Features of Deamination

- Ammonia production: Free NH_3 is generated (distinct from transamination).
- Energy provision: Carbon skeleton becomes keto acid $\rightarrow$ used in TCA cycle.
- Site of reaction: Liver and kidneys.
- Link to urea cycle: NH_3 is converted to urea for safe excretion.
- Oxidative vs non-oxidative: Most deamination is oxidative (produces NADH/NADPH), but some amino acids undergo non-oxidative deamination.
- Glutamate central role: Glutamate often receives amino groups via transamination and then undergoes oxidative deamination to release NH_3 .
- Combined pathway: The sequence of transamination followed by deamination is sometimes called transdeamination.

Urea Cycle

- Urea is the final product of protein (amino acid) catabolism.
- Nitrogen from amino acids is converted into ammonia (NH_3), which is toxic. Urea formation detoxifies ammonia for safe excretion.
- About 80–90% of nitrogen-containing compounds are excreted as urea.
- Site of synthesis: Liver; urea is transported to kidneys for excretion.
- Also called the Krebs-Henseleit cycle (discovered by Hans Krebs & Kurt Henseleit, 1932).

Urea Cycle Enzymes & Location

Mitochondrial Enzymes

1. Carbamoyl Phosphate Synthetase I (CPSI)
 - First and rate-limiting step of the cycle.
 - Converts ammonia + bicarbonate + 2 ATP → carbamoyl phosphate.
 - Requires N-acetylglutamate (NAG) as an obligate activator.
2. Ornithine Transcarbamylase (OTC)
 - Combines carbamoyl phosphate + ornithine → citrulline + Pi.

Cytosolic Enzymes

1. Argininosuccinate Synthetase (ASS)
 - Condenses citrulline + aspartate → argininosuccinate.
2. Argininosuccinate Lyase (ASL)
 - Cleaves argininosuccinate → fumarate + arginine.
3. Arginase (ARG1)
 - Hydrolyzes arginine → urea + ornithine, completing the cycle.

Energetics of the Urea Cycle

Total ATP used: 4 ATP per urea molecule

- 2 ATP for carbamoyl phosphate
- 2 ATP equivalent for argininosuccinate formation

Inborn Errors of Metabolism (IEM)

Genetic disorders where specific enzymes or proteins do not function properly, leading to accumulation of some substances and deficiency of others.

Glycogen Storage Diseases (GSD)

- Cause: Deficiency of specific enzymes → glycogen cannot be properly broken down or stored.
- Symptoms:
 - Liver: Hypoglycemia, hepatomegaly

- Muscles: Weakness, fatigue
- Examples:
 - Type I (Von Gierke's Disease): Glucose-6-phosphatase deficiency → severe hypoglycemia
 - Type II (Pompe Disease): Alpha-glucosidase deficiency → glycogen accumulation in muscles
- Management: Dietary modification, enzyme replacement therapy in some cases

Fructosuria

- Benign Fructosuria: Fructokinase deficiency
- Hereditary Fructose Intolerance (HFI): Aldolase B deficiency → accumulation of toxic fructose-1-phosphate → vomiting, hypoglycemia, liver/kidney damage; requires strict dietary control

Phenylketonuria (PKU)

- Cause: Phenylalanine hydroxylase deficiency → phenylalanine accumulates → brain damage
- Symptoms: Intellectual disability, developmental delay, seizures, characteristic odor
- Management: Low-phenylalanine diet, special medical formulas, sometimes medication

Maple Syrup Urine Disease (MSUD)

- Cause: Defective breakdown of branched-chain amino acids (leucine, isoleucine, valine)
- Symptoms: Sweet-smelling urine, poor feeding, vomiting, lethargy, seizures, neurological deficits
- Management: Low-protein diet, special BCAA-free formulas

Alkaptonuria

- Cause: Homogentisate 1,2-dioxygenase deficiency → homogentisic acid accumulates
- Symptoms: Dark urine, arthritis, darkened cartilage, black pigmentation of teeth and sclera, heart valve issues
- Management: Symptomatic treatment, dietary restrictions of tyrosine and phenylalanine, Nitisinone in some cases

FOOD AND NUTRITION

Part-I I

1. Approximate composition of common food stuffs cereals, meat, fish, eggs, milk, pulses

and legumes, nuts and oil-seeds, vegetables and fruits.

Cereals

In developing countries, cereals provide 70–80% of calories and 25–30% of protein, making them staple foods. Cereal grains have **three main parts**:

1. Bran layer – outer layer, rich in fiber and minerals; includes the aleurone layer.
2. Endosperm – main starchy part, rich in carbohydrates.
3. Germ – the embryo, gives rise to the sprout, rich in nutrients.

Nutritional Value of Cereals

1. Starch (Carbohydrate)

- **Rice:** 77–79%
- **Wheat:** 70–72%

2. Protein

- **Content:** 7–12%
- **Major Proteins:**
 - In rice and most cereals: **Prolamin, Glutelin**
 - In wheat: **Gluten** → becomes soft and elastic when kneaded with water → important for **bread and bakery products**.
- **Limitation:** Low in **Lysine** and **Tryptophan** (wheat also low in Methionine) → limits protein quality.

Protein-rich Foods: Meat

Meat is the edible muscle tissue of domestic animals and birds.

Protein Content:

- 18–25% protein
- High-quality, easily digestible protein containing essential amino acids.
- Major proteins: Myosin, Actin
 - In live muscle: Present as Myosinogen
 - After slaughter: Rigor mortis occurs; later, enzymes and microbial action soften the meat.

Color:

- Due to myoglobin, a heme pigment.

Fat Content:

- Mainly saturated fat, which is stable.
- Contains cholesterol and phospholipids.

Nutritional Value and Importance of Fish

Protein:

- Fish contains 18–25% high-quality protein.
- Rich in essential amino acids for growth and body repair.
- Major proteins: Myosin, Actin
- Fish protein is highly digestible and easily absorbed.

Fat and Lipids:

- Fat content: **15–25%**, mostly **unsaturated fatty acids**.
- Rich in polyunsaturated fatty acids (PUFAs), especially omega-3 (EPA & DHA).
- Provides vitamins A & D, especially in fatty fish.

Egg

An egg is a complete food and has three main parts: **shell, albumen (egg white), and yolk.**

1. Shell

It contains mainly calcium carbonate.

2. Albumen (Egg White)

- The egg white is rich in high-quality protein.
- Composition of egg white: 87% water, 10–12% protein, 1% minerals.
- Proteins in egg white include:
 1. Ovalbumin (70%) – main storage protein, coagulates on heating.
 2. Conalbumin (9%) – binds iron, has antimicrobial properties.
 3. Ovomucoid (11–13%) – glycoprotein, inhibits trypsin.
 4. Globulins, Lysozyme (2–6%), Ovomucin (2%), Avidin (0.06%) – other functional proteins.

3. Yolk

- The yolk makes up 30–31% of the egg and contains 50% water, 31% fat, and 15–17% protein.
- Yolk contains emulsified fats, including lipovitellin and lipovitellenin, and proteins such as livetins.
- Also rich in phospholipids and cholesterol: ~1330 mg cholesterol per 100 g yolk.
- Provides vitamins A, D, E, and B-complex.

Nutritional Quality of Egg Protein

- High digestibility and rich in essential amino acids.
- Protein Efficiency Ratio (PER): 4.5
- Net Protein Utilization (NPU): 98
- Biological Value (BV): 100 – making egg protein ideal for human nutrition.

Energy Value

- 100 g of egg provides 163–170 kcal.

Milk

- Milk contains about **3% protein**.
- Major milk proteins are divided into two groups:
 1. **Casein (≈80%)** – the main milk protein; forms curd when milk is acidified.
 2. **Whey proteins (≈20%)** – includes:
 - Globulin
 - Albumin

Nutritional Composition of Milk

1. Protein

- High biological value and rich in essential amino acids.
- Biological Value (BV): 87–90.

2. Fat

- Present as an emulsion (fat droplets dispersed in water).
- Contains both saturated and unsaturated fatty acids.
- Also contains cholesterol and phospholipids.

3. Carbohydrate

- Mainly **lactose**.

4. Minerals

- Rich in calcium, phosphorus, potassium, magnesium, and chloride.

5. Vitamins

- Contains fat-soluble vitamins (A, D) and water-soluble vitamins.

Milk-based Products

Yogurt (Curd)

- A natural fermented milk product.
- Lactose-intolerant people often tolerate yogurt better.
- Acidity of yogurt helps calcium absorption.

Powdered Milk

- Typical composition: 20% protein, 26% fat.

Pulses (Legumes)

- Protein content: ≈20–28%.
- Pulses also contain essential amino acids, though their biological value is lower than animal proteins.
- Protein from pulses is often called “Poor Man’s Meat” due to its affordability and high nutritional value.

Carbohydrates

- Pulses contain 50–65% carbohydrates, mainly non-starch polysaccharides like pentosans and galactans.

Cautions

- Some pulses, if consumed excessively (e.g., certain types of Lathyrus), may cause Lathyrism, a neurological disorder affecting spinal cord and legs.

Nuts and Oilseeds

- **Groundnut**
 - Protein: 22–28%, Fat 42-50%.
- **Soybean:**
 - Protein: 43%, Fat: 19%.

Vegetables

- Improve dietary diversity, digestion, and metabolism.
- Provide vitamins, minerals, fiber, and phytochemicals.
- Generally contain >80% water and 2–3% protein.

Nutritional Role

- Leafy vegetables → rich in proteins, minerals (K, Ca, Fe, Na, Mg).
- Roots & tubers → higher in carbohydrates.
- Contain cellulose, hemicellulose, pectins, gums → improve digestion.
- Enzymes present: oxidoreductase, peroxidase, hydrolases, lyases.
- Also contain enzyme inhibitors.

Organic Compounds

- Malic acid (in fruits/vegetables), oxalic acid (in leafy greens).
- Phenolics, flavones, hydroxy acids → add health value.
- Volatile compounds (e.g., dimethyl sulfide in garlic, thiopropanal-S-oxide in onion) → give flavor and aroma.

Vitamins & Minerals

- Good source of Vitamin C, Vitamin A (carotenoids), B-complex vitamins.
- Rich in potassium, calcium, iron, sodium, magnesium.

2. Nutrition during normal life cycle:

(a) Pregnancy and lactation- nutrition requirement, effect of malnutrition during pregnancy.

(b) Infancy and early childhood- nutritional requirement breast-feeding and weaning.

(c) Elderly- health problem and nutritional modification of adult diet for old people

Pregnancy is the physiological state when a woman carries a fetus in her uterus from conception to birth.

Causes of Increased Nutritional Needs during Pregnancy

- **Hormonal & metabolic changes:** Increased hormones raise metabolism, requiring extra (+300)calories, especially in the 3rd trimester.
- **Protein:** Essential for fetal tissue, organ development, and maternal blood. Additional 10–15 g/day in the last trimester.
- **Calcium & Phosphorus:** Needed for fetal bones (≈ 30 g calcium, mainly in last 3 months). Deficiency $\rightarrow$ maternal osteoporosis.
- **Iron:** Builds fetal stores (3–4 months) and compensates delivery blood loss. 25–35 mg/day required. Deficiency $\rightarrow$ anemia.
- **Iodine:** Supports metabolism & thyroid function. 125 μg /day required.
- **Vitamins:** A, C, and B-complex are crucial for fetal growth and maternal metabolism.

Nutritional Requirements for Lactating Mothers:

1. **Energy:** An extra 700–1000 kcal needed. Calorie intake should be adjusted if milk production changes.
2. **Protein:** An additional 18–20 g/day is required for milk production.
3. **Calcium:** 850 ml of milk provides 290 mg calcium. Mothers need 1–1.5 g calcium/day; insufficient intake can weaken bones and teeth.
4. **Vitamin A (Retinol):** 850 ml of milk contains 300 μg retinol; lactating mothers need an extra 300 μg /day.
5. **B-vitamins:** Higher protein and calorie needs also increase B-complex vitamin requirements.
6. **Water:** Adequate fluid intake is necessary to maintain milk's water content.

Exclusive Breastfeeding (EBF): Feeding the infant only breast milk for the first 6 months, with no other food or drink, not even water.

Colostrum:

- Thick, yellowish fluid produced during the first 2–4 days after birth.
- Small in quantity but nutrient-dense and rich in protective factors.
- Acts as the infant's first immunization, containing antiviral substances, antibodies (against smallpox, polio, measles, influenza), and enzymes like lysozyme, peroxidase, and xanthine oxidase.
- Contains a vitamin B₁₂-binding protein that inhibits harmful bacterial growth.

Importance of Breast Milk:

- **Complete Nutrition:** Provides optimal nutrient balance for growth.

- **Easily Digestible Protein:** Soft curds form, easier on the infant's digestion.
- **Rich in Lactose:** Supports brain development and maintains low electrolyte concentration.
- **Healthy Fat Composition:** High in essential PUFAs (linoleic and α -linolenic acids) for growth and brain function.
- **Adequate Vitamins:** Contains both fat- and water-soluble vitamins.
- **Anti-infective Agents:** Antibodies, lactoferrin, lysozyme, lactoperoxidase, phagocytes, and bifidus factor protect against infections.
- **Anti-allergic Properties:** Reduces risk of allergies.
- **Immunological Support:** Lymphocytes stimulate Immunoglobulin A (IgA) production.
- **Emotional Bonding:** Strengthens mother-infant connection.

Nutritional Requirements for the Elderly

Energy:

- Metabolic rate and physical activity decline with age, reducing energy needs by ~7.5% per decade after age 30.
- Recommended daily intake: 2200 kcal for men, 1900 kcal for women.

Macronutrients:

- **Carbohydrates:** 50–55% of total calories, mainly from starches. High-fiber, soft foods prevent constipation; limit sugars due to delayed insulin response.
- **Fats:** 10–15% of total calories. Avoid high-cholesterol foods (egg yolk, whole milk, organ meats) and prefer PUFA-rich fats. Limit excess fat due to slower absorption.
- **Proteins:** 0.8 g/kg body weight (15–20% of total calories).

Vitamins:

- Antioxidants (A, C, E, β -carotene) help delay aging and prevent organ degeneration.
- Vitamin D supports bone health; fat-soluble vitamins (A, D) and B-complex vitamins (thiamine, pyridoxine, cyanocobalamin, folic acid) should be supplemented as needed.

Minerals:

- **Calcium:** 800 mg/day, increasing to 1200 mg/day for women >50 or with osteoporosis. Maintains teeth and bones.
- **Iron:** 20–30 mg/day due to low absorption in old age.
- Other minerals typically sufficient in normal aging.

Water:

- Adequate fluid intake is essential to prevent dehydration, low urine output, and constipation, especially with dry mouth (xerostomia).

3. Assessment of nutritional status of community:

(a) Types of assessment- anthropometry, clinical, biochemical, dietary assessment and

surveys.

(b) Advantage and disadvantages of each type.

Methods for Assessing Nutritional Status:

1. Direct Methods:

These involve measuring the individual's physical condition, clinical signs, and laboratory tests. Key direct methods include:

- **Clinical Examination:** Checking for malnutrition signs in eyes, skin, mouth, throat, bones, etc.
- **Biochemical Tests:** Blood and urine tests (e.g., measuring hemoglobin, albumin) to detect nutrient deficiencies.
- **Anthropometry:** Measuring height, weight, arm circumference, etc., across different age groups to assess malnutrition levels.

2. Indirect Methods:

These assess nutritional status through population-level data. Important indirect methods include:

- **Vital Statistics:** Analysis of birth and death rates, morbidity rates, and their patterns in the population.
- **Dietary Surveys:** Studying food consumption patterns and linking them to nutritional deficiencies.
- **Agricultural Data and Food Balance Sheets:** Estimating nutrient availability in the community from food production and supply.

