Question 1: (a) Explain the following terms briefly (any five): (i) Blanching (ii) Iodized salt (iii) Scurvy (iv) Mutual supplementation (v) Dextrinisation (vi) Balanced Diet (vii) Probiotics

- **Blanching:**
  - Blanching is a cooking process where food, usually vegetables or fruits, is plunged into boiling water for a brief period, then quickly transferred to ice water to stop the cooking process.
  - This technique is used to deactivate enzymes that cause spoilage, preserve color, texture, and nutritional value, and remove any unpleasant tastes. It also helps in peeling fruits like tomatoes and peaches.
- **Iodized salt:**
  - Iodized salt is table salt (sodium chloride) that has been fortified with small amounts of potassium iodide or sodium iodide.
  - Iodine is an essential trace mineral necessary for the proper functioning of the thyroid gland, which produces hormones that regulate metabolism and growth.
  - Iodized salt helps prevent iodine deficiency disorders, such as goiter and cretinism.
- **Scurvy:**
  - Scurvy is a disease caused by a severe deficiency of Vitamin C (ascorbic acid).
  - Vitamin C is crucial for the synthesis of collagen, a protein essential for connective tissues, wound healing, and maintaining healthy blood vessels, bones, and gums.
  - Symptoms include fatigue, swollen and bleeding gums, joint pain, easy bruising, and poor wound healing.
- **Mutual supplementation:**

- Mutual supplementation, also known as complementary protein, is a strategy used by vegetarians and vegans to obtain all essential amino acids.
- It involves combining two or more incomplete protein sources (foods that are low in one or more essential amino acids) in the same meal or within a day.
- When consumed together, the amino acid deficiencies of one food are compensated by the other, providing a complete protein profile similar to that found in animal products. For example, combining legumes (deficient in methionine) with grains (deficient in lysine) like rice and beans.

- **Dextrinisation:**
  - Dextrinisation is a chemical process that occurs when dry starch (e.g., flour, bread) is exposed to dry heat.
  - During this process, starch molecules break down into smaller polysaccharides called dextrins.
  - This results in changes in color (browning), flavor (toasty aroma), and texture (becomes crispier or more soluble). It is responsible for the browning of toast and the flavor of roasted flour.

- **Balanced Diet:**
  - A balanced diet is one that provides all the essential nutrients (carbohydrates, proteins, fats, vitamins, minerals, and water) in the right proportions to meet an individual's specific needs.
  - It ensures proper growth, development, maintenance of health, and prevention of nutrient deficiencies and excesses.
  - A balanced diet includes a variety of foods from all food groups, such as fruits, vegetables, grains, protein sources, and healthy fats.

- **Probiotics:**
    - Probiotics are live microorganisms, primarily bacteria and sometimes yeasts, that, when administered in adequate amounts, confer a health benefit on the host.
    - They are often referred to as "good" or "friendly" bacteria and are commonly found in fermented foods like yogurt, kefir, and kimchi, as well as in supplements.
    - Probiotics help maintain a healthy balance of gut microbiota, aiding in digestion, nutrient absorption, and supporting the immune system.

Question 1: (b) Give reasons for the following: (any four) (i) Tea should be avoided with meals. (ii) We need to expose our skin to sunlight every day. (iii) We should not use soda for cooking pulses. (iv) Boiling milk curdles if lemon juice is added to it. (v) A green ring forms around the yolk in hard-boiled eggs. (vi) A cut apple becomes brown on keeping.

- **Tea should be avoided with meals:**
    - Tea contains compounds called tannins (polyphenols) that can bind with non-heme iron (iron from plant sources) present in food.
    - This binding forms insoluble complexes, which inhibit the absorption of iron in the digestive tract.
    - Consuming tea with meals, especially for individuals at risk of iron deficiency anemia, can reduce the bioavailability of dietary iron.
- **We need to expose our skin to sunlight every day:**
    - Sunlight, specifically ultraviolet B (UVB) radiation, is essential for the skin to synthesize Vitamin D.

- When UVB rays hit the skin, a precursor molecule (7-dehydrocholesterol) is converted into cholecalciferol (Vitamin D3).
- Vitamin D is crucial for calcium absorption and bone health, immune function, and overall well-being. Regular, moderate sun exposure helps maintain adequate Vitamin D levels.

- **We should not use soda for cooking pulses:**
  - Baking soda (sodium bicarbonate) is an alkaline substance. When added to pulses during cooking, it can cause the pulses to become mushy and lose their texture.
  - More importantly, soda significantly degrades certain heat-sensitive vitamins, particularly B vitamins (like thiamine) and Vitamin C, which are present in pulses.
  - It can also affect the flavor and increase the sodium content of the food.

- **Boiling milk curdles if lemon juice is added to it:**
  - Milk contains casein proteins, which are suspended in a stable emulsion. The pH of milk is slightly acidic (around 6.7).
  - Lemon juice is highly acidic. When added to boiling milk, the sudden drop in pH causes the casein proteins to denature and coagulate rapidly.
  - This coagulation leads to the separation of solid casein curds from the liquid whey, resulting in curdling.
- **A green ring forms around the yolk in hard-boiled eggs:**
  - This green or grayish-green discoloration is caused by a chemical reaction between sulfur in the egg white and iron in the egg yolk.

- When eggs are overcooked or cooked at too high a temperature, the sulfur-containing proteins in the white break down, releasing hydrogen sulfide gas.
- This gas reacts with the iron in the yolk, forming iron sulfide, which is green in color and deposits on the surface of the yolk.

- **A cut apple becomes brown on keeping:**
  - This browning is an enzymatic oxidation process. Apples contain an enzyme called polyphenol oxidase (PPO) and phenolic compounds.
  - When an apple is cut or bruised, the cell structure is damaged, exposing PPO and phenolic compounds to oxygen in the air.
  - PPO catalyzes the oxidation of phenolic compounds, leading to the formation of brown-colored pigments called melanins.

Question 2: (a) Carbohydrates vary in the degree of their structural complexity. Describe the classification of carbohydrates based on structure giving appropriate examples.

- Carbohydrates are broadly classified into three main groups based on the number of sugar units (saccharides) they contain: monosaccharides, disaccharides, and polysaccharides.
- **Monosaccharides (Simple Sugars):**
  - **Description:** These are the simplest form of carbohydrates, consisting of a single sugar unit. They are the basic building blocks of all carbohydrates and cannot be hydrolyzed into smaller sugar units. They are typically sweet, soluble in water, and crystalline.
  - **Examples:**
    - **Glucose:** The primary source of energy for the body's cells. Found in fruits, honey, and corn syrup.

        - **Fructose:** Known as fruit sugar, it is the sweetest monosaccharide. Found in fruits, honey, and high-fructose corn syrup.
        - **Galactose:** Not found freely in nature in significant amounts but is a component of lactose (milk sugar).

- **Disaccharides (Double Sugars):**
    - **Description:** These are formed when two monosaccharide units are joined together by a glycosidic bond, with the removal of a water molecule (dehydration synthesis). They can be hydrolyzed back into two monosaccharides.
    - **Examples:**
        - **Sucrose:** Commonly known as table sugar. It is composed of one glucose unit and one fructose unit. Found in sugarcane, sugar beets, and fruits.
        - **Lactose:** Known as milk sugar. It is composed of one glucose unit and one galactose unit. Found in milk and dairy products.
        - **Maltose:** Known as malt sugar. It is composed of two glucose units. Formed during the digestion of starch and found in malt products like beer.
- **Polysaccharides (Complex Carbohydrates):**
    - **Description:** These are complex carbohydrates formed by linking many (hundreds to thousands) monosaccharide units together via glycosidic bonds. They are typically not sweet, are often insoluble or form colloids in water, and serve as energy storage or structural components.
    - **Examples:**