Method / Test	Nature / What It Measures	Nutritional Significance / Advantage
Clinical Examination	Physical signs in eyes, skin, mouth, etc.	Identifies malnutrition quickly, low cost, minimal training required
Biochemical Tests	Blood and body fluid analysis for nutrients	Accurate assessment of nutrient deficiencies and physiological effects; but costly and technically demanding
Anthropometry	Body measurements: height, weight, circumferences	Evaluates growth and severity of malnutrition; low cost, simple
Dietary Survey	Quantity and quality of food intake, dietary history	Detects under/over-consumption, dietary patterns, food distribution; may be influenced by personal reporting

Agricultural Data / Food Balance Sheet	Food production, supply, imports, exports, storage, distribution	Estimates food security, nutrient availability, and potential deficits; data may be imprecise
Vital Statistics	Birth/death rates, morbidity, mortality	Identifies at-risk groups, maternal/child health; supports public health planning
Additional Clinical / Health Data	Disease prevalence, poisoning, infection rates	Investigates links between malnutrition and diseases (e.g., arsenic poisoning); helps plan interventions

অপুষ্টি / Nutrient Deficiency	ডাক্তারি বৈশিষ্ট্য (Clinical Features)	প্রাণ-রাসায়নিক পরীক্ষা (Biochemical Tests)
PEM / কোয়াশিওরফর	দৈহিক বৃদ্ধি ব্যাহত, ইডিমা, শ্রলম্বিত পেট, চুল বিবর্ণ, চর্মরোগ, ডায়রিয়া	সিরাম প্রোটিন কম, এলবুমিন কম
জেরপথ্যালমিয়া (Xerophthalmia)	রাতকানা, বিট্রেস ফোটা	সিরাম ভিটামিন-এ কম ($<10 \mu\text{g/dl}$)
বেরিবেরি (Beriberi)	ওজন হ্রাস, ইডিমা, হাত-পায়ে অবসন্নতা, দুর্বলতা, বুক ধড়ফড়, দ্রুত নাড়ীর গতি	রক্তে erythrocyte transketolase সক্রিয়তা হ্রাস, B_1 এর পরিমাণ কম
পেলগ্রা (Pellagra / B_3 অভাব)	চর্মরোগ, ডায়রিয়া, মানসিক বিমর্ষতা, হতাশাগ্রস্ত	রক্তে B_3 কম, মূত্রে N-methyl nicotinamide কম
B_2 অভাব / Ariboflavinosis	ঠোঁটের কোণায় ঘা, জিহ্বায় প্রদাহ	রক্তে erythrocyte glutathione reductase সক্রিয়তা হ্রাস, মূত্রে B_2 রেচন কম
স্কারভি (Scurvy / Vitamin C)	স্পঞ্জি গাম, দাঁতের মাড়ি থেকে রক্তক্ষরণ, কালশিটে দাগ, অস্থি সন্ধিতে ব্যথা	Leucocyte-এ ভিটামিন-C এর পরিমাণ কম
ফলিক এসিড / B_{12} অভাব (Megaloblastic Anemia)	ক্ষুধামান্দ্য, দুর্বলতা, অজীর্ণতা	Hb কম, রক্তে ফলিক এসিড ও B_{12} হ্রাস

দ্ধতি (Method)	বর্ণনা / বৈশিষ্ট্য	সুবিধা (Advantages)	অসুবিধা / সীমাবদ্ধতা (Limitations)
খাদ্য রেকর্ড (Food Record)	প্রতিদিন বা নির্দিষ্ট সময়ে গ্রহণকৃত খাদ্য লিপিবদ্ধ করা হয়; পরিমাণ পরিমাপ করা হয়	স্মৃতিশক্তি নির্ভর নয়; পরিমাণ পরিমাপ সহজ	সময়সাপেক্ষ; ব্যয়বহুল;

২৪ ঘণ্টা স্মরণ পদ্ধতি (24-hour Recall)	প্রশ্নকারীর ২৪ ঘণ্টার খাদ্য গ্রহণ স্মরণ করে রেকর্ড করা হয়	প্রশ্নকারীর চাপ কম; লেখাপড়া জানা প্রয়োজন নেই	স্মৃতিশক্তি নির্ভরশীল; পরিমাণ নির্ধারণ কঠিন; পুনরাবৃত্তি প্রয়োজন
ফ্রিকোয়েন্সি ফুড কোয়েশন (FFQ)	নির্দিষ্ট খাদ্যের তালিকা অনুযায়ী কতবার ও কত পরিমাণ গ্রহণ হয়েছে তা প্রণয়ন করা হয়	স্বল্প খরচ; সহজ; দ্রুত;	স্মৃতিশক্তি নির্ভরশীল; লেখাপড়া জানা প্রয়োজন;
খাদ্য ইতিহাস (Dietary History)	ইন্টারভিউ, ২৪ ঘণ্টা স্মরণ, খাদ্য রেকর্ড, ও food composition data ব্যবহার করে হিসাব করা হয়	দীর্ঘমেয়াদী খাদ্য প্যাটার্ন জানা যায়; জাতীয় খাদ্য নীতি প্রণয়ন, খাদ্য সমৃদ্ধকরণে তথ্য সরবরাহ	সময়সাপেক্ষ; প্রশ্নকারীকে দক্ষ হতে হয়; বিশ্লেষণ জটিল

4. Concept and importance of nutrition education:

(a) Objectives of nutrition education and implementing nutrition education program in

a community.

(b) Use of audio-visual aids in nutrition education.

পুষ্টিশিক্ষা (Nutrition Education)

স্বাস্থ্য, খাদ্য ও পুষ্টিবিষয়ক শিক্ষাকে **পুষ্টিশিক্ষা** বলা হয়। অনেক সময় অপুষ্টির মূল কারণ হয়ে দাঁড়ায় জ্ঞানের অভাব, অজ্ঞতা, ভ্রান্ত ধারণা ও কুসংস্কার। সেক্ষেত্রে পুষ্টিশিক্ষাই অপুষ্টি দূরীকরণের কার্যকর উপায়। যেমন—আয়োডিন অভাবজনিত রোগ দূর করার একমাত্র উপায় আয়োডিনের গুরুত্ব সম্পর্কে সচেতনতা বৃদ্ধি।

পুষ্টিশিক্ষা প্রদানের ধরন

১. আনুষ্ঠানিক (Formal):

- শিক্ষা পাঠ্যক্রমে স্বাস্থ্য ও পুষ্টি বিষয় অন্তর্ভুক্ত করা।

২. অনানুষ্ঠানিক (Informal):

- জনগোষ্ঠীর মধ্যে নির্দিষ্ট পুষ্টি বিষয়ক বার্তা ও ধারণা পৌঁছে দেওয়া।
- গণমাধ্যম (রেডিও, টেলিভিশন, দৈনিক পত্রিকা, দেওয়াল পত্রিকা)
- সাংস্কৃতিক মাধ্যম (সঙ্গীত, ছড়া, গান ইত্যাদি)
- এভাবে জনগণকে পুষ্টি বিষয়ে সচেতন করা সম্ভব।

পুষ্টিশিক্ষা কার্যক্রম বাস্তবায়নের জন্য করণীয়

১. জনগণকে স্বাস্থ্য ও পুষ্টির গুরুত্ব উপলব্ধি করানো।
২. সঠিক খাদ্য নির্বাচনের গুরুত্ব শেখানো।
৩. পরিচ্ছন্নতা ও জীবাণুমুক্ত পরিবেশের গুরুত্ব বোঝানো।
৪. ভ্রান্ত ধারণা ও কুসংস্কার বর্জনে উদ্বুদ্ধ করা।

পুষ্টিশিক্ষার কার্যক্রম পরিচালনার স্থান

- মাতৃসদন
- টিকাদান কেন্দ্র
- পল্লী স্বাস্থ্যকেন্দ্র
- হাসপাতাল ইত্যাদি

পুষ্টিশিক্ষার গুরুত্ব

১. স্বাস্থ্য ও পুষ্টি বিষয়ে সচেতনতা
২. অপুষ্টি প্রতিরোধ
৩. স্বল্পমূল্যে পুষ্টিকর খাদ্য নির্বাচন
৪. সঠিক খাদ্য উৎপাদন ও নির্বাচন
৫. পরিচ্ছন্নতা ও নিরাপদ খাদ্যাভ্যাস
৬. মা ও শিশুর পুষ্টির গুরুত্ব
৭. ভ্রান্ত ধারণা ও কুসংস্কার দূরীকরণ
৮. সাধারণ জনগণের মধ্যে পুষ্টি বার্তা প্রচার

প্রদর্শন (Demonstration) ও গণমাধ্যমে পুষ্টিশিক্ষা

মাধ্যম (Media)	ব্যবহার/পদ্ধতি	সুবিধা	অসুবিধা
রেডিও	স্লোগান, গান, কবিতা	নিরক্ষর জনগণ উপকৃত হয়, খরচ কম, সহজলভ্য	বিদ্যুৎ না থাকলে অকার্যকর
টেলিভিশন	বিজ্ঞাপন, টক শো, নাটক, যাত্রা গান	বৃহৎ জনগোষ্ঠীর কাছে বার্তা পৌঁছানো যায়	ব্যয়বহুল, শহরমুখী
খবরের কাগজ	নিবন্ধ, বিজ্ঞাপন	শহরে শিক্ষিত জনগোষ্ঠীর জন্য উপযোগী	লেখাপড়া জানা লাগে, নিরক্ষরের জন্য অকার্যকর
প্রদর্শন (Demo)	প্রকৃত খাদ্যসামগ্রী ও শিশু ব্যবহার করে বার্তা প্রদান	অল্প খরচে কার্যকর, সহজবোধ্য, সরাসরি শিখন	সীমিত পরিসরে ব্যবহারযোগ্য

পুষ্টিশিক্ষা প্রোগ্রাম পরিকল্পনার ধাপসমূহ

ধাপ	শিরোনাম	কার্যক্রম/কাজ
ধাপ-১ প্রস্তুতকরণ (Preparation)		১. পুষ্টি সমস্যা চিহ্নিতকরণ ২. সমস্যার কারণ সনাক্তকরণ ৩. শিক্ষার কাঠামো প্রস্তুত ১. লক্ষ্য নির্ধারণ ২. বার্তা ঠিককরণ
ধাপ-২ Formulation		৩. মাধ্যম/মাল্টিমিডিয়া নির্বাচন ৪. ব্যয় নির্ধারণ ৫. সময়সীমা নির্ধারণ ১. উপকরণ তৈরি
ধাপ-৩ বাস্তবায়ন (Implementation)		২. কর্মীদের প্রশিক্ষণ ও হাতে-কলমে শিক্ষা ৩. যোগাযোগ মাধ্যম নির্ধারণ
ধাপ-৪ মূল্যায়ন (Evaluation)		১. কার্যক্রমের সাফল্য ও সীমাবদ্ধতা মূল্যায়ন
5. Community based approaches to solve nutritional problems:		
(a) Improving household food security.		
(b) Food fortifications and supplementation.		
(c) Promoting appropriate dietary guidelines.		

খাদ্য নিরাপত্তা (Food Security)

সংজ্ঞা:

সব মানুষ সর্বদা সক্রিয় ও সুস্থ জীবনযাপনের জন্য প্রয়োজনীয়, পর্যাপ্ত ও পুষ্টিকর খাদ্যে প্রবেশাধিকার পেলে তাকে খাদ্য নিরাপত্তা বলে।

খাদ্য প্রাপ্তির উৎস:

১. নিজস্ব উৎপাদন
২. বাজার থেকে ক্রয়

খাদ্য নিরাপত্তার প্রধান বিষয়:

- খাদ্য উৎপাদন, সংরক্ষণ, পরিবহন ও বাজারজাতকরণ
- মূল্য নিয়ন্ত্রণ ও খাদ্যের প্রাপ্যতা
- পারিবারিক আয়, স্থিতিশীলতা ও ক্রয়ক্ষমতা
- প্রাকৃতিক দুর্যোগ (খরা, বন্যা) ও জমির মালিকানা
- গ্রামে জমি ও উৎপাদন নির্ভরতা, শহরে আয়, ক্রয়, ভাড়া ও কর্মসংস্থান

Household Food Security বৃদ্ধির উপায়

১. বাড়ির আঙিনায় সবজি বাগান, হাঁস-মুরগি ও মাছ চাষ
২. নারীর আয় বৃদ্ধি ও সিদ্ধান্ত গ্রহণের ক্ষমতা বৃদ্ধি

3. পারিবারিক খাদ্য সংরক্ষণ ও সঠিক রান্নার কৌশল শেখানো
4. আয় বৃদ্ধি ও সঞ্চয়ের ব্যবস্থা
5. পুষ্টি শিক্ষা ও সুস্বাদু খাদ্য তালিকা তৈরি

Supplementation

সংজ্ঞা:

স্বল্পমেয়াদি হস্তক্ষেপ যেখানে ঝুঁকিপূর্ণ জনগোষ্ঠীকে নির্দিষ্ট পুষ্টি উপাদান সরবরাহ করে দ্রুত পুষ্টি অবস্থার উন্নতি করা হয়।

বৈশিষ্ট্য

- স্বল্পমেয়াদি হস্তক্ষেপ
- দ্রুত ও দৃশ্যমান ফলাফল দেয়

উদাহরণ

- ভিটামিন A ক্যাপসুল বিতরণ
- গর্ভবতী মায়েদের আয়রন ও ফোলিক এসিড ট্যাবলেট
- আয়োডিন ঘাটতি এলাকায় গর্ভবতী মায়েদের Lipiodol injection
- স্কুল টিফিন প্রোগ্রাম
- ফুড-ফর-ওয়ার্ক প্রোগ্রাম

Promoting Appropriate Dietary Guidelines

Educating individuals and communities about healthy eating practices to ensure balanced nutrition, prevent deficiencies, and reduce the risk of chronic diseases. Helps people make informed food choices considering nutritional needs, cultural habits, and available resources.

Objectives

1. Ensure adequate intake of macronutrients (carbohydrates, proteins, fats) and micronutrients (vitamins, minerals)
2. Prevent malnutrition (under- and over-nutrition)
3. Promote healthy eating habits from childhood to adulthood
4. Encourage safe food handling and hygiene
5. Support public health interventions like food fortification and supplementation

Food Fortification

The process of adding essential nutrients to staple foods to improve their quality and prevent nutrition-related diseases in the population.

Objectives

1. Restore nutrients lost during food processing (**Restoration**)
2. Enhance the nutritional value of foods (**Enrichment**)
3. Address existing nutrient deficiencies (e.g., iodine in salt, iron in flour)

Effects / Benefits

- Reduces nutrient deficiencies in large populations
- Creates long-term positive impacts on public health and nutrition
- Improves maternal and child nutrition
- More cost-effective than nutrition education or supplementation programs
- Helps prevent widespread malnutrition in vulnerable groups

Deficiency	Source / Intervention	Example Foods / Supplements
Iodine Deficiency (IDD)	Fortification	Iodized salt, milk, oil, fortified foods
Vitamin A Deficiency	Supplementation	Vitamin A capsule, leafy vegetables, milk, liver
Iron Deficiency / Anemia (IDA)	Diversification / Supplementation	Leafy greens, legumes, meat, iron-fortified foods, iron tablets

6. Causes, symptom and nutritional management in-

- (a) Diarrhea;
- (b) Constipation;
- (c) Diabetes mellitus;
- (d) Hypertension;
- (e) Liver and kidney diseases.

Diabetes Mellitus

A metabolic disorder marked by persistent hyperglycemia due to defects in insulin secretion, action (resistance), or both, influenced by genetic and/or environmental factors. Chronic hyperglycemia can damage organs such as eyes, kidneys, nerves, heart, and blood vessels.

Types (WHO Classification)

1. Type I / IDDM – Insulin-dependent diabetes
2. Type II / NIDDM – Non-insulin-dependent diabetes
3. Malnutrition-Related Diabetes (MRDM)
4. Gestational Diabetes (GDM)

Main Causes

1. Hereditary Factors: Higher risk if one/both parents are diabetic; twins at higher risk
2. Juvenile Diabetes (IDDM): Post-adolescence due to malnutrition or infection; requires insulin
3. Acquired / Environmental Factors: Obesity, sedentary lifestyle, stress, smoking, infections, hyperthyroidism, pancreatic diseases

Symptoms

- Hyperglycemia: High blood glucose; glucose appears in urine (glycosuria)
- Polyuria: Frequent urination
- Polydipsia: Excessive thirst
- Polyphagia: Excessive hunger
- Weakness & Weight Loss: Muscle and fat breakdown
- Reduced Immunity: Slow wound healing, higher infection risk
- Organ Complications: Eye, kidney, heart, blood vessels affected
- Ketoacidosis: Increased ketone bodies; insulin required

Dietary Management of Diabetes

1. Calorie Control

- Maintain ideal body weight.
- Calorie needs based on body type:
 - Obese: 20 kcal/kg
 - Normal: 30 kcal/kg
 - Underweight: 40 kcal/kg
 - Age >50 years: Reduce total calories by 10%

2. Calorie Distribution

- Carbohydrates: 60–65%
- Protein: 15–20%
- Fat: 15–25%

3. Protein

- 1.25–1.5 g/kg body weight

4. Carbohydrates

- Minimum 100 g/day to prevent ketosis
- Prefer complex carbs (rice, whole wheat, barley, mixed grains). Up to 250 g/day for diabetics patients.