- **Starch:** The primary energy storage carbohydrate in plants. It is composed of many glucose units. Found in grains (wheat, rice, corn), potatoes, and legumes.
- **Glycogen:** The primary energy storage carbohydrate in animals (including humans). It is a highly branched polymer of glucose units, stored mainly in the liver and muscles.
- **Cellulose:** A structural polysaccharide found in the cell walls of plants. It is composed of many glucose units linked in a way that humans cannot digest (dietary fiber). Found in fruits, vegetables, and whole grains.
- **Pectin:** A complex polysaccharide found in the cell walls of fruits. Used as a gelling agent in jams and jellies.

Question 2: (b) Which macronutrient is the building block of the body? Describe its sources and functions.

- The macronutrient that is the building block of the body is **protein**.
- **Sources of Protein:**
  - **Animal Sources (Complete Proteins):** These sources provide all nine essential amino acids that the body cannot synthesize on its own.
    - Meat (beef, chicken, pork, lamb)
    - Fish and seafood (salmon, tuna, shrimp, cod)
    - Eggs
    - Dairy products (milk, cheese, yogurt)
  - **Plant Sources (Often Incomplete Proteins, but can be made complete through mutual supplementation):**
    - Legumes (beans, lentils, chickpeas, peanuts)

    - Soy products (tofu, tempeh, edamame, soy milk)
    - Nuts and seeds (almonds, walnuts, chia seeds, flax seeds, pumpkin seeds)
    - Grains (quinoa, oats, brown rice, whole wheat products)
    - Certain vegetables (broccoli, spinach)

- **Functions of Protein:**
    - **Building and Repairing Tissues:** Proteins are fundamental components of all cells and tissues in the body, including muscles, organs, skin, hair, and nails. They are essential for growth, maintenance, and repair of tissues throughout life.
    - **Enzyme Production:** All enzymes, which are biological catalysts that facilitate nearly all biochemical reactions in the body (e.g., digestion, metabolism), are proteins.
    - **Hormone Production:** Many hormones, which act as chemical messengers regulating various physiological processes (e.g., insulin, growth hormone), are proteins.
    - **Immune Function:** Antibodies, which are crucial components of the immune system that identify and neutralize pathogens (bacteria, viruses), are proteins.
    - **Transport and Storage:** Proteins transport vital substances throughout the body (e.g., hemoglobin transports oxygen in the blood, lipoproteins transport fats). They can also store certain molecules (e.g., ferritin stores iron).
    - **Fluid and Electrolyte Balance:** Proteins, particularly albumin in the blood, help maintain the balance of fluids between blood and tissues, preventing edema.
    - **Acid-Base Balance:** Proteins act as buffers, helping to maintain the proper pH balance in the blood and other body fluids.

- **Energy Source:** While not their primary role, proteins can be broken down to provide energy (4 kcal/gram) if carbohydrate and fat intake is insufficient.

Question 3: Describe the clinical manifestations of any three of the following deficiency diseases: (i) Beriberi (ii) Iron deficiency anemia (iii) Vitamin A deficiency (VAD) (iv) Pellagra (v) Rickets

- **Beriberi (Thiamine/Vitamin B1 Deficiency):**
  - **Wet Beriberi (affecting the cardiovascular system):**
    - Edema (swelling), particularly in the legs and feet.
    - Enlarged heart.
    - Shortness of breath.
    - Rapid heart rate.
    - Congestive heart failure in severe cases.
  - **Dry Beriberi (affecting the nervous system):**
    - Muscle weakness and atrophy (wasting).
    - Peripheral neuropathy (nerve damage) leading to pain, tingling, or loss of sensation in the hands and feet.
    - Difficulty walking, staggering gait.
    - Foot drop or wrist drop.
    - Confusion, memory loss (Wernicke-Korsakoff syndrome in severe chronic cases, often associated with alcoholism).
  - **Infantile Beriberi:** Occurs in breastfed infants whose mothers are thiamine deficient. Symptoms include vomiting, diarrhea, cyanosis, rapid heart rate, and convulsions, often leading to sudden death.

- **Iron Deficiency Anemia:**
    - **Fatigue and Weakness:** Due to reduced oxygen transport to tissues.
    - **Pallor (Paleness):** Especially of the skin, mucous membranes, and nail beds, as a result of decreased hemoglobin.
    - **Shortness of Breath:** Even with mild exertion.
    - **Dizziness and Lightheadedness:** Due to insufficient oxygen supply to the brain.
    - **Headaches:**
    - **Cold Hands and Feet:** Impaired circulation.
    - **Brittle Nails:** Often spoon-shaped (koilonychia).
    - **Glossitis:** Inflammation and soreness of the tongue.
    - **Angular Stomatitis:** Cracks at the corners of the mouth.
    - **Pica:** Craving for non-food items like ice, dirt, or starch.
    - **Weakened Immune System:** Increased susceptibility to infections.
- **Vitamin A Deficiency (VAD):**
    - **Night Blindness (Nyctalopia):** This is often the earliest symptom, characterized by difficulty seeing in dim light or adapting to darkness.
    - **Xerophthalmia:** A progressive eye disease that can lead to permanent blindness.
        - **Conjunctival Xerosis:** Dryness and thickening of the conjunctiva (white of the eye).
        - **Bitot's Spots:** Foamy, triangular patches on the conjunctiva, usually on the temporal side.

        - **Corneal Xerosis:** Dryness and clouding of the cornea.
        - **Keratomalacia:** Softening and ulceration of the cornea, leading to blindness if untreated.
    - **Impaired Immune Function:** Increased susceptibility to infections, especially respiratory and diarrheal diseases.
    - **Impaired Growth and Development:** Particularly in children.
    - **Follicular Hyperkeratosis (Phrynoderma or Toad Skin):** Dry, rough, and bumpy skin due to excessive keratinization of hair follicles.

Question 4: (a) How is egg white foam formed? What are the factors affecting egg white foam formation?

- **How Egg White Foam is Formed:**
    - Egg white is primarily composed of water (about 88%) and proteins (about 11%, mainly ovalbumin, ovotransferrin, ovomucoid).
    - When egg whites are beaten (e.g., with a whisk or electric mixer), mechanical energy is introduced, causing the proteins to denature.
    - Denaturation unfolds the coiled protein molecules, exposing their hydrophobic (water-repelling) and hydrophilic (water-attracting) regions.
    - As beating continues, air is incorporated into the egg white. The denatured proteins then migrate to the air-water interface, where they align themselves.
    - The hydrophobic parts of the proteins orient towards the air bubbles, and the hydrophilic parts remain in the water phase.
    - This arrangement forms a stable film around each air bubble, trapping the air and creating a foam.

- Disulfide bonds can then form between protein molecules, further stabilizing the foam structure, creating a strong, elastic network that holds the trapped air.

- **Factors Affecting Egg White Foam Formation:**
  - **Temperature of Eggs:**
    - **Effect:** Room temperature egg whites (20-25°C) produce a larger volume and more stable foam than cold egg whites.
    - **Reason:** Proteins in warmer egg whites denature more easily and quickly, allowing for better air incorporation and foam formation. Cold egg whites are more viscous and resistant to denaturation.
  - **Presence of Fat/Oil:**
    - **Effect:** Even a tiny amount of fat (e.g., from egg yolk, greasy bowl, or oil) will inhibit foam formation.
    - **Reason:** Fat molecules interfere with the protein network formation by disrupting the protein film around the air bubbles, preventing stabilization.
  - **Acidity (pH):**
    - **Effect:** Adding a small amount of acid (e.g., cream of tartar, lemon juice, vinegar) improves foam stability and volume.
    - **Reason:** Acid lowers the pH, bringing the proteins closer to their isoelectric point, making them less soluble and more likely to denature and coagulate, thus strengthening the foam structure. It also helps achieve a whiter foam.
  - **Sugar:**

- **Effect:** Sugar stabilizes the foam, makes it more elastic and glossy, and prevents weeping (syneresis). However, it should be added gradually after the foam has started to form.
- **Reason:** Sugar dissolves in the water phase of the foam, increasing viscosity and competing with proteins for water, which delays denaturation. When added too early, it can reduce foam volume.