5. Fat

- Prioritize unsaturated fats
- Keep cholesterol <300 mg/day

6. Dietary Fiber

- Slows glucose absorption → prevents blood sugar spikes
- Improves insulin sensitivity
- Reduces serum cholesterol & triglycerides
- Enhances glucose utilization
- Supplies additional micronutrients

7. Fruits and Vegetables

- 150–200 g/day of fresh, low-calorie, nutrient-rich produce

Heart Disease

Causes of Heart Disease:

Type	Factors
Non-modifiable	Age, sex, genetics, family history
Behavioral / Lifestyle	Smoking, alcohol, physical inactivity, stress, unhealthy diet
Metabolic / Physiological	High blood pressure, obesity, abnormal blood lipids, diabetes, high LDL cholesterol

Heart Disease – Dietary Management

1. Fats

- Limit saturated fats (butter, ghee, fatty meat, cream)
- Include PUFA (polyunsaturated fatty acids): supports prostaglandin synthesis, regulates blood pressure
- Omega-3 fats: reduce thrombosis risk, found in fatty fish
- Healthy oils & nuts: olive oil, sunflower oil, flaxseed oil, almonds help reduce heart risk

2. Carbohydrates

- Prefer pulses and whole grains
- Limit sugar, molasses, refined carbs to prevent hyperlipidemia
- Include fruits like apples, amla for benefits

3. Minerals

- Potassium & magnesium: maintain blood pressure
- Sources: bananas, carrots, spinach, pumpkin, seeds, guava, mango, watermelon
- Calcium-rich foods recommended to reduce hypertension risk

Hypertension

Definition:

Consistently high blood pressure:

- **Normal:** $\leq 120/80$ mmHg
- **High:** $\geq 160/95$ mmHg

Causes:

- Heart disease, kidney disorders, diabetes
- Lifestyle: smoking, stress, obesity
- Hereditary factors

Symptoms:

- Dizziness, neck pain, fatigue, occasional chest pain

Dietary Management for Hypertension

1. Fats and Calories

- Reduce total fat intake
- Control overall calorie intake

2. Sodium & Potassium

- Limit sodium intake: 1–3 g/day
- Low-sodium foods: leafy vegetables, pumpkin, bottle gourd, cucumber, rice, lentils, potatoes, honey
- High-sodium foods (to avoid): processed meat, canned foods, pickles, cheese, salted nuts, milk, fish, beans
 - Limit sodium to **1–3 g/day**

Others:

- Avoid excessive intake of butter, ghee, saturated fats, and high-calorie foods
- Include **vitamins, minerals, and fiber** through leafy vegetables, fruits, and fish
- Prioritize **unsaturated fats**
- Consume **whole grains** and **plant-based foods**
- Control **blood sugar and cholesterol** to lower heart disease and diabetes risk

Diarrhea

Causes

1. **Contaminated food & water:** Bacteria like *E. coli* and *Shigella*
2. **Malnutrition:** Protein, B-vitamin, and niacin deficiencies
3. **Lactose intolerance:** Inability to digest milk sugar

Symptoms

- Frequent watery stools
- Dehydration: low blood volume, weak pulse, low BP
- Cold hands/feet, sunken eyes, dry tongue, reduced urine
- Loss of skin elasticity (especially in children)

Treatment Objectives

1. Replace lost water and electrolytes
2. Relieve dehydration symptoms

Oral Rehydration Solution (ORS) – WHO/UNICEF Formula

- Boiled & cooled water: 1 liter
- Salt (NaCl): 3.5 g (~½ tsp)
- Sugar/molasses: 40 g (~handful)
- Potassium chloride: 1.5 g (or a few drops of lemon juice)

ORS Administration

- Give after each loose stool
- Children <2 yrs: 50–100 ml
- Children 2–10 yrs: 100–200 ml
- Older children & adults: 200–400 ml

BRAT Diet (for children with temporary diarrhea)

- B = Banana
- R = Rice
- A = Apple sauce
- T = Toast

Constipation

Causes

1. **Diet & Lifestyle:** Low fiber, inadequate fluids, sedentary lifestyle, ignoring urge, stress
2. **Medical Conditions:** IBS, neurological disorders, hypothyroidism, diabetes, intestinal obstruction, pelvic floor dysfunction
3. **Medications:** Opioids, iron, antacids, antidepressants, some BP meds
4. **Other:** Pregnancy, aging, overuse of laxatives

Dietary Management

High-fiber foods: Leafy vegetables, fruits (ripe papaya, banana, guava), dried fruits (dates, figs), whole grains (brown rice, whole wheat)

Soft & easy-to-digest foods: Soft bread, porridge, potatoes, poultry, milk, ripe banana, papaya

Others: Salad, soup, pulses, fish, meat; adequate water; regular walking; reduce stress; maintain proper toilet habits

Avoid: Refined flour foods, pastries, biscuits, tea, coffee, white rice

Liver Diseases

- Liver dysfunction causes **bilirubin accumulation**, leading to yellow eyes and skin.

Symptoms:

- Fever, loss of appetite, headache
- Weight loss, abdominal pain, digestive problems
- Yellow-colored urine

Main Causes:

1. **Infections:** Viral hepatitis
 - Hepatitis A: contaminated food/water
 - Hepatitis B: infected blood, injections, sexual contact
2. **Toxins:** Alcohol, drugs, chemicals
3. **Malnutrition:** Protein deficiency
4. **Bile duct obstruction:** Impaired vitamin absorption (fat-soluble & B-complex)

Treatment Goals:

- Adequate rest
- Restore liver cells
- Nutritious diet & sufficient water

Dietary Management:

- **Protein:** 75–100 g/day (fish, meat, eggs, milk) → repairs liver cells; provides lipotropic agents (methionine, choline)
- **Carbohydrates:** 300–400 g/day → increases liver glycogen
- **Energy/Calories:** 2500–3000 kcal/day → supports liver repair

Kidney Diseases

- Kidneys filter blood, remove waste, and maintain fluid-electrolyte balance.
- Each kidney has ~1 million nephrons; glomerulus filters blood.

Causes of Kidney Dysfunction:

- Infections (e.g., Streptococcal)
- Diabetes

- High blood pressure
- Inflammatory/degenerative diseases

Major Types:

1. Glomerulonephritis: Inflammation of glomerulus; hematuria, proteinuria; common in children 3–10 years; caused by Streptococcal infection.
2. Nephrotic Syndrome
3. Chronic Renal Failure
4. Kidney Stones

Diagnostic Tests:

- Blood: urea, creatinine, uric acid, Na, K, alkaline phosphatase
- Urine: color, pH, protein, ketones
- GFR: <30 mL/min indicates significant impairment

Dietary Management (Glomerulonephritis)

1. **Protein:** Reduce intake to limit kidney stress
 - Adults: 0.5 g/kg/day
 - Children: 1 g/kg/day
 - Limit fish, meat, milk, eggs; increase fruits, vegetables, cereals
2. **Salt & Fluid:**
 - Restrict sodium
 - Daily fluid: 500–700 ml; adjust with edema
3. **Energy Supply:**
 - Provide adequate calories from honey, sugar, glucose, fruit juice
 - Use moderate cooking oil

7. Food additives and Food Preservation:

- (a) Classification of food additives and their uses in food industry.
- (b) Method of food preservation- heating, refrigeration, drying, use of chemicals, irradiation, pasteurization, canning, bottling, jams, pickles etc.
- (c) Causes of Food spoilage.

Food Additives

- খাদ্যের গ্রহণযোগ্যতা ও মান বাড়াতে খাদ্যে পুষ্টি ছাড়া অন্যান্য পদার্থ যোগ করা হয়।
- উদাহরণ: রং, স্বাদ, ঘ্রাণ, জমিন, ভিসকোসিটি পরিবর্তন, সংরক্ষণ ইত্যাদি।

শ্রেণীবিভাগ

1. প্রাকৃতিক Additives

- Vanilla extract, Almond extract, Lemon extract
- মসলা ও হার্বস: তেজপাতা, পুদিনা, মরিচ, গোলমরিচ, ধনিয়া, মেথি, দারুচিনি, লবঙ্গ, সরিষা
- প্রাকৃতিক রঞ্জক: ক্যারামেল (বাদামী), ক্যারোটিন, সেফরন (হলুদ),

2. সিন্থেটিক Additives (Synthetic)

- উদাহরণ: Tartrazine (হলুদ), Sweeteners, Emulsifiers, Flavor modifiers

প্রকার	উদাহরণ	ব্যবহার
Baking agents	NaHCO ₃ , Tartaric acid	Baking, Carbonated drinks
Anti-oxidants	BHA, Citric acid	Oils, Fats, Margarine – prevent rancidity
Colouring agents	Annatto, Carotene, Artificial colours	Jam, sweets, ice cream, drinks
Flavouring agents	Vanilla, Benzaldehyde, Banana flavour, Essential oils	Bakery, ice cream, meat, drinks
Sweeteners	Saccharin, Aspartate	Ice cream, drinks
Taste modifiers	MSG, Aspartate	Drinks, processed foods
Stabilizers	Gelatin, Pectin	Pie filling, fruit preserves
Emulsifiers	Lecithin, Mono/Di-glycerides	Baked goods, dairy products

Causes of Food Spoilage

- Microbial growth**
 - ব্যাকটেরিয়া, ফাঙ্গাস, খামির
 - উদাহরণ: Salmonella, E. coli, Aspergillus
- Enzymatic activity**
 - খাদ্যের নিজস্ব এনজাইম খাদ্যের গুণাগুণ পরিবর্তন করে
 - উদাহরণ: পাকা ফলের পাকা হওয়া
- Chemical reactions**
 - অক্সিডেশন, র্যানসিডিটি, পিগমেন্ট পরিবর্তন
 - উদাহরণ: তেলের রূপান্তর, ভিটামিনের ক্ষয়
- Physical factors**
 - তাপমাত্রা, আর্দ্রতা, আলো, প্যাকেজিং ত্রুটি
 - উদাহরণ: গরমে দুধ দ্রুত নষ্ট হওয়া
- Infestation**
 - পোকা, কীট, দানাদার প্রাণী
 - উদাহরণ: গম, চাল, বাদামে পোকাকার আক্রমণ
- Mechanical damage**
 - চাপ বা ভাঙচুর খাদ্যের নষ্ট হওয়া দ্রুত করে

Methods of Food Preservation

1. Cold-based Methods

- Refrigeration (4–10°C):** Slows microbial growth and enzyme activity. Suitable for cooked food, fruits, vegetables, eggs; keeps fresh for days to a week.
 - Pros:** Maintains nutrition, color, flavor; reduces food waste.
 - Cons:** Requires continuous electricity; long-term storage may affect taste/texture.

- **Freezing ($\leq -18^{\circ}\text{C}$):** Freezes water in food, stops microbial growth and enzyme activity. Suitable for meat, fish, vegetables; keeps quality for months.
 - **Pros:** Maintains nutrition, flavor, color; reduces seasonal dependency.
 - **Cons:** Requires 24/7 electricity; prolonged storage may alter taste/texture

2. Heat-based Methods

- **Sterilization ($120-150^{\circ}\text{C}$):** Destroys all microbes, increases shelf life 2–5 years.
- **Pasteurization (71.5°C for 15 sec):** Destroys pathogens in liquids (milk, juices), preserves flavor and nutrients.
- **Canning:** Food packed in airtight containers, heated to destroy microbes.
 - **Pros:** Safe, long shelf life, easy storage and transport.
 - **Cons:** Improper canning may cause botulism; time-consuming.

3. Moisture Reduction Methods

- **Drying/Dehydration:** Removes water to prevent microbial growth. Suitable for grains, pulses, fruits.
 - **Pros:** Simple, long storage, lightweight, easy transport.
 - **Cons:** High heat may destroy sensitive nutrients and alter taste/texture.

4. Chemical-based Methods

- **Curing (Salt):** Uses 15% salt solution; removes moisture via osmosis, inhibits microbes. Common for meat and fish.
- **Sugaring:** Uses concentrated sugar syrup (65–70%) for jams, preserves; prevents microbial growth via osmotic effect.
- **Pickling:** Preserves in alcohol, vinegar, or oil; antimicrobial properties.
- **Smoking:** Exposes food to smoke; heat and antimicrobial compounds preserve food and add flavor.

8. Antioxidant in health and nutrition:

- (a) Chemical nature and sources of anti-oxidants.
- (b) Role of anti-oxidants in detoxification of the body.
- (c) Free radicals and oxidative stress.

Antioxidants

- Antioxidants are chemical compounds that protect the human body from the harmful effects of free radicals by neutralizing them. They are not a single substance but a group of compounds with similar functions.
- Antioxidants donate an electron to unstable free radicals, stabilizing them and reducing their reactivity.

Free Radicals

- Free radicals are oxygen-containing molecules with unpaired electrons, making them highly reactive.
- They can damage DNA, proteins, and cell membranes, leading to oxidative stress.

Roles of Free Radicals

- **Beneficial:** In small amounts, they help in immune defense against pathogens and signal transduction in cells.
- **Harmful:** Excess free radicals damage cells and tissues, contributing to chronic diseases.

Oxidative Stress

- Occurs when free radical levels exceed antioxidant defenses.
- Linked to various diseases, including diabetes, cardiovascular disease, neurodegenerative diseases (Parkinson's, Alzheimer's), cancer, eye disorders, and arthritis.

Functions of Antioxidants

1. **Direct neutralization:** Donate electrons to free radicals, making them stable.
2. **Metal chelation:** Bind harmful metal ions (like Fe and Cu) to prevent radical formation via Fenton reaction.
3. **Enzyme regulation:**
 - Inhibit free radical-producing enzymes (e.g., xanthine oxidase).
 - Enhance protective antioxidant enzymes (e.g., **Glutathione peroxidase, Superoxide dismutase (SOD), Catalase**) to reduce oxidative stress.

Types of Antioxidants

- **Water-soluble (hydrophilic):** Act in cytoplasm and blood (e.g., Vitamin C, uric acid).
- **Fat-soluble (lipophilic):** Protect cell membranes from lipid peroxidation (e.g., Vitamin E, carotenoids).

Sources of Antioxidants

1. **Endogenous:** Produced by the body, mainly in the liver. Example: SOD, CAT
2. **Dietary/Natural sources:** Fruits, vegetables, nuts, seeds, spices, and herbs.
 - Vitamin C: Citrus, strawberries, kiwi
 - Vitamin E: Nuts, seeds, spinach
 - Carotenoids: Tomatoes, carrots, sweet potatoes

- Polyphenols & flavonoids: Apples, berries, dark chocolate
- Resveratrol: Red wine, grapes
- Curcumin: Turmeric
- Selenium: Nuts, seeds

3. **Synthetic:** BHA, BHT, or supplements of vitamins/minerals.

Role in Detoxification and Liver Protection

- Antioxidants protect the liver from oxidative stress caused by toxins, alcohol, and unhealthy foods.
- Support detoxification and prevent fat accumulation (e.g., in non-alcoholic fatty liver disease).
- Glutathione: Key endogenous antioxidant, repairs liver cells, and supports detoxification.

Health Benefits

- Heart disease prevention: CoQ10, flavonoids, and resveratrol reduce oxidative damage, inflammation, and maintain vascular health.
- Cancer prevention: Neutralize DNA-damaging free radicals (e.g., lycopene in tomatoes, sulforaphane in broccoli).
- Neuroprotection: Flavonoids and other antioxidants reduce risk of Alzheimer's and Parkinson's.
- Anti-aging: Reduce oxidative stress, protecting cells and prolonging healthy lifespan.