- **Salt:**
  - **Effect:** Small amounts of salt can slightly decrease foam volume and stability.
  - **Reason:** Salt ions can interfere with the protein network and draw water out, weakening the foam.
- **Utensils and Equipment:**
  - **Effect:** Clean, dry bowls and whisks are crucial. Copper bowls are traditionally used.
  - **Reason:** Any fat residue will inhibit foam. Copper ions from a copper bowl react with egg white proteins (specifically conalbumin), forming a stable complex that enhances foam stability and volume, preventing over-beating.
- **Degree of Beating:**
  - **Effect:** Under-beating results in unstable foam; over-beating leads to a dry, brittle foam that can separate and "weep."
  - **Reason:** Proper beating incorporates enough air and creates a stable protein network. Over-beating can cause the protein network to become too rigid and eventually break, expelling the trapped air and water.

Question 4: (b) Explain the effect of processing on at least 4 different toxic constituents of pulses.

- Pulses (legumes) are nutritious but contain several naturally occurring antinutritional factors (ANFs) or toxic constituents that can interfere with nutrient absorption or cause adverse physiological effects. Processing methods are crucial to reduce or eliminate these compounds.
- **1. Trypsin Inhibitors (e.g., in soybeans, kidney beans):**
  - **Effect:** These are proteins that inhibit the activity of trypsin, a key proteolytic enzyme in the small intestine. This reduces protein digestion and amino acid absorption, potentially leading to pancreatic hypertrophy (enlargement) in severe cases.
  - **Processing Effects:**
    - **Heat Treatment (Boiling, Roasting, Steaming, Pressure Cooking):** This is the most effective method. Heat denatures the protein structure of trypsin inhibitors, rendering them inactive. Boiling for 30-60 minutes or pressure cooking for 10-20 minutes significantly reduces their activity.
    - **Soaking:** Reduces some inhibitors, primarily by leaching them out.
- **2. Lectins / Phytohemagglutinins (e.g., in red kidney beans - Phaseolus vulgaris):**
  - **Effect:** Lectins are carbohydrate-binding proteins that can bind to the lining of the gut, interfering with nutrient absorption, causing gastrointestinal distress (nausea, vomiting, diarrhea), and damaging intestinal villi. Raw kidney beans are particularly high in these.
  - **Processing Effects:**

- **Soaking and Thorough Boiling:** Soaking kidney beans for at least 12 hours (changing water) and then boiling vigorously for at least 10 minutes (preferably 30 minutes to ensure full cooking) is critical. The combination of soaking and high heat denatures and inactivates the lectins.
- **Pressure Cooking:** Very effective due to high temperatures.
- **Germination/Sprouting:** Can reduce lectin content.

- **3. Phytic Acid (Phytate) (present in all pulses):**
  - **Effect:** Phytic acid is a storage form of phosphorus in plants. It acts as a chelating agent, binding to essential minerals like iron, zinc, calcium, and magnesium, making them unavailable for absorption in the human gut.
  - **Processing Effects:**
    - **Soaking:** Activates endogenous phytase enzymes (if present in the pulse) and leaches out some phytic acid. Changing soaking water is important.
    - **Germination/Sprouting:** Significantly activates phytase enzymes, leading to substantial degradation of phytic acid.
    - **Fermentation:** Microorganisms (e.g., in tempeh, sourdough) produce phytase, breaking down phytic acid.
    - **Milling/Decortication (Removing Outer Bran):** Reduces phytic acid as it's concentrated in the bran.
    - **Pressure Cooking/Boiling:** While heat can inactivate phytase, prolonged cooking can also break down some phytate if the pH is favorable.

- **4. Oligosaccharides (e.g., raffinose, stachyose, verbascose - in most pulses, especially beans):**
    - **Effect:** These are complex sugars that humans lack the enzyme (alpha-galactosidase) to digest in the small intestine. They pass undigested into the large intestine, where they are fermented by gut bacteria, leading to gas production (flatulence), bloating, and discomfort.
    - **Processing Effects:**
        - **Soaking (especially prolonged soaking with multiple water changes):** Leaches out a significant portion of these water-soluble sugars.
        - **Germination/Sprouting:** Enzymes produced during sprouting can break down oligosaccharides.
        - **Fermentation:** Microorganisms involved in fermentation (e.g., in miso, tempeh) can metabolize these sugars.
        - **Pressure Cooking/Thorough Cooking:** While heat doesn't directly break them down, it can help make them more accessible for leaching.
- **5. Cyanogenic Glycosides (e.g., in lima beans, particularly bitter varieties):**
    - **Effect:** These compounds can release hydrogen cyanide (HCN) when hydrolyzed by enzymes (beta-glucosidases), which can be toxic and interfere with cellular respiration.
    - **Processing Effects:**
        - **Soaking and Thorough Cooking (especially boiling in plenty of water, with water changes):** Soaking allows enzymes to act and HCN to leach out. Boiling denatures the enzymes and allows volatile HCN to escape with steam.

- **Grinding and Fermentation:** Can also aid in detoxification.

Question 5: (a) Explain the different changes taking place during the ageing of meat. How can meat be made more tender?

- **Changes Taking Place During the Ageing of Meat (also known as "Conditioning" or "Ripening"):**
  - Aging is the process of holding carcasses or cuts of meat under controlled temperature (typically 0-4°C) and humidity conditions for a period after slaughter. This allows natural enzymatic processes to occur, leading to significant improvements in tenderness, flavor, and juiciness.
  - **1. Tenderness Improvement (Primary Change):**
    - **Mechanism:** After slaughter, muscles stiffen due to rigor mortis. Over time, endogenous proteolytic enzymes (cathepsins and calpains) naturally present in the muscle cells begin to break down the complex proteins, particularly structural proteins (myofibrillar proteins like titin and nebulin) and connective tissue (collagen, though to a lesser extent than myofibrillar proteins).
    - **Result:** This enzymatic breakdown weakens the muscle fibers and connective tissue, leading to a significant increase in tenderness. The meat becomes less tough and easier to chew.
  - **2. Flavor Development:**
    - **Mechanism:** Enzymatic reactions during aging also produce various volatile compounds and precursors that contribute to the characteristic "aged meat" flavor. These include breakdown products of proteins (peptides, amino acids) and fats (fatty acids).

        - **Result:** The meat develops a more complex, richer, and often nuttier or beefier flavor compared to fresh, unaged meat.
    - **3. Juiciness (Water-Holding Capacity):**
        - **Mechanism:** As proteins degrade, the muscle structure loosens, allowing cells to hold onto water more effectively.
        - **Result:** Aged meat often retains more moisture during cooking, leading to a perception of increased juiciness.
    - **4. Color Change:**
        - **Mechanism:** The surface of meat can darken due to oxidation of myoglobin (the pigment responsible for red color) during dry aging.
        - **Result:** A darker, often brownish crust may form on the exterior of dry-aged meat.

- **How Meat Can Be Made More Tender:**
    - **1. Aging (Post-Slaughter Processing):**
        - **Mechanism:** As described above, natural enzymes break down muscle proteins and connective tissue.
        - **Application:** This is a controlled process done by butchers and meat processors (e.g., dry aging, wet aging in vacuum bags).
    - **2. Mechanical Tenderization:**
        - **Mechanism:** Physically breaking down muscle fibers and connective tissue.
        - **Application:**
            - **Pounding/Malleting:** Using a meat mallet to flatten and break fibers (e.g., for schnitzel).