9. **Micronutrient malnutrition in Bangladesh:**

(a) Prevalence of vitamin A deficiency, IDD and anemia.

(b) Steps and measures to remove micronutrient malnutrition among the population.

(c) Importance of nutritional rehabilitation for the vulnerable group

ভিটামিন 'এ'-এর অভাব (Vitamin A Deficiency)

কারণ

- জন্মের পর শিশুকে মায়ের দুধ না খাওয়ানো
- পরিপূরক খাবারে ভিটামিন 'এ'-সমৃদ্ধ খাবারের অভাব (শাকসব্জি, মাছ, ফল)
- প্রোটিনের অপুষ্টি, হাম, ডায়রিয়া

প্রভাব/লক্ষণ

1. **রাতকানা (Night blindness)** – অল্প আলোতে দেখার ক্ষমতা কমে যায়
2. **Conjunctivitis** – চোখ লাল ও চুলকানো, জীবাণু সংক্রমণ
3. **Bitot's spot** – চোখের সাদা অংশে ফেনার মতো সাদা দাগ
4. **Keratomalacia** – কর্ণিয়ার ক্ষয়, চোখের অস্বচ্ছতা ও ঘা, দৃষ্টিশক্তি নষ্ট

প্রতিকার ও প্রতিরোধ

- আক্রান্ত শিশুকে ভিটামিন 'এ' ক্যাপসুল খাওয়ানো
 - প্রথম দিন: ১টি ক্যাপসুল
 - দ্বিতীয় দিন: ১টি ক্যাপসুল
 - ১৪ দিন পর: ১টি ক্যাপসুল

- খাবারে ভিটামিন 'এ'-সমৃদ্ধ খাদ্য যোগ: কলিজা, চর্বিযুক্ত মাছ, মাছের তেল, ডিম, হলুদ ও কমলা রঙের শাকসব্জি

রক্তস্বল্পতা (Anaemia)

কারণ

- লৌহ (Iron) অভাব → হিমোগ্লোবিন কমে যায়
- ফলিক এসিড, প্রোটিন অভাব
- কৃমি সংক্রমণ, ডায়রিয়া, ম্যালেরিয়া
- গর্ভবতী মা ও কিশোরীদের মধ্যে বেশি দেখা যায়

লক্ষণ

- দুর্বলতা, অল্পতেই ক্লান্তি
- মাথা ঘোরা, শ্বাসকষ্ট
- চোখ-মুখ ফ্যাকাসে
- মারাত্মক অবস্থায় হাত-পায়ে পানি জমা

হিমোগ্লোবিনের স্বাভাবিক মান

বয়স/লিঙ্গ স্বাভাবিক Hb (গ্রাম/১০০ মি.লি.)

পূর্ণবয়স্ক পুরুষ ১৩-১৪

পূর্ণবয়স্ক মহিলা ১২-১৩

প্রকট রক্তস্বল্পতা:

- পুরুষ: Hb < 9 গ্রাম
- মহিলা: Hb < 7 গ্রাম

চিকিৎসা

- লৌহসমৃদ্ধ খাবার: কলিজা, ডিম, মাছ, মাংস
- ভিটামিন সি ও ফলিক এসিড যুক্ত খাবার: লেবু, শাক, সালাদ, কচু শাক, পুদিনা
- মারাত্মক ক্ষেত্রে লৌহের ট্যাবলেট (Iron tablets)
- সংক্রমণ ও কৃমি নিরাময়

আয়োডিনের অপর্যাপ্ততা (Iodine Deficiency)

প্রাদুর্ভাব

- বাংলাদেশে জনসংখ্যার ≈ ৪৭% আয়োডিনের অভাবে আক্রান্ত
- ১০-১২% গলগণ্ড (Goitre) আক্রান্ত
- বছরে ≈ ৩,৯০,০০০ শিশু আঘাতগ্রস্ত, ২০ লক্ষ শিশুর মধ্যে ১ বছরের কম বয়সে আয়োডিন অভাবে বিভিন্ন প্রতিবন্ধকতা

কারণ

- খাদ্যে আয়োডিনের অভাব
- পানি ও মাটিতে আয়োডিন কম থাকলে শাক-সব্জি, প্রাণীর দেহেও ঘাটতি
- অতিরিক্ত বৃষ্টি, বন্যা, ভূমিধ্বস → মাটির আয়োডিন ধুয়ে যায়

প্রভাব (Age-wise)

বয়সকাল	প্রভাব / রোগাবস্থা
তৃণকাল (ফিটাস)	মৃত শিশু, গর্ভপাত, জন্মগত ত্রুটি, মানসিক প্রতিবন্ধকতা
নবজাতক	হাইপোথাইরয়েডিজম, মানসিক প্রতিবন্ধকতা, ক্রেটিনিজম (Cretinism)
শৈশব ও কৈশোর	গলগণ্ড, দৈহিক ও মানসিক বৃদ্ধি ব্যাহত, হাবা গোবা, বামনতা
প্রাপ্তবয়স্ক	গলগণ্ড, মিক্সেডিমা
প্রতিকার	- প্রাথমিক গলগণ্ড: পটাসিয়াম আয়োডাইড ট্যাবলেট (৬০ মি.গ্রা/দিন) - গলগণ্ড বৃদ্ধি হলে: চিকিৎসা প্রয়োজন, পুরোপুরি কমানো সম্ভব নয় - গর্ভবতী মাকে আয়োডিন ইনজেকশন → গর্ভস্থ সন্তান সুরক্ষা

প্রতিরোধ

- লবণে আয়োডিন যোগ (২০–২৫ মি.গ্রা/কেজি) → দৈনিক চাহিদা পূরণ
- আয়োডিনসমৃদ্ধ খাদ্য গ্রহণে উৎসাহ প্রদান
- জনগণকে সচেতন করা → গলগণ্ড ও আইডিন অভাব প্রতিরোধ

খাদ্য ও পুষ্টি বিষয়ের প্রস্তুতির শেষ মুহূর্তের সংক্ষিপ্ত নির্দেশনা

১. নিউট্রিয়েন্টস এবং তাদের ডেফিসিয়েন্সি

- ম্যাক্রোনিউট্রিয়েন্টস:** কার্বোহাইড্রেট, প্রোটিন, ফ্যাট – উৎস, ফাংশন, অভাবে যা হয়।
- মাইক্রোনিউট্রিয়েন্টস:**
 - ভিটামিন:** A, D, E, K, B কমপ্লেক্স, C – ফাংশন, coenzyme, উৎস, অভাবে রোগ।
 - মিনারেলস:** Ca, Fe, I, Zn, Mg, Na, K, Cu, Se, Cr – ফাংশন, উৎস, অভাবে রোগ।

২. কার্বোহাইড্রেট, প্রোটিন, লিপিড ও ফাইবার

- Classification:** Simple, complex carbs; Complete & incomplete proteins; Saturated, unsaturated fats.
- Chemical nature:** গঠন ও রাসায়নিক প্রকৃতি।
- Fiber:** Soluble & insoluble – function, health benefit

৩. এসেসিয়াল অ্যামাইনো অ্যাসিড এবং ফ্যাটি অ্যাসিড

- Essential Amino Acids:** Name + function (growth, tissue repair, enzyme synthesis)।
- Fatty Acids (Omega-3, Omega-6):** Name + function (heart health, brain development, anti-inflammatory)।

৪. ভিটামিন এবং মিনারেলস

- Coenzyme Function of Vitamin**
- Sources:** Food sources of important vitamins & minerals
- Deficiency diseases:** Night blindness, anemia, goiter, rickets ইত্যাদি।

৫. এনার্জি ক্যালকুলেশন

- **Energy expenditure components** – BMR, physical activity, TEF।
- **Factors affecting requirement:** Age, sex, weight, activity।
- **Energy from foods:** Carb/protein/fat calculation।

৬. Enzyme and hormone

- **Enzymes:** Name, function, factors affecting activity।
- **Digestive enzymes** – carbohydrate, protein, fat digestion।
- **Hormones:** ADH, GH, Oxytocin, Prolactin, FSH/LH, T3/T4, Calcitonin – function & mechanism

৭. Metabolism

- **Carbohydrate metabolism:** Glycolysis, TCA cycle, ATP yield, required enzymes।
- **Fat metabolism:** Beta-oxidation steps, enzymes।
- **Amino acid metabolism:** Deamination, transamination, urea cycle।
- **Metabolic disorders:** Names, causes।

৮. Composition of Food stuff

- **Rice, Wheat, Milk, Meat, Fish:** Carb, protein, fat content।
- **Fruits & Vegetables:** Key vitamins, minerals, phytochemicals + function

৯. প্রেগনেন্সি ও ল্যাকটেশন

- **Nutritional requirement:** Energy, protein, vitamins, minerals during pregnancy & lactation।
- **Colostrum:** Function & benefits।
- **Complementary & supplementary feeding**

১০. Nutrition Assessment

- **Anthropometric methods**
- **Clinical & Biochemical tests:** Feature, advantages, disadvantages
- **Dietary survey:** 24-hour recall, FFQ, food count – pros & cons

১১. রোগ এবং পুষ্টি ব্যবস্থাপনা

- **Diabetes, Heart, Kidney, Liver diseases:** Cause, symptoms, recommended nutrients, restricted nutrients।
- **Diarrhea & Constipation:** Cause, symptom, dietary management

১২. ফুড প্রিজারভেশন ও এডিটিভস

- **Food additives:** Name, function, application
- **Food spoilage:** Causes
- **Preservation methods:** Freezing, pasteurization, dehydration, irradiation, curing, smoking

১৩. অ্যান্টিঅক্সিডেন্টস

- **Sources & names** – Vitamin C, E, carotenoids, flavonoids
- **Health benefits:** Reduce oxidative stress, prevent chronic disease

১৪. মাইক্রোনিউট্রিয়েন্টস ডেফিসিয়েন্সি

- **Vitamin A deficiency:** Night blindness, keratomalacia – treatment & prevention
- **Iron deficiency:** Anemia – treatment & dietary management
- **Iodine deficiency:** Goiter, IDD – supplementation & prevention

MCQ

1. Which age group is most affected by Kwashiorkor?

- ক) 0–6 months খ) 6–18 months
গ) 12–38 months ঘ) 3–5 years

Answer: গ) 12–38 months

Kwashiorkor typically affects children aged 12–38 months. It is a severe form of protein malnutrition, often occurring when weaning from breast milk. Recognizing this age group helps prioritize early intervention and nutritional support.

2. What is the key difference between Marasmus and Kwashiorkor?

- ক) Marasmus shows edema; Kwashiorkor shows extreme thinness
খ) Marasmus shows extreme weight loss; Kwashiorkor shows edema
গ) Marasmus occurs after 3 years; Kwashiorkor occurs after 5 years
ঘ) Marasmus is due to vitamin deficiency; Kwashiorkor is due to mineral deficiency

Answer: খ) Marasmus shows extreme weight loss; Kwashiorkor shows edema

Marasmus is characterized by severe weight loss, thinness, and wasting of muscle and fat tissues, while Kwashiorkor presents with edema, a distended abdomen, and less visible weight loss. Both are forms of severe malnutrition but require slightly different dietary interventions and care.

3. Which trace mineral is required for thyroid hormone synthesis and regulation of metabolism?

- a) Zinc b) Iodine
c) Selenium d) Copper

Answer: b)

Iodine is necessary for thyroid hormones, which control metabolism, growth, and development.

4. Which vitamin is essential for vision (especially in low light) and also supports skin, bones, and immunity?

- a) Vitamin A b) Vitamin D
c) Vitamin E d) Vitamin K

Answer: a)

Vitamin A (Retinol) is needed for good vision, healthy skin, bone growth, and immune system support.

5. Which group of foods mainly helps in growth, repair, and maintenance of body tissues?

- a) Protective and regulatory foods b) Energy-giving foods
c) Functional foods d) Body-building foods

Answer: d)

Body-building foods (meat, fish, egg, milk, pulses) are protein-rich, and proteins are needed for growth and repair.

6. Which nutrient is the primary source of energy for the body?

- a) Protein
- b) Fat
- c) Carbohydrate
- d) Vitamins

Answer: c)

Carbohydrates (rice, wheat, sugar) are the main source of energy for physical activity, growth, and maintaining body functions.

6. Which group of nutrients regulates body processes and maintains overall health?

- a) Vitamins and minerals
- b) Carbohydrates
- c) Proteins
- d) Fats

Answer: a)

Vitamins and minerals help in enzymatic reactions, metabolism, immunity, and overall health maintenance.

7. Why is proper nutrition important for overall health?

- a) Provides energy, supports growth, and maintains body functions
- b) Prevents disease and enhances immunity
- c) Supports maternal and child development
- d) All of the above

Answer: d)

Good nutrition ensures energy, growth, proper body functions, immunity, and development of mother and child.

8. What is the main cause of anaemia?

- ক) Calcium deficiency
- খ) Protein deficiency
- গ) Vitamin D deficiency
- ঘ) Iron deficiency

Answer: d)

Anaemia mainly occurs due to iron deficiency, which reduces hemoglobin synthesis.

9. Which of the following is the most common form of malnutrition in Bangladesh?

- a) Overnutrition
- b) Undernutrition
- c) Obesity
- d) Vitamin toxicity

Answer: b)

Undernutrition is widespread in Bangladesh, affecting growth, immunity, and overall health.

10. Which of the following is an example of a micronutrient deficiency problem in Bangladesh?

- a) Iron-deficiency anemia
- b) Marasmus
- c) Obesity
- d) Protein deficiency

Answer: a)

Micronutrient deficiencies include iron, iodine, vitamin A, and zinc, causing anemia, goiter, and other health issues.

11. What is meant by the “Double Burden of Malnutrition”?

- a) Presence of only undernutrition in a population
- b) Presence of both undernutrition and overnutrition in the same population
- c) High protein and fat intake
- d) Only micronutrient deficiencies

Answer: b)

Double burden refers to coexistence of undernutrition and obesity/overweight in the same community or population.

12. Which population group is most vulnerable to Protein-Energy Malnutrition (PEM) in Bangladesh?

- a) Adults aged 30–50 years b) Teenagers aged 15–18 years
c) Infants and children under 5 years d) Elderly above 60 years

Answer: C)

Children under 5 years are most at risk due to high growth requirements and inadequate dietary intake.

13. The Gomez classification is based on:

- a) Height-for-age
b) Weight-for-age
c) Mid-upper arm circumference
d) Body mass index

Answer: b)

Gomez classification uses weight-for-age (W/A) to assess the degree of malnutrition in children.

14. Which of the following is a non-reducing sugar

- ক) Maltose খ) Galactose
গ) Lactose ঘ) Sucrose

Answer: ঘ) Sucrose

Reducing sugar: Sugars that have a free aldehyde or ketone group are called reducing sugars. All monosaccharides are reducing sugars.

Non-reducing sugar: When the free aldehyde or ketone groups of two monosaccharides are linked to form a disaccharide, it becomes a non-reducing sugar.

Examples: Maltose and lactose → Reducing sugars

Sucrose → Non-reducing sugar.

15. What percentage of total calories in our daily diet should come from carbohydrates?

- ক) 60–70% খ) 20–30%
গ) 50–55% ঘ) 35–40%

Ans: ক) 60–70%

According to health guidelines, 60–70% of the total energy requirement should come from carbohydrates. If a person's daily energy requirement is 2400 kilocalories, then 70% from carbohydrates would be 1680 kilocalories. That means, $(1680 \div 4) = 420$ grams of carbohydrates are needed. For physically active individuals, this amount can be increased.

16. Which of the following is found in the muscles of an animal body? (প্রাণীদেহের পেশীতে নিচের কোনটি পাওয়া যায়?)

- ক) Starch (স্টার্চ) খ) Cellulose (সেলুলোজ)
গ) Sucrose (সুক্রোজ) ঘ) Glycogen (গ্লাইকোজেন)

Ans: ঘ) Glycogen (গ্লাইকোজেন)

Just as starch is the energy reserve in the plant kingdom, glycogen is the energy reserve in the animal body. It is also called animal starch. Glycogen molecules contain a relatively high amount of branched 1,6-linked amylopectin, which allows glycogen to be easily broken down into glucose when energy is needed. Glycogen is

soluble in water. It is a non-reducing sugar and gives a reddish color when reacted with iodine. This is the test for the identification of glycogen.

17. Which test is commonly used to detect starch in food samples? (খাবারে স্টার্চ পরীক্ষা করার জন্য কোন টেস্ট সাধারণত ব্যবহৃত হয়?)

ক) Benedict's Test (বেনেডিক্টস টেস্ট)

খ) Biuret Test (বাই-ইউরেট টেস্ট)

গ) Iodine Test (আয়োডিন টেস্ট)

ঘ) Fehling's Test (ফেলিং টেস্ট)

Ans: গ) Iodine Test (আয়োডিন টেস্ট)

When starch is treated with iodine solution, it produces a deep blue color. This reaction occurs due to the presence of amylose in starch. This is the basic principle of the starch test.

(শ্বেতসারকে আয়োডিন দ্রবণের সাথে মেশালে এটি গাঢ় নীল বর্ণ ধারণ করে।

এই বিক্রিয়াটি মূলত শ্বেতসারের অ্যামাইলোজ (Amylose) অংশের কারণে ঘটে।

এটিই শ্বেতসার পরীক্ষার মূল নীতি

18. Which principle of dietary fiber helps prevent constipation? (খাদ্যাংশের কোন নীতি কোষ্ঠকাঠিন্য প্রতিরোধে সাহায্য করে?)

ক) Bulk-forming principle (বাল্ক-ফর্মিং নীতি)

খ) Gel-forming principle (জেল-ফর্মিং নীতি)

গ) Fermentation principle (ফার্মেন্টেশন নীতি)

ঘ) Osmotic principle (অস্মোটিক নীতি)

Ans: ক) Bulk-forming principle (বাল্ক-ফর্মিং নীতি)

Insoluble fibers like cellulose and hemicellulose absorb water, increase stool bulk and soften it. This stimulates bowel movement and prevents constipation.

(অদ্রবণীয় আঁশ যেমন সেলুলোজ ও হেমিসেলুলোজ পানি শোষণ করে, মলের ভলিউম বৃদ্ধি করে এবং মলকে নরম করে। এটি অন্ত্রের গতি বাড়ায় এবং কোষ্ঠকাঠিন্য প্রতিরোধ করে।)

19. Which type of sugar is mainly found in sprouted seeds? (অঙ্কুরিত বীজে নিচের কোনটি পাওয়া যায়?)

ক) Starch (স্টার্চ)

খ) Lactose (ল্যাক্টোজ)

গ) Maltose (মাল্টোজ)

ঘ) Galactose (গ্যালাক্টোজ)

Ans: গ) Maltose (মাল্টোজ)

During germination, starch is broken down into maltose by enzyme like amylose.

(অঙ্কুরোদগমের সময় স্টার্চ অ্যামাইলোজ এনজাইমের সহায়তাই মাল্টোজ এ পরিণত হয়।)

20. Which carbohydrate cannot be digested by the human body? (মানবদেহ কোন কার্বোহাইড্রেট হজম করতে পারে না?)

ক) Starch (শ্বেতসার)

খ) Glycogen (গ্লাইকোজেন)

গ) Cellulose (সেলুলোজ)

ঘ) Sucrose (সুক্রোজ)

Ans: গ) Cellulose (সেলুলোজ)

Cellulose is an insoluble fiber present in plant cell walls. Humans cannot digest cellulose because we lack the enzyme cellulase.

(সেলুলোজ উদ্ভিদের কোষপ্রাচীরে উপস্থিত একটি অদ্রবণীয় আঁশ। মানুষের দেহে সেলুলোজ হজম করতে পারে না, কারণ আমাদের কাছে সেলুলেজ নামক এনজাইম নেই।)

21. Which sugar is a component of DNA? (ডিএনএ এর গঠনে কোন ধরনের শর্করা থাকে)

ক) Glucose (গ্লুকোজ)

খ) Ribose (রাইবোজ)

গ) Deoxyribose (ডিঅক্সি রাইবোজ)

ঘ) Fructose (ফ্রুকটোজ)

Ans: গ) Deoxyribose (ডিঅক্সি রাইবোজ)

DNA contain deoxyribose, a five carbon sugar. This sugar forms the backbone of the DNA along with phosphate group.

(ডিএনএতে থাকে ডিঅক্সি রাইবোজ, যা একটি পাঁচ কার্বন বিশিষ্ট শর্করা। এটি ফসফেট গ্রুপের সাথে যুক্ত ডিএনএ অনুর কাঠামো তৈরি করে?)

22. Maltose is composed of which monosaccharides?

a) Glucose + Fructose

b) Glucose + Galactose

c) Glucose + Glucose

d) Fructose + Galactose

Answer: c)

Maltose is a disaccharide formed by two glucose molecules joined together.

23. Which enzyme helps in carbohydrate digestion? (কোন এনজাইম কার্বোহাইড্রেট হজমে সাহায্য করে?)

ক) Amylase (অ্যামাইলেজ)

খ) Lipase (লাইপেজ)

গ) Protease (প্রোটিনেজ)

ঘ) Pepsin (পেপসিন)

Ans: ক) Amylase (অ্যামাইলেজ)

Amaylase is an enzyme that break down starch and other carbohydrate into simple sugars like glucose. It is secreted by salivary glands and pancreas.

(অ্যামাইলেজ জটিল শর্করগুলোকে ভেঙ্গে সরল শর্করা তথা গ্লুকোজ এ পরিণত করে। এটি লালা গ্রন্থি ও অগ্নাশয় থেকে নিঃসৃত হয়)

24. Proteins are polymers of which compound? (প্রোটিন কোন পদার্থের পলিমার?)

ক) Fatty acid

খ) Sugar

গ) Nucleic acid

ঘ) Amino acid

Ans: ঘ) Amino acid

Proteins are made by linking many amino acids through peptide bonds, forming long chains.

(অ্যামিনো অ্যাসিডকে পেপটাইড বন্ডের মাধ্যমে যুক্ত করে প্রোটিন গঠিত হয়, যা দীর্ঘ চেইন তৈরি করে।)

25. Approximately what percentage of a protein molecule is nitrogen? (প্রোটিন অণুর প্রায় কত শতাংশ নাইট্রোজেন থাকে?)

ক) 51–55%

খ) 20–24%

গ) 16%

ঘ) 6–7%

Ans: গ) 16%

Proteins are macromolecules composed of carbon, hydrogen, oxygen, and nitrogen. The approximate percentage composition of these elements in proteins is: Carbon 51–55%, Hydrogen 6–7%, Oxygen 20–24%, Nitrogen 16%, and Sulfur 0–3%. Small amounts of phosphorus and iron may also be present.

(প্রোটিন হলো একটি ম্যাক্রোমলিকিউল যা কার্বন, হাইড্রোজেন, অক্সিজেন এবং নাইট্রোজেন নিয়ে গঠিত। প্রোটিনে এই মৌলগুলির আনুমানিক শতাংশ গঠন হলো: কার্বন ৫১-৫৫%, হাইড্রোজেন ৬-৭%, অক্সিজেন ২০-২৪%, নাইট্রোজেন ১৬%, এবং সালফার ০-৩%। সামান্য পরিমাণে ফসফরাস এবং লৌহও থাকতে পারে।)

26. Which of the following is an essential amino acid for adults?

- a) Glycine
- b) Methionine
- c) Alanine
- d) Serine

Answer: b)

Methionine is an essential amino acid, meaning it must be obtained from the diet.

27. Which proteins are primarily responsible for muscle contraction?

- a) Collagen and Elastin
- b) Actin and Myosin
- c) Keratin and Albumin
- d) Fibrin and Globulin

Answer: b)

Actin and Myosin are the contractile proteins in muscle fibers that enable muscle contraction.

28. Which enzyme helps in protein digestion? (প্রোটিন হজমে কোন এনজাইম সাহায্য করে?)

- ক) Amylase (অ্যামাইলেজ)
- খ) Lipase (লাইপেজ)
- গ) Pepsin (পেপসিন)
- ঘ) Maltase (মাল্টেজ)

Ans: গ) Pepsin (পেপসিন)

Pepsin is a proteolytic enzyme secreted by the stomach that breaks down proteins into smaller peptides.

29. Which proteins form the structural framework of hair and nails?

- a) Collagen
- b) Elastin
- c) Keratin
- d) Actin

Answer: c)

Keratin is a structural protein found in hair, nails, and the outer layer of skin.

30. Collagen is mainly found in:

- a) Muscles and nerves
- b) Bones, joints, and teeth
- c) Blood plasma
- d) Lymph

Answer: b)

Collagen provides strength and structure to bones, joints, teeth, and connective tissues.

31. Ruhemann's purple is formed due to:

- a) Oxidation of amino acids
- b) Reaction of released ammonia with Ninhydrin
- c)) Reaction of aldehyde with Ninhydrin
- d) Decomposition of carbon dioxide

Answer: c)

The ammonia released from amino acids reacts with another Ninhydrin molecule to produce the purple-colored Ruhemann's purple.

32. Which of the following can cause protein denaturation?

- a) Heat
- b) Extreme pH (acid or base)
- c) Mechanical agitation
- d) All of the above

Answer: d)

Proteins can be denatured by **heat, acids/bases, chemicals, mechanical agitation, and radiation.**

33. Which of the following is an example of secondary structure of protein

ক) Alpha-helix

খ) Myosin

গ) Globular protein

ঘ) Collagen triple helix

Ans: ক) Alpha-helix

Secondary structure refers to local folding patterns of the polypeptide chain, mainly alpha-helix and beta-pleated sheet, stabilized by hydrogen bonds.

35. According to FAO, what percentage of total daily calories should come from protein for adults?

a) 5–8%

b) 20–25%

c) 12–15%

d) 30–35%

Answer: c)

Adults should obtain **12–15% of total daily calories from protein**, supporting growth and maintenance.

36. The recommended protein intake for an adult is approximately:

a) 0.3 g per kg body weight

b) 0.8 g per kg body weight

c) 1.5 g per kg body weight

d) 2 g per kg body weight

Answer: b)

The FAO recommends **0.8 g of protein per kg body weight per day** for adults

37. What percentage of body and food fats are made up of simple lipids?

a) 50–60%

b) 70–80%

c) 98–99%

d) 10–20%

Answer: c)

Simple lipids account for **98–99% of food and body fats**.

38. Which of the following lipoproteins contain the highest proportion of triglycerides? (নিচের কোন লিপোপ্রোটিনে ট্রাইগ্লিসারাইডের পরিমাণ সবচেয়ে বেশি থাকে?)

ক) VLDL (ভিএলডিএল)

খ) LDL (এলডিএল)

গ) HDL (এইচডিএল)

ঘ) Chylomicrons (কাইলোমাইক্রনস)

Ans: ঘ) Chylomicrons (কাইলোমাইক্রনস)

Chylomicrons are the largest lipoproteins and have the highest proportion of triglycerides. Their main role is to transport dietary fats from the intestine to other tissues.

VLDL is synthesized in the liver and transports triglycerides, cholesterol, and other lipids to peripheral tissues. Later, VLDL is converted into LDL.

(কাইলোমাইক্রনস হলো সবচেয়ে বড় লিপোপ্রোটিন, যেখানে ট্রাইগ্লিসারাইডের পরিমাণ সবচেয়ে বেশি থাকে। এরা প্রধানত অন্ত্র থেকে খাবারের চর্বি শরীরের বিভিন্ন টিস্যুতে বহন করে। ভিএলডিএল লিভারে তৈরি হয় এবং এটি ট্রাইগ্লিসারাইড, কোলেস্টেরল ও অন্যান্য লিপিড মাংসপেশী ও টিস্যুতে বহন করে। পরে ভিএলডিএল রূপান্তরিত হয়ে এলডিএল হয়।)

39. Which type of triglyceride is high in saturated fatty acids?

a) Fats

b) oils

c) Phospholipids

d) Glycolipids

Answer: a)

Fats are rich in **saturated fatty acids** and are usually solid at room temperature.

40. Olive oil is mainly composed of:

a) Saturated fatty acids

b) Unsaturated fatty acids

c) Trans fatty acids

d) Phospholipids

Answer: b)

Olive oil is high in **unsaturated fatty acids** and is liquid at room temperature.

41. Which organ is the primary site for the production of HDL? (HDL উৎপাদনের প্রধান স্থান কোন অঙ্গ?)

ক) Intestine (পাচকতন্ত্র)

খ) Kidney (কিডনি)

গ) Liver (যকৃৎ)

ঘ) Heart (হৃদয়)

Ans: গ) Liver (যকৃৎ)

Lipoproteins are responsible for transporting lipids in the body. Chylomicrons are the largest lipoproteins, produced in the intestine after dietary fat absorption, and transport triglycerides, cholesterol, and phospholipids to various tissues. Very Low Density Lipoproteins (VLDL) are synthesized in the liver to transport triglycerides and cholesterol to peripheral tissues. Low Density Lipoproteins (LDL), often called “bad cholesterol,” are formed from VLDL metabolism and carry 60–80% of the body’s cholesterol to cells and glands. High LDL levels increase the risk of cardiovascular disease. High Density Lipoproteins (HDL), known as “good cholesterol,” are primarily produced in the liver and in small amounts in the intestine. HDL removes excess cholesterol from tissues and blood and transports it back to the liver for excretion via bile, thereby protecting against heart disease.

42. What forms the backbone of a phospholipid molecule?

a) Fatty acids

b) Glycerol

c) Phosphate group

d) Nitrogenous base

Answer: b)

Glycerol forms the backbone of phospholipids, with fatty acids and a phosphate group attached.

43. Nonessential fatty acids (NEFAs) are:

a) Fatty acids that can be synthesized in the body

b) Fatty acids that must be obtained from the diet

c) Fatty acids only found in plants

d) Fatty acids that cannot be metabolized

Answer: a)

Nonessential fatty acids can be **synthesized by the body** and do **not need to be supplied through the diet**.

44. What does the Saponification Value of a fat indicate? (একটি চর্বি স্যাপোনিফিকেশন মান কী নির্দেশ করে?)

ক) Color of fat (চর্বির রঙ)

খ) Melting point of fat (চর্বির গলনাঙ্ক)

গ) Degree of unsaturation of fat (চর্বির অসম্পৃক্ততার পরিমাণ)

ঘ) Amount of alkali required to hydrolyze 1 g of fat (1 গ্রাম চর্বি হাইড্রোলাইজ করতে প্রয়োজনীয় ক্ষারের পরিমাণ)

Ans: ঘ) Amount of alkali required to hydrolyze 1 g of fat (1 গ্রাম চর্বি হাইড্রোলাইজ করতে প্রয়োজনীয় ক্ষারের পরিমাণ)

The saponification value measures the amount of alkali (usually KOH in mg) needed to completely hydrolyze 1 g of fat into glycerol and fatty acid salts (soap). It also gives an idea of the average molecular weight of the fatty acids in the sample—the higher the value, the shorter the fatty acid chains.

(স্যাপোনিকেশন ভ্যালু হলো একটি চর্বি সম্পূর্ণ হাইড্রোলাইজ করতে প্রয়োজনীয় ক্ষারের পরিমাণ (সাধারণত KOH মিলিগ্রামে), যাতে গ্লিসারল এবং ফ্যাটি অ্যাসিডের লবণ (সাবান) তৈরি হয়। এটি চর্বিতে উপস্থিত ফ্যাটি অ্যাসিডের গড় অণু ভরের ধারণাও দেয়—এর মান যত বেশি, ফ্যাটি এসিডের চেইনগুলো তত ছোট।)

45. **the primary dietary sources of EPA are:**

- a) Coconut oil and palm oil
- b) Olive oil and canola oil
- c) Fish oil, especially from cold-water fish
- d) Butter and ghee

Answer: c)

Fish oil, especially from **cold-water fish**, is rich in **EPA**.

46. **Which essential fatty acid is known to reduce LDL cholesterol and triglycerides, lowering heart disease risk?**

- a) Omega-6 (ARA)
- b) Omega-3 (EPA & DHA)
- c) Saturated fatty acids
- d) Trans fatty acids

Answer: b)

Omega-3 (EPA & DHA) help reduce **LDL cholesterol and triglycerides**, lowering cardiovascular risk

47. **DHA, an omega-3 fatty acid, is important for:**

- a) Blood clotting
- b) Neurodevelopment, learning, memory, and cognition
- c) Skin keratin synthesis
- d) Calcium absorption

Answer: b)

DHA supports **brain and nervous system development**, including learning and cognition.