        - **Scoring/Cutting:** Making shallow cuts across the grain.
        - **Needling/Blade Tenderizing:** Passing meat through blades that pierce it repeatedly, cutting connective tissue.
        - **Grinding:** Breaking down tissue completely (e.g., ground beef).
    - **3. Enzymatic Tenderization (Using External Enzymes):**
        - **Mechanism:** Applying enzymes from plant sources that break down proteins.
        - **Application:**
            - **Commercial Meat Tenderizers:** Powders containing papain (from papaya), bromelain (from pineapple), or ficin (from figs). Applied as a rub or marinade.
            - **Natural Tenderizers:** Using fruit juices like pineapple juice or papaya juice in marinades.
    - **4. Acidic Marinades:**
        - **Mechanism:** Acids (e.g., vinegar, lemon juice, buttermilk, yogurt) partially denature proteins and weaken connective tissue.
        - **Application:** Soaking meat in acidic marinades for several hours or overnight. Over-marinating can make meat mushy.
    - **5. Slow, Moist Heat Cooking:**
        - **Mechanism:** Prolonged cooking at low temperatures in the presence of moisture (e.g., braising, stewing, slow

cooking) allows tough collagen in connective tissue to convert into gelatin.

- **Application:** Ideal for tougher cuts of meat with abundant connective tissue (e.g., chuck, brisket, shanks). This process makes the meat fall-apart tender.

- **6. Cutting Against the Grain:**
  - **Mechanism:** Shortening the length of muscle fibers, making them easier to chew.
  - **Application:** Always slice cooked meat across the direction of the muscle fibers.

Question 5: (b) Lipids are essential ingredients in a diet. Support the statement by explaining the role of lipids in diet.

- Lipids (fats and oils) are indeed essential ingredients in a diet, playing numerous vital roles beyond just providing energy. Their functions encompass structural, physiological, and nutritional aspects.

- **1. Concentrated Source of Energy:**
  - Lipids provide the most concentrated form of energy, yielding 9 kilocalories per gram, more than double that of carbohydrates or proteins (4 kcal/g). This makes them an efficient energy reserve for the body, especially during periods of low food intake or high energy demand.
- **2. Source of Essential Fatty Acids (EFAs):**
  - The body cannot synthesize certain polyunsaturated fatty acids, namely Linoleic Acid (an omega-6 fatty acid) and Alpha-Linolenic Acid (an omega-3 fatty acid). These are "essential" and must be obtained from the diet.
  - EFAs are crucial for various physiological functions, including cell membrane structure, brain development and function, nerve transmission, blood clotting, and inflammation regulation.

- **3. Absorption of Fat-Soluble Vitamins:**
    - Dietary fats are necessary for the absorption and transport of fat-soluble vitamins: Vitamin A, Vitamin D, Vitamin E, and Vitamin K. These vitamins are absorbed into the bloodstream along with dietary fat. Without adequate fat intake, the absorption of these crucial vitamins would be severely impaired, leading to deficiencies.
- **4. Structural Components of Cells:**
    - Phospholipids and cholesterol are integral components of cell membranes, providing structural integrity and regulating the passage of substances into and out of cells.
    - Lipids are also major components of the myelin sheath that insulates nerve fibers, facilitating rapid nerve impulse transmission.
- **5. Insulation and Organ Protection:**
    - Adipose tissue (body fat) beneath the skin acts as an insulating layer, helping to maintain body temperature and prevent heat loss.
    - Fat also surrounds and cushions vital organs (like kidneys, heart), protecting them from physical shock and injury.
- **6. Hormone Production:**
    - Cholesterol, a type of lipid, is a precursor for the synthesis of important steroid hormones, including sex hormones (estrogen, testosterone), adrenal hormones (cortisol), and Vitamin D.
- **7. Satiety and Flavor:**
    - Fats slow down gastric emptying, leading to a feeling of fullness and satiety after meals, which can help in appetite control.