48. **How many kcal per gram does fat provide?**

- a) 4 kcal/g
- b) 7 kcal/g
- c) 9 kcal/g
- d) 2 kcal/g

Answer: c)

Fat provides 9 kcal/g, more than carbohydrates or proteins, which is why excess intake contributes to weight gain.

49. **Excess dietary fat can lead to obesity because:**

- a) Fat is not stored in the body
- b) Excess calories are stored as body fat
- c) Fat reduces appetite
- d) Fat is excreted without digestion

Answer: b)

Excess calories from fat are **stored as body fat**, increasing the risk of overweight and obesity.

50. **High intake of saturated and trans fats increases the risk of which chronic disease?**

- a) Scurvy
- b) Rickets
- c) Osteoporosis
- d) Type 2 Diabetes

Answer: d)

Excess **saturated and trans fats** can cause **insulin resistance**, leading to **Type 2 Diabetes**.

51. **Which of the following is a fat-soluble vitamin?**

- a) Vitamin C
- b) Vitamin B6
- c) Vitamin A
- d) Vitamin B12

Answer: c)

Vitamin A is **fat-soluble** and can be stored in liver and adipose tissue.

52. **Excess intake of fat-soluble vitamins may lead to:**

- a) Scurvy
- b) Hypervitaminosis
- c) Rickets
- d) Beriberi

Answer: b)

Excess fat-soluble vitamins can cause **toxicity (hypervitaminosis)** because they are stored in the body.

53. **Good dietary sources of Vitamin A include:**

- a) Fish liver oil, carrot, spinach, mango, papaya
- b) Milk, cheese, butter
- c) Citrus fruits and green vegetables
- d) Meat and poultry only

Answer: a)

Vitamin A is found in **fish liver oil, egg yolk, liver, carrots, colored vegetables and fruits.**

54. **Which vitamin regulates calcium absorption and maintains blood calcium levels?**

- a) Vitamin C
- b) Vitamin D
- c) Vitamin A
- d) Vitamin E

Answer: b)

Vitamin D regulates **calcium absorption from the intestine, reabsorption from kidneys, and bone mineralization.**

55. **What is the chemical name of Vitamin E?**

- a) Thiamine
- b) Retinol
- c) Riboflavin
- d) Tocopherol

Answer: d)

Vitamin E is chemically known as **Tocopherol.**

56. **Vitamin E primarily functions to:**

- a) Regulate calcium absorption
- b) Protect cell membranes from oxidative damage
- c) Support vision in low light
- d) Aid in blood clotting

Answer: b)

Vitamin E protects **cell membranes** from **oxidative damage** and free radicals, maintaining cell function.

57. **Vitamin K is essential for:**

- a) Blood clotting by activating clotting factors
- b) Energy production
- c) Antioxidant protection
- d) Calcium absorption

Answer: a)

Vitamin K supports **blood clotting** and enhances **Ca²⁺ function** in the coagulation process.

58. **The active coenzyme form of Vitamin B1 (Thiamine) is:**

- a) FMN
- b) TPP (Thiamine pyrophosphate)
- c) NAD⁺
- d) Coenzyme A

Answer: b)

Thiamine pyrophosphate (TPP) is the active form of **Vitamin B1**, essential for carbohydrate metabolism and nerve function.

59. **Thiamine (Vitamin B1) deficiency leads to:**

- a) Beriberi
- b) Mouth ulcers
- c) Pellagra
- d) Fatigue only

Answer: a)

Vitamin B1 deficiency causes **beriberi**, affecting the **nervous and cardiovascular systems**.

60. **Vitamin B2 (Riboflavin) acts as a coenzyme in the form of:**

- a) NAD⁺ and NADP⁺
- b) FMN and FAD
- c) TPP
- d) Coenzyme A

Answer: b)

FMN (Flavin mononucleotide) and **FAD (Flavin adenine dinucleotide)** are the active forms of **Vitamin B2**, involved in redox reactions.

61. **Deficiency of Vitamin B3 (Niacin) results in:**

- a) Beriberi
- b) Rickets
- c) Scurvy
- d) Pellagra

Answer: d)

Niacin deficiency causes **pellagra**, characterized by **dermatitis, diarrhea, and dementia**.

62. **Vitamin B5 (Pantothenic Acid) is essential for:**

- a) Coenzyme A formation for carbohydrate, protein, and fat metabolism
- b) Vision in low light
- c) Blood clotting
- d) Calcium absorption

Answer: a)

Vitamin B5 is required for **CoA synthesis**, which participates in **CHO, protein, and fat metabolism** and **fatty acid/cholesterol synthesis**.

63. **The active coenzyme form of Vitamin B6 (Pyridoxine) is:**

- a) N-carboxybiotin
- b) Pyridoxal phosphate (PLP)
- c) Tetrahydrofolate (THF)
- d) Methylcobalamin

Answer: b)

Vitamin B6 functions as **PLP**, participating in **amino acid metabolism, transamination, decarboxylation, and heme synthesis**.

64. **Which vitamin is abundant in fresh fruits, vegetables, and citrus fruits and prevents scurvy?**

- a) Vitamin B12
- b) Vitamin B7
- c) Vitamin B9
- d) Vitamin C

Answer: d)

Vitamin C is essential for **collagen synthesis, antioxidant function, and prevents scurvy**.

65. **Which of the following is a major mineral?**

- a) Iron
- b) Calcium
- c) Zinc
- d) Iodine

Answer: b)

Calcium is a **major mineral** required in amounts ≥ 100 mg/day for **bones, teeth, and other body functions**.

66. **Phosphorus works together with calcium to:**

- a) Maintain fluid balance
- b) Regulate thyroid function
- c) Form strong bones and teeth
- d) Support vision

Answer: c)

Phosphorus combines with calcium for **bone and teeth formation** and is also essential for **ATP/GTP energy molecules and nucleic acids**.

67. Which mineral is the major extracellular action, important for fluid balance, acid-base balance, nerve and muscle function?

- a) Sodium
- b) Potassium
- c) Calcium
- d) Magnesium

Answer: a)

Sodium (Na^+) is the **main extracellular action**, crucial for **fluid balance, nerve impulses, muscle contraction, and the sodium pump**.

68. The principal intracellular action that works with Na and Ca to regulate muscle and nerve activity is:

- a) Calcium
- b) Potassium
- c) Magnesium
- d) Iron

Answer: b)

Potassium (K^+) is the **main intracellular action**, essential for **nerve function, muscle contraction, heart rhythm, and glycogen/protein synthesis**.

69. What is the richest dietary source of iodine? (আয়োডিনের সবচেয়ে সমৃদ্ধ খাদ্য উৎস কোনটি?)

- ক) Milk (দুধ)
- খ) Vegetables (শাকসবজি)

গ) Sea foods (সামুদ্রিক খাবার)

ঘ) Meat (মাংস)

Ans: Sea foods (সামুদ্রিক খাবার)

Sea foods, especially sea fish and seaweed, are the richest sources of iodine. Other sources include iodized salt and vegetables grown in iodine-rich soils. Iodine is essential for the synthesis of thyroid hormones, thyroxine (T_4) and triiodothyronine (T_3). These regulate metabolic rate, growth, and brain development.

70. Which trace mineral is essential for hemoglobin formation and acts as a cofactor for enzymes involved in protein metabolism?

- a) Zinc
- b) Copper
- c) Iron
- d) Selenium

Answer: b)

Copper (Cu^{2+}) is required for **hemoglobin synthesis, protein metabolism, and functioning of several oxidase enzymes**.

71. Common dietary sources of zinc include:

- a) Milk and cheese
- b) Fruits
- c) Leafy vegetables
- d) Meat, eggs, fish, and whole grains

Answer: d)

Zinc is abundant in **eggs, meat, fish, grains, and seafood**, supporting **growth and enzymatic functions**.

72. What is the unit of energy commonly used in nutrition?

- a) Calorie
- b) Watt
- c) Newton
- d) no one

Answer: a)

Energy in food is measured in calories (kcal) or joules (kJ).

73. How much energy does 1 gram of protein provide?

- a) 9 kcal
- b) 4 kcal
- c) 7 kcal
- d) 2 kcal

Answer: b)

1 gram of protein provides 4 kilocalories of energy.

74. What is Basal Energy Expenditure (BEE)?

- a) Energy used during heavy physical activity
- b) Energy used only for digestion
- c) Minimum energy required at complete rest to maintain vital functions
- d) Energy used for weight loss

Answer: c)

BEE (or BMR) is the energy needed at rest to maintain vital functions like breathing, circulation, and protein synthesis.

75. Approximate BEE for an adult male is:

- a) 0.5 kcal/kg/hr
- b) 0.8 kcal/kg/hr
- c) 1 kcal/kg/hr
- d) 1.5 kcal/kg/hr

Answer: c)

Adult male BEE $\approx$ 1 kcal per kg body weight per hour.

76. Energy expenditure for moderate physical activity (like brisk walking or cycling) is:

- a) 300–400 kcal/hr
- b) 150–250 kcal/hr
- c) 100–150 kcal/hr
- d) 450–590 kcal/hr

Answer: a)

Moderate activity requires 300–400 kcal/hr depending on intensity and body weight.

77. What is the Thermic Effect of Food (TEF)?

- a) Energy used for sleeping
- b) Energy used for digestion, absorption, and metabolism of food
- c) Energy lost during exercise
- d) Energy stored as fat

Answer: b)

TEF is the energy required to digest, absorb, and metabolize nutrients from food, about 8–10% of total calorie intake.

78. What is the approximate Respiratory Quotient (RQ) for fat metabolism?

- a) 1.0
- b) 0.7
- c) 0.8
- d) 0.9

Answer: b)

RQ for fat is about 0.7, for carbohydrate $\approx$ 1.0, and for protein $\approx$ 0.8.

79. Indirect Calorimetry estimates energy expenditure based on:

- a) Oxygen consumption and carbon dioxide production
- b) Body weight and height
- c) Sweat production
- d) Heart rate

Answer: a)

Indirect calorimetry calculates energy expenditure using O_2 consumed and CO_2 produced

80. Which method measures energy expenditure by capturing body heat in a respiration chamber?

- a) Indirect Calorimetry
- b) Doubly Labeled Water (DLW) Method
- c) Direct Calorimetry
- d) Respiratory Quotient

Answer: c)

Direct calorimetry measures energy expenditure by detecting heat produced by the body.

81. Which factor increases energy requirements in children and adolescents?

- a) Reduced physical activity b) Growth and development
c) Higher fat mass d) Aging

Answer: b)

Energy needs are higher in children and adolescents due to growth and development.

82. How does body size and lean mass affect energy requirements?

- a) Smaller body → higher BMR
b) Larger body and more lean mass → higher BMR and energy needs
c) Larger body → lower energy needs
d) Lean mass has no effect

Answer: b)

A larger body and more lean mass increase basal metabolic rate and total energy needs.

83. Why do men generally require more energy than women?

- a) Women have higher muscle mass
b) Men have more fat mass
c) Men have higher muscle mass and BMR
d) Women have higher basal metabolism

Answer: c)

Men need more energy because they typically have more muscle mass, leading to a higher basal metabolic rate

84. TEF (Thermic Effect of Food) মোট শক্তির কত শতাংশ ধরা হয়?

- a) ৫% b) ৮-১০% c) ১৫% d) ২০%

Answer: b)

TEF ≈ মোট শক্তির ৮-১০% ধরা হয়।

85. A 60 kg male performs moderate physical activity (75% of BMR). His BMR is 1 kcal/kg/hour and the thermic effect of food is 10%. What is his total daily calorie requirement?

(৬০ কেজি ওজনের একজন পুরুষ মাঝারি শ্রমে লিপ্ত (মৌলিক বিপাকের ৭৫%)। তার মৌলিক বিপাক ১

কিলোক্যালরি/কেজি/ঘণ্টা এবং খাদ্যের বিশেষ চলক্রিয়া মোট শক্তির ১০%। তার দৈনিক মোট ক্যালরি চাহিদা কত?)

- ক) 2450 খ) **2772**
গ) 2380 ঘ) 1820

Ans: খ) 2772

BMR / মৌলিক বিপাক:

→ BMR = weight × 1 × 24 = 60 × 1 × 24 = 1440 kcal

(মৌলিক বিপাক = ৬০ × ১ × ২৪ = ১৪৪০ কিলোক্যালরি)

Moderate activity / মাঝারি শ্রম:

→ Activity = 75% of BMR = 0.75 × 1440 = 1080 kcal

Total after activity = 1440 + 1080 = 2520 kcal

(মৌলিক বিপাক ও মাঝারি শ্রম = ১৪৪০ + ১০৮০ = ২৫২০ কিলোক্যালরি)

Thermic effect of food / খাদ্যের বিশেষ চলক্রিয়া:

→ 10% of total = $0.10 \times 2520 \approx 252$ kcal

Total daily energy $\approx 2520 + 252 \approx 2772$ kcal

(খাদ্যের বিশেষ চলক্রিয়া = ১০% ≈ ২৫২ কিলোক্যালরি, মোট ≈ ২৭৭২ কিলোক্যালরি)।

85. How many grams of carbohydrate are in a total daily intake of 2530 kcal?

- a) 443 g b) 127 g
c) 28 g d) 506 g

Answer: a)

Carbohydrate = $70\% \times 2530 = 1771$ kcal $\rightarrow 1771 \div 4 \approx 443$ g

86. Which class of enzymes catalyzes oxidation-reduction reactions by transferring electrons or hydrogen ions?

- a) Transferases b) Oxidoreductases
c) Hydrolases d) Lyases

Answer: b)

Oxidoreductases (e.g., Dehydrogenases, Oxidases) transfer electrons and catalyze redox reactions.

87. Kinases and Methyltransferases belong to which class of enzymes?

- a) Ligases b) Hydrolases
c) Transferases d) Isomerases

Answer: c)

Transferases catalyze the transfer of functional groups, such as phosphorylation by kinases.

88. Which enzyme class cleaves bonds by adding water?

- a) Hydrolases b) Lyases
c) Oxidoreductases d) Ligases

Answer: a)

Hydrolases (e.g., Esterases, Peptidases) catalyze hydrolysis reactions.

89. Glutamine synthetase catalyzes bond formation coupled with ATP hydrolysis. This enzyme belongs to which class?

- a) Ligases b) Isomerases
c) Hydrolases d) Oxidoreductases

Answer: a)

Ligases catalyze formation of new bonds (C-C, C-S, C-O, C-N) using energy from ATP.

90. Most enzymes are composed of which type of macromolecule?

- a) Carbohydrates b) Proteins
c) Lipids d) Nucleic acids

Answer: b)

Most enzymes are proteins with primary, secondary, and tertiary structures.

Some RNA molecules (ribozymes) also have catalytic activity.

91. Enzymes are generally soluble in which type of solvent?

- a) Non-polar solvents (e.g., benzene) b) Polar solvents (e.g., water)
c) Oils and fats d) Alcohol only

Answer: b)

Enzymes are soluble in polar solvents like water and insoluble in non-polar organic solvents.

92. A holoenzyme consists of:

- a) Only the protein part of the enzyme
b) Only the coenzyme or prosthetic group

- c) Apoenzyme (protein) + Coenzyme/Prosthetic group
- d) Substrate and enzyme

Answer: c)

Holoenzyme = Apoenzyme (protein) + Coenzyme/Prosthetic group (non-protein)

93. Which statement best describes the lock-and-key model of enzyme-substrate interaction?

- a) The enzyme changes shape to fit any substrate
- b) The active site and substrate are perfectly complementary and no structural change occurs in the enzyme
- c) The substrate is non-specific and can bind to any enzyme
- d) The enzyme is permanently altered after binding

Answer: b): In the lock-and-key model, the enzyme's active site is a pre-shaped template that perfectly fits only a specific substrate. No change occurs in the enzyme structure upon binding.

94. Which statement describes the induced-fit model of enzyme action?

- a) The enzyme and substrate are rigid and perfectly complementary
- b) The active site changes shape to fit the substrate after binding
- c) Substrate is non-specific and binds randomly
- d) The enzyme is permanently inactivated after binding

Answer: b)

In the induced-fit model, the enzyme's active site is flexible and molds itself around the substrate to ensure proper binding and catalysis.

95. Which factor will increase reaction rate only until enzyme saturation is reached?

- a) Enzyme concentration
- b) Temperature
- c) pH
- d) Substrate concentration

Answer: d)

Increasing substrate concentration increases reaction rate until all enzyme active sites are occupied, after which the rate plateaus (saturation).

96. At what temperature do most human enzymes show maximum activity?

- a) 40–45°C
- b) 0–20°C
- c) 20–30°C
- d) 50–60°C

Answer: a)

Most human enzymes have an optimum temperature around 40–45°C; above ~50°C, denaturation occur.

97. Which model explains enzyme flexibility and adjustment to substrate binding?

- a) Lock-and-Key
- b) Induced Fit
- c) Substrate Strain
- d) None of these

Answer: b)

In the induced-fit model, the enzyme's active site molds around the substrate to ensure proper binding.

98. What is a hormone?

- a) A digestive enzyme
- b) A chemical messenger secreted by endocrine glands
- c) A structural protein
- d) A neurotransmitter

Answer: b)

Hormones are chemical messengers secreted by endocrine glands that travel through the blood to regulate specific body functions.

99. Hormones are mainly secreted by:

- a) Digestive glands
- b) Exocrine glands
- c) Endocrine glands
- d) Sweat glands

Answer: c)

Endocrine glands release hormones directly into the bloodstream for body-wide effects.

100. How do hormones act in the body?

- a) They provide structural support to cells
- b) They bind to target cell receptors and trigger biochemical reactions
- c) They store energy
- d) They transport oxygen

Answer: b)

Hormones act by attaching to specific receptors on target cells, initiating biochemical changes that can activate or inhibit cell functions.

101. Which of the following is a peptide hormone?

- a) Cortisol
- b) Epinephrine
- c) Testosterone
- d) Insulin

Answer: d)

Peptide hormones are made of proteins or peptides. Examples include insulin, glucagon, oxytocin, and growth hormone.

102. Steroid hormones are synthesized from:

- a) Amino acids
- b) Cholesterol
- c) Fatty acids
- d) Glucose

Answer: b)

Steroid hormones such as testosterone, cortisol, and estrogen are synthesized from cholesterol.

103. Amino acid-derived hormones are made from:

- a) Tyrosine or tryptophan
- b) Glucose
- c) Cholesterol
- d) Fatty acids

Answer: a)

Examples include epinephrine and norepinephrine.

104. Which step is first in hormone action on target cells?

- a) Hormone binds to receptor
- b) Biochemical reaction starts
- c) Hormone secreted into blood
- d) Cell function changes

Answer: c)

The first step is hormone secretion into the bloodstream; then it reaches target cells and binds to receptors.

105. Which hormone increases water reabsorption in the kidneys?

- a) Oxytocin
- b) TSH
- c) ADH (Vasopressin)
- d) Cortisol

Answer: c)

ADH, secreted by the posterior pituitary, increases water reabsorption and maintains fluid balance.

106. Oxytocin primarily functions to:

- a) Increase uterine contraction and facilitate milk ejection
- b) Stimulate thyroid hormone secretion

- c) Increase blood calcium
- d) Promote growth of bones and muscles

Answer: a)

Oxytocin stimulates uterine contractions during labor and helps with milk ejection.

107. Which pituitary hormone stimulates thyroid hormone (T3 & T4) secretion?

- a) FSH
- b) LH
- c) TSH
- d) ACTH

Answer: c)

TSH from the anterior pituitary stimulates thyroid activity and hormone release.

108. Cortisol effects include:

- a) Protein and fat breakdown, increasing blood glucose, reducing inflammation
- b) Stimulating uterine contractions
- c) Decreasing thyroid activity
- d) Increasing calcium deposition in bones

Answer: a)

Cortisol mobilizes energy and suppresses inflammation.

109. Parathormone (PTH) function:

- a) Increases blood calcium and decreases phosphate
- b) Decreases blood calcium
- c) Stimulates thyroid hormone secretion
- d) Promotes growth hormone release

Answer: a)

PTH raises blood calcium by mobilizing it from bones and decreases phosphate reabsorption.

110. Which hormone increases heart rate, blood pressure, respiration, and blood glucose during “fight or flight”?

- a) Noradrenaline
- b) Adrenaline
- c) Cortisol
- d) Insulin

Answer: b)

Adrenaline from the adrenal medulla triggers the fight-or-flight response.

111. Insulin secreted by the pancreas:

- a) Increases blood glucose by breaking down glycogen
- b) Regulates circadian rhythm
- c) Stimulates adrenal medulla
- d) Decreases blood glucose

Answer: d)

112. Melatonin is secreted by the pineal gland to:

- a) Regulate sleep, circadian rhythm, and biological clock
- b) Increase blood glucose
- c) Stimulate thyroid hormone release
- d) Promote ovulation

Answer: a)

Melatonin from the pineal gland controls sleep patterns, circadian rhythm, and the biological clock.

113. Estrogen functions to:

- a) Promote male sexual characteristics
- b) Regulate menstrual cycle and protect pregnancy
- c) Express female sexual characteristics and increase uterine lining

d) Stimulate glycogen breakdown

Answer: c)

Estrogen promotes female sexual characteristics and thickens the uterine lining.

114. Which pathway breaks down glucose into pyruvate or lactate to release energy (ATP)?

- | | |
|--------------------|----------------------|
| a) Gluconeogenesis | b) Glycolysis |
| c) Glycogenesis | d) Citric Acid Cycle |

Answer: b)

Glycolysis breaks down glucose into pyruvate or lactate, producing ATP.

115. Which cycle oxidizes Acetyl-CoA to CO₂ and produces NADH, FADH₂, and ATP?

- | | |
|--|--------------------|
| a) Glycolysis | b) Glycogenolysis |
| c) Citric Acid Cycle (TCA/Krebs cycle) | d) Gluconeogenesis |

Answer: c)

The Citric Acid Cycle oxidizes Acetyl-CoA to CO₂ and generates energy-rich molecules.

116. Which pathway synthesizes glucose from non-carbohydrate sources like amino acids and glycerol?

- | | |
|--------------------|-------------------|
| a) Glycogenesis | b) Glycogenolysis |
| c) Gluconeogenesis | d) Glycolysis |

Answer: c)

Gluconeogenesis forms glucose from non-carbohydrate precursors.

117. Which process stores glucose as glycogen in liver and muscles?

- | | |
|-------------------|----------------------|
| a) Glycolysis | b) Citric Acid Cycle |
| c) Glycogenolysis | d) Glycogenesis |

Answer: d)

Glycogenesis stores glucose in the form of glycogen.

119. Which pathway breaks down glycogen to release glucose for energy?

- | | |
|-------------------|--------------------|
| a) Glycogenesis | b) Gluconeogenesis |
| c) Glycogenolysis | d) Glycolysis |

Answer: c)

Glycogenolysis releases glucose from stored glycogen for energy.

120. Where does glycolysis occur in the cell?

- | | |
|--------------------------|--------------------|
| a) Mitochondrial matrix | b) Golgi apparatus |
| c) Endoplasmic reticulum | d) Cytoplasm |

Answer: d)

Glycolysis takes place in the cytoplasm of both plant and animal cells.

121. How many enzymes are involved in glycolysis?

- | | | | |
|------|-------|-------|------|
| a) 5 | b) 10 | c) 12 | d) 8 |
|------|-------|-------|------|

Answer: b)

Glycolysis involves 10 enzymes to convert glucose to pyruvate.

122. Which enzyme catalyzes the phosphorylation of glucose to glucose-6-phosphate?

- | | |
|-----------------------------|--------------------------|
| a) Hexokinase / Glucokinase | b) Phosphofructokinase-1 |
| c) Pyruvate kinase | d) Aldolase |

Answer: a)

Hexokinase (or Glucokinase in the liver) catalyzes the first irreversible step of glycolysis.

123. **The final irreversible step of glycolysis, converting phosphoenolpyruvate to pyruvate, is catalyzed by:**

- a) Hexokinase
- b) Pyruvate kinase
- c) Lactate dehydrogenase
- d) Glucose-6-phosphate isomerase

Answer: b)

Pyruvate kinase catalyzes the last irreversible reaction of glycolysis

124. **How many ATP molecules are used during glycolysis per glucose molecule?**

- a) 1
- b) 6
- c) 4
- d) 2

Answer: d)

2 ATP are consumed in the preparatory phase of glycolysis.

125. **What is the total net energy yield (ATP equivalent) from glycolysis per glucose molecule?**

- a) 2–3 ATP
- b) 4–5 ATP
- c) 7–8 ATP
- d) 10–12 ATP

Answer: c)

Net gain = 2 ATP + 2 NADH (~5–6 ATP) = 7–8 ATP per glucose.

126. **Where does the TCA (Krebs) cycle occur in the cell?**

- a) Cytoplasm
- b) Mitochondrial matrix
- c) Nucleus
- d) Endoplasmic reticulum

Answer: b)

The TCA cycle takes place in the mitochondrial matrix.

127. **What percentage of the body's ATP is generated via the TCA cycle?**

- a) 20–25%
- b) 40–45%
- c) 65–70%
- d) 80–85%

Answer: c)

The TCA cycle generates about 65–70% of cellular ATP.

128. **Which vitamin acts as a cofactor in the TCA cycle?**

- a) Vitamin B₁ (Thiamine)
- b) Vitamin C
- c) Vitamin D
- d) Vitamin K

Answer: a)

Thiamine (B₁) is required for pyruvate dehydrogenase and α -ketoglutarate dehydrogenase in the TCA cycle.

129. **Before β -oxidation, fatty acids are activated in the cytoplasm to:**

- a) Acetyl-CoA
- b) Acyl-CoA
- c) Carnitine
- d) Free fatty acids

Answer: b)

Fatty acids are converted to Acyl-CoA by Acyl-CoA synthetase, consuming 2 ATP equivalents.

130. **During fasting or energy demand, which hormones stimulate β -oxidation?**

- a) Insulin
- b) TSH
- c) TSH
- d) Glucagon and Adrenaline

Answer: d)

Glucagon and adrenaline stimulate β -oxidation to provide energy during fasting.

131. **Deamination is the process in which:**

- a) Amino group is transferred to another molecule
- b) Amino group is removed as free ammonia (NH₃)
- c) Amino acid is converted to glucose
- d) Amino acid forms peptide bonds

Answer: b)

Deamination removes the amino group as free ammonia, which is toxic and must be eliminated.

132. **How much ATP is consumed per molecule of urea in the urea cycle?**

- a) 2 ATP
- b) 3 ATP
- c) 4 ATP
- d) 5 ATP

Answer: c)

The urea cycle consumes **4 ATP equivalents per urea molecule**: 2 ATP for carbamoyl phosphate formation and 2 ATP equivalents for argininosuccinate formation.

133. **Glycogen Storage Diseases (GSD) are caused by:**

- a) Excess glycogen synthesis
- b) Deficiency of specific enzymes in glycogen metabolism
- c) High glucose intake
- d) Low insulin levels

Answer: b)

GSD occurs due to **enzyme deficiencies** that impair glycogen breakdown or storage.

134. **Phenylketonuria (PKU) is caused by:**

- a) Tyrosine hydroxylase deficiency
- b) Leucine metabolism defect
- c) Tryptophan hydroxylase deficiency
- d) Phenylalanine hydroxylase deficiency

Answer: d)

PKU occurs due to **deficiency of phenylalanine hydroxylase**, leading to accumulation of **phenylalanine**, which can cause **brain damage** if untreated.

135. **The major protein in wheat that provides elasticity to dough is:**

- a) Albumin
- b) Globulin
- c) Gluten
- d) Prolamin

Answer: c)

Wheat contains **gluten**, which becomes **soft and elastic** when kneaded with water, essential for **bread and bakery products**.

136. **A limitation of cereal proteins (like rice and wheat) is that they are low in:**

- a) Lysine and Tryptophan
- b) Methionine and Valine
- c) Leucine and Isoleucine
- d) Glutamine and Proline

Answer: a)

Cereal proteins are generally **deficient in Lysine and Tryptophan**, limiting **protein quality**.

137. **In live muscle, the protein myosin is present as:**

- a) Myosinogen
- b) Actinogen
- c) Tropomyosin
- d) Collagen

Answer: a)

In **live muscle**, myosin exists in the form of **Myosinogen**, which changes during **post-slaughter rigor**.

138. **Fish fats are predominantly:**

- a) Saturated fatty acids
- b) Trans fats
- c) Unsaturated fatty acids
- d) Cholesterol only

Answer: c)

Fish fat is mostly **unsaturated**, rich in **polyunsaturated fatty acids (PUFAs)**, especially **omega-3 (EPA & DHA)**.

139. **Which vitamins are especially abundant in fatty fish?**

- a) B₁ and B₂
- b) Vitamins A & D
- c) Vitamin C only
- d) Vitamin K only

Answer: b)

Explanation: Fatty fish provide **fat-soluble vitamins A and D**, in addition to high-quality protein and essential fatty acids.

140. **The main protein in egg white, which coagulates on heating, is:**

- a) Conalbumin
- b) Ovomucoid
- c) Ovalbumin
- d) Lysozyme

Answer: c)

Ovalbumin (≈70%) is the major storage protein in egg white and coagulates when heated.

141. **The Biological Value (BV) of egg protein is approximately:**

- a) 70
- b) 85
- c) 90
- d) 100

Answer: d)

Egg protein has a **BV of 100**, meaning it contains all essential amino acids in the proportions needed for human nutrition, making it an **ideal protein source**.

142. **Which of the following is the main protein in milk?**

- a) Albumin
- b) Casein
- c) Globulin
- d) Whey protein

Answer: b)

Explanation: Casein constitutes about **80% of milk protein** and is the primary milk protein, forming curd when milk is acidified. Whey proteins make up the remaining 20% and include globulin and albumin.

143. **Vegetables generally contain:**

- a) >80% water and 2–3% protein
- b) <50% water and high fat
- c) Mostly starch and cholesterol
- d) No vitamins or minerals

Answer: a)

Vegetables are **mostly water (>80%)** and contain a small amount of protein (2–3%), along with vitamins, minerals, and phytochemicals.

144. **How many extra calories are generally required during pregnancy, especially in the 3rd trimester?**

- a) 100 kcal/day
- b) 200 kcal/day
- c) 300 kcal/day
- d) 500 kcal/day

Answer: c)

Hormonal and metabolic changes **increase maternal metabolism**, requiring an extra **≈300 kcal/day**, particularly in the **third trimester**.

145. **How much iron is recommended during pregnancy?**

- a) 10–15 mg/day
- b) 15–20 mg/day
- c) 25–35 mg/day
- d) 40–50 mg/day

Answer: c)

Iron (25–35 mg/day) is essential to build **fetal stores** and compensate for **maternal blood loss during delivery**.

146. **Additional protein requirement during lactation is:**

- a) 5–10 g/day
- b) 12–15 g/day

c) 18–20 g/day

d) 25–30 g/day

Answer: c)

Lactating mothers need **18–20 g extra protein/day** to support milk protein synthesis and maternal tissue repair.

147. **Why is adequate water intake crucial for lactating mothers?**

a) To prevent constipation only

b) To maintain blood pressure

c) To maintain milk's milk volume

d) To prevent vitamin deficiency

Answer: c)

Breast milk is about **87–90% water**; hence, adequate **fluid intake** is necessary for sufficient milk volume and hydration.

148. **Exclusive breastfeeding (EBF) means:**

a) Feeding breast milk + water for 6 months

b) Feeding only breast milk for 6 months

c) Feeding breast milk + honey for 3 months

d) Feeding breast milk + cow's milk for 6 months

Answer: b)

EBF is defined as **feeding the infant only breast milk for the first 6 months**, with no other food or drink, not even water.

149. **Colostrum is produced during:**

a) Last trimester of pregnancy

b) Weaning period

c) 2–4 weeks after birth

d) First 2–4 days after birth

Answer: d)

Colostrum, a thick yellowish secretion, is produced in the **first 2–4 days after delivery** before mature milk appears.

150. **The main carbohydrate in breast milk is:**

a) Glucose

b) Sucrose

c) Lactose

d) Galactose

Answer: c)

Breast milk is rich in **lactose**, which supports **brain development** and helps maintain low electrolyte concentration.

151. **In elderly people, energy requirements decline mainly due to:**

a) Increased muscle mass and activity

b) Reduced metabolic rate and physical activity

c) Increased insulin sensitivity

d) Increased digestive efficiency

Answer: b)

Aging reduces **basal metabolic rate** and physical activity, lowering energy needs (~7.5% per decade after 30).

152. **Which of the following fats should be preferred in elderly nutrition?**

a) Saturated fats from butter and ghee

b) Cholesterol-rich organ meats

c) Polyunsaturated fatty acids (PUFAs)

d) Trans fats

Answer: c)

PUFAs are preferred for heart health; **cholesterol-rich foods should be limited**.

153. **Which of the following is a direct method of nutritional assessment?**

a) Dietary survey

b) Agricultural data

c) Clinical examination

d) Food balance sheet

Answer: c)

Direct methods include **clinical, biochemical, and anthropometric assessments** at the individual level.

154. **Measuring height, weight, and mid-arm circumference is an example of:**

- a) Anthropometry
- b) Clinical examination
- c) Biochemical test
- d) Dietary survey

Answer: a)

Anthropometry evaluates body measurements to detect malnutrition.

155. **Which of the following is an indirect method of nutritional assessment?**

- a) Biochemical test
- b) Clinical examination
- c) Anthropometry
- d) Vital statistics

Answer: d)

Vital statistics (birth, death, morbidity rates) are indirect indicators at the population level.

156. Which is the simplest and lowest-cost method of assessing malnutrition?

- a) Biochemical Tests
- b) Anthropometry
- c) Food Balance Sheet
- d) Vital Statistics

Answer: b)

Anthropometry (height, weight, arm circumference) is easy and cheap.

157. Which method relies heavily on self-reporting and may be inaccurate?

- a) Dietary Survey
- b) Clinical Examination
- c) Biochemical Tests
- d) Agricultural Data

Answer: a)

Dietary surveys depend on memory and honesty of participants.

158. A quick and low-cost method for detecting malnutrition by examining eyes, skin, hair, and mouth is:

- a) Clinical Examination
- b) Biochemical Tests
- c) Agricultural Data
- d) Dietary Survey

Answer: a)

Clinical examination gives rapid information on physical signs.

159. **Nutrition Education refers to:**

- a) Determining food quality
- b) Education on health, food, and nutrition
- c) Chemical analysis of food
- d) Disease diagnosis

Answer: b)

Nutrition education means providing knowledge related to health, food, and nutrition to improve awareness and prevent malnutrition.

160. **Including nutrition topics in school curricula is an example of:**

- a) Informal education
- b) Traditional practices
- c) Mass media education
- d) Formal nutrition education

Answer: d)

Formal nutrition education is integrated into structured learning systems like school syllabi.

161. **Which media method is cost-effective, reaches illiterate populations, and uses slogans, songs, or poems?**

- a) Television
- b) Radio
- c) Newspaper
- d) Demonstration

Answer: b)

Radio is inexpensive, easy to access, and suitable for illiterate audiences, though it is ineffective without electricity.

162. **Television as a medium for nutrition education is:**

- a) Costly and urban-focused but reaches a large audience
- b) Low-cost and ideal for rural illiterate populations
- c) Only suitable for written messages
- d) Ineffective for mass communication

Answer: a)

TV can reach broad audiences through ads, talk shows, dramas, and songs, but it is expensive and mainly urban-centered.

163. **Food security is defined as:**

- a) Having enough money to buy luxury food
- b) Growing crops without selling them
- c) Government-provided free food only
- d) Access to sufficient, safe, and nutritious food for an active and healthy life at all times

Answer: d)

Food security means all people have consistent access to adequate, safe, and nutritious food to lead an active, healthy life.

164. **The main sources of food for a household are:**

- a) Only government distribution
- b) Own production and purchase from the market
- c) Imported packaged foods
- d) Wild food gathering only

Answer: b)

Households obtain food from self-production (gardens, livestock, fish) and by buying from markets.

165. **Which of the following is NOT a key aspect of food security?**

- a) Food production, storage, transport, and marketing
- b) Price control and food availability
- c) Household income and purchasing power
- d) Fashion trends in food presentation

Answer: d)

Fashion trends do not affect food security; other options are essential factors.

166. **Which strategy helps improve long-term household nutrition security?**

- a) Income increase and savings
- b) Nutrition education and balanced meal planning
- c) Backyard food production
- d) All of the above

Answer: d)

Combining income generation, nutrition education, and home production ensures sustainable household food security.

167. **Supplementation is defined as:**

- a) Long-term food-based intervention
- b) Short-term provision of specific nutrients to at-risk populations for rapid improvement in nutritional status
- c) Only providing vitamins to children
- d) Mandatory food rationing by the government

Answer: b)

Supplementation is a short-term intervention aimed at quickly improving nutrition in vulnerable groups.

168. **he main objectives of promoting dietary guidelines include:**

- a) Supporting public health interventions like fortification and supplementation
- b) Encouraging unhealthy fast food consumption
- c) Focusing only on calorie intake
- d) Discouraging balanced nutrition

Answer: a)

Promoting dietary guidelines supports fortification, supplementation, and informed food choices.

169. **Objective of food fortification is:**

- a) To increase food shelf life only
- b) Restore nutrients lost during food processing
- c) Reduce protein content in staple foods
- d) Encourage fast food consumption

Answer: b)

Fortification restores nutrients lost during processing (restoration).

170. **Vitamin A deficiency is commonly addressed by:**

- a) Fortification of flour
- b) Iron supplementation
- c) Vitamin A capsules, leafy vegetables, milk, liver
- d) Reducing fat intake

Answer: c)

Vitamin A supplementation through capsules and food sources prevents deficiency.

171. **Gestational Diabetes Mellitus (GDM) occurs:**

- a) Only in children
- b) During pregnancy
- c) Due to malnutrition in adolescence
- d) In the elderly

Answer: b)

GDM develops during pregnancy and usually resolves after delivery.

172. **A major hereditary factor for diabetes mellitus is:**

- a) Family history of diabetes
- b) Consuming too much sugar
- c) Lack of exercise
- d) Vitamin deficiency

Answer: a)

Genetics increase the risk of diabetes, especially in children of diabetic parents.

173. **Which of the following is NOT a classic symptom of diabetes?**

- a) Polydipsia
- b) Weakness & weight loss
- c) Ketoacidosis
- d) Increased hemoglobin

Answer: d)

Diabetes causes polydipsia, polyphagia, weakness, weight loss, and sometimes ketoacidosis, but not increased hemoglobin.

174. **For diabetic patients, complex carbohydrates are preferred. Which of the following is a recommended source?**

- a) White sugar
- b) Rice and whole wheat
- c) Honey
- d) Soft drinks

Answer: b)

Complex carbs like rice, whole wheat, barley, and mixed grains provide slow-release energy and maintain blood glucose.

175. **Which of the following is a non-modifiable risk factor for heart disease?**

- a) Smoking
- b) Physical inactivity
- c) Age
- d) Unhealthy diet

Answer: c)

Non-modifiable factors such as age, sex, and genetics cannot be changed but increase heart disease risk.

176. **Which type of fat is recommended to reduce heart disease risk?**

- a) Saturated fat
- b) Trans fat
- c) Polyunsaturated fat (PUFA)
- d) Refined fat

Answer: c)

PUFAs support prostaglandin synthesis and help regulate blood pressure, reducing heart disease risk.

177. **In managing hypertension, daily sodium intake should be limited to:**

- a) 5–6 g/day
- b) 1–3 g/day
- c) 7–8 g/day
- d) 10 g/day

Answer: b)

Limiting sodium to 1–3 g/day helps reduce blood pressure.

178. **The main objectives of diarrhea treatment are:**

- a) Reduce appetite
- b) Limit fluid intake
- c) Increase sugar intake
- d) Replace lost water and electrolytes and relieve dehydration

Answer: d)

Rehydration is essential to prevent complications and restore fluid balance.

179. **A common dietary cause of constipation is:**

- a) High fiber intake
- b) Low fiber intake and inadequate fluids
- c) Excess water consumption
- d) High fruit consumption

Answer: b)

Low fiber and insufficient fluid intake slow bowel movements, leading to constipation.

180. **Accumulation of bilirubin due to liver dysfunction causes:**

- a) Pale stools
- b) Low blood pressure
- c) Dark hair
- d) Yellow eyes and skin

Answer: d)

Bilirubin buildup in blood leads to jaundice, showing as yellow eyes and skin.

181. **A major dietary goal for liver disease patients is:**

- a) Provide sufficient protein (75–100 g/day) to repair liver cells
- b) Restrict protein completely
- c) Only consume fats
- d) Avoid carbohydrates entirely

Answer: a)

Adequate protein helps regenerate liver cells and provides lipotropic agents like methionine and choline.

182. **The primary function of kidneys is to:**

- a) Produce hormones only
- b) Filter blood, remove waste, and maintain fluid-electrolyte balance
- c) Store bile
- d) Digest proteins

Answer: b)

Kidneys filter blood, remove waste products, and regulate fluids and electrolyte

183. **In glomerulonephritis, the recommended daily protein intake for adults is:**

- a) 2 g/kg/day
- b) 1 g/kg/day
- c) 0.5 g/kg/day
- d) 1.5 g/kg/day

Answer: c)

Protein is restricted to 0.5 g/kg/day to reduce kidney stress.

184. **Which of the following is a diagnostic marker for kidney dysfunction?**

- a) Blood urea, creatinine, uric acid, Na, K
- b) Blood glucose only
- c) Cholesterol level
- d) Hemoglobin A1c

Answer: a)

Blood tests measuring urea, creatinine, uric acid, sodium, and potassium indicate kidney function.

185. **Which age group is most commonly affected by post-streptococcal glomerulonephritis?**

- a) Infants (0–1 yr)
- b) Children (3–10 yrs)
- c) Adults (30–50 yrs)
- d) Elderly (>65 yrs)

Answer: b)

Glomerulonephritis post-streptococcal infection is common in children aged 3–10 years.

186. **Which of the following is used as a natural colorant in foods?**

- a) Saffron
- b) Tartrazine
- c) Monosodium glutamate
- d) Aspartame

Answer: a)

Saffron, caramel, and carotene are natural colorants.

187. **Which of the following is used as a baking agent?**

- a) NaHCO_3
- b) BHA
- c) Lecithin
- d) Vanilla

Answer: a)

Baking agents like sodium bicarbonate (NaHCO_3) and tartaric acid are used in baking and carbonated drinks.

188. **Antioxidants such as BHA and citric acid are added to foods to:**

- a) Enhance flavor
- b) Prevent rancidity of oils and fats
- c) Improve color
- d) Sweeten foods

Answer: b)

Antioxidants prevent oxidation and spoilage of oils, fats, and margarine.

189. **MSG and aspartate are primarily used as:**

- a) Stabilizers
- b) Taste modifiers
- c) Colouring agents
- d) Baking agents

Answer: b)

Taste modifiers like MSG and aspartate enhance umami and overall taste in drinks and processed foods.

190. **Oxidation of oils and vitamin loss in foods are examples of:**

- a) Microbial spoilage
- b) Enzymatic spoilage
- c) Chemical spoilage
- d) Mechanical spoilage

Answer: c)

Chemical reactions like oxidation, rancidity, and pigment changes lead to food spoilage.

191. **Freezing preserves food by:**

- a) Adding preservatives
- b) Removing all moisture
- c) Freezing water to stop microbial growth and enzyme activity
- d) Increasing salt concentration

Answer: c)

Freezing ($\leq -18^{\circ}\text{C}$) halts microbial and enzymatic activity, suitable for meat, fish, and vegetables; quality is maintained for months.

192. **Pasteurization is mainly used for:**

- a) Dry grains and pulses
- b) Liquids like milk and juice to destroy pathogens
- c) Cured meat and fish
- d) Frozen foods

Answer: b)

Pasteurization (71.5°C for 15 sec) destroys pathogens while preserving flavor and nutrients.

193. **Which chemical-based preservation method uses high salt concentration to inhibit microbial growth?**

- a) Curing
- b) Sugaring
- c) Smoking
- d) Pasteurization

Answer: a)

Curing uses ~15% salt solution to remove moisture via osmosis and inhibit microbes, common for meat and fish.

194. **Antioxidants protect the body by:**

- a) Producing free radicals
- b) Donating electrons to neutralize free radicals
- c) Increasing oxidative stress
- d) Breaking down enzymes

Answer: b)

Antioxidants stabilize free radicals by donating an electron, reducing their reactivity.

195. **Metal chelation by antioxidants prevents:**

- a) Formation of harmful free radicals via Fenton reaction
- b) DNA synthesis
- c) Protein digestion
- d) Water-soluble vitamin absorption

Answer: a)

Antioxidants bind harmful metal ions like Fe and Cu, stopping free radical formation through the Fenton reaction.

196. **Water-soluble antioxidants like Vitamin C primarily act in:**

- a) Cell membranes
- b) Fat tissue
- c) Bone tissue
- d) Cytoplasm and blood

Answer: d)

Hydrophilic antioxidants act in aqueous environments like cytoplasm and blood to neutralize radicals.

197. **Synthetic antioxidants include:**

- a) Vitamin C and carotenoids
- b) BHA, BHT, and vitamin/mineral supplements
- c) Polyphenols from berries
- d) Curcumin and resveratrol

Answer: b)

Synthetic antioxidants like BHA and BHT are used to prevent food oxidation or as supplements.

198. **A common cause of Vitamin A deficiency in children is:**

- a) Excessive sunlight exposure
- b) Lack of breastfeeding and insufficient vitamin A-rich foods
- c) High protein diet
- d) Excessive fruit consumption

Answer: b)

Vitamin A deficiency occurs due to inadequate breastfeeding and insufficient intake of vitamin A-rich foods like leafy vegetables, fish, and fruits.

199. **Severe anaemia is defined as hemoglobin below:**

- a) 12 g/100 ml for men, 11 g/100 ml for women
- b) 10 g/100 ml for men, 9 g/100 ml for women
- c) 9 g/100 ml for men, 7 g/100 ml for women
- d) 7 g/100 ml for men, 5 g/100 ml for women

Answer: c)

Severe anaemia: Hb < 9 g/100 ml for men, Hb < 7 g/100 ml for women.

200. **Treatment for pregnant women in iodine-deficient areas may include:**

- a) Iodine injection (Lipiodol)
- b) Calcium tablets
- c) Vitamin D supplements
- d) High-sugar diet

Answer: a)

Iodine injection protects the fetus from iodine deficiency-related complications.

খাদ্য ও পুষ্টি – বিসিএস শেষ মুহূর্তের পড়ার কৌশল

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- Live MCQ-এর আর্কাইভ থেকে বারবার পরীক্ষা দিয়ে ভুল/confusion দূর করুন এবং সঠিক উত্তরগুলো শিখুন।

পরীক্ষার হলে করণীয়

- সবার প্রথমে বাংলাদেশের বিষয়ভিত্তিক অংশের প্রশ্ন থেকে শুরু করুন।
- যারা বিষয়ভিত্তিক অংশে ভালো প্রস্তুতি রাখেন, তারা এরপর বিশ্বভিত্তিক অংশের প্রশ্ন সমাধান শুরু করতে পারেন।
- পরীক্ষার হলে টাইম ম্যানেজমেন্ট অত্যন্ত গুরুত্বপূর্ণ।
- সহজ ও পরিচিত প্রশ্ন আগে সমাধান করুন।
- কঠিন বা সন্দেহজনক প্রশ্নের জন্য চিহ্ন দিয়ে পরে উত্তর করুন।
- সময় অনুযায়ী ধাপে ধাপে সমস্ত অংশের উত্তর দেওয়ার চেষ্টা করুন।

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4. Handbook of Food and Nutrition – Dr. Swaminathan
5. খাদ্য ও পুষ্টি বোর্ড বই (একাদশ ও দ্বাদশ শ্রেণি)
6. Fundamentals of Biochemistry – A.C DEB
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সমাপ্ত