- Lipids also carry fat-soluble flavor compounds and contribute to the palatability, aroma, and texture of foods, making meals more enjoyable.

- **8. Source of Glycerol:**
  - Glycerol, the backbone of triglycerides, can be converted into glucose by the liver, serving as an energy source when needed.

Question 6: (a) How is cooking beneficial for us? Suggest some dishes that are prepared by at least 3 different moist heat methods for cooking with their advantages and disadvantages especially with reference to nutrients retention.

- **How is Cooking Beneficial for Us?**
  - **Improved Digestibility:** Cooking breaks down complex carbohydrates, proteins, and fats, making them easier for the digestive enzymes to act upon and absorb. For example, cooking starch gelatinizes it, making it more digestible.
  - **Enhanced Palatability:** Cooking improves the taste, aroma, color, and texture of food, making it more appealing and enjoyable to eat.
  - **Safety and Hygiene:** Heat kills harmful microorganisms (bacteria, viruses, parasites) present in raw food, reducing the risk of foodborne illnesses.
  - **Increased Nutrient Bioavailability:** Cooking can sometimes increase the bioavailability of certain nutrients by breaking down antinutritional factors (e.g., trypsin inhibitors in legumes, oxalates in spinach).
  - **Variety in Diet:** Cooking allows for a wide range of culinary preparations, leading to a more diverse and interesting diet.
  - **Preservation:** Some cooking methods (e.g., canning, blanching before freezing) can extend the shelf life of food.

- **Dishes Prepared by Moist Heat Methods with Advantages and Disadvantages (Nutrient Retention Focus):**
    - Moist heat cooking methods involve cooking food in a liquid (water, broth, steam) or by steam. They generally cause less surface browning but are effective for tenderizing tough cuts of meat and for cooking delicate foods.
    - **1. Boiling:**
        - **Description:** Cooking food by submerging it in rapidly bubbling liquid at 100°C (212°F).
        - **Dish Example:** Boiled Potatoes, Boiled Vegetables (e.g., carrots, green beans), Pasta
        - **Advantages (Nutrient Retention):**
            - Quick for small, tender items.
            - No added fat.
            - Good for tenderizing tough items (though often by prolonged boiling, which has disadvantages).
        - **Disadvantages (Nutrient Retention):**
            - **Significant nutrient loss:** Water-soluble vitamins (B vitamins, Vitamin C) and some minerals can leach out into the cooking water, which is often discarded.
            - Overcooking easily occurs, further degrading heat-sensitive nutrients and causing loss of texture, flavor, and color.
    - **2. Steaming:**
        - **Description:** Cooking food by exposing it to steam, either in a steamer basket above boiling water or in a dedicated steam oven.

- **Dish Example:** Steamed Fish, Steamed Vegetables (e.g., broccoli, asparagus), Dim Sum
- **Advantages (Nutrient Retention):**
    - **Excellent nutrient retention:** Nutrients do not leach into cooking water as they do with boiling, as the food does not directly contact the water. Water-soluble vitamins and minerals are largely retained.
    - Preserves natural flavor, color, and texture of food well.
    - Requires no added fat.
- **Disadvantages (Nutrient Retention):**
    - Can be slower than boiling for some foods.
    - Does not produce browning or crust development, which might be desirable for some dishes.

- **3. Braising/Stewing:**
    - **Description:**
        - **Braising:** Food (typically larger cuts of meat) is first seared at high heat, then cooked slowly in a small amount of liquid (partially submerged) in a covered pot.
        - **Stewing:** Food (typically smaller, uniform pieces of meat and/or vegetables) is completely submerged in liquid and simmered slowly.
    - **Dish Example:** Beef Bourguignon (Braising), Lentil Stew (Stewing), Chicken Curry (Stewing)
    - **Advantages (Nutrient Retention):**

- **Good for retaining nutrients:** Since the cooking liquid is usually consumed along with the food, water-soluble vitamins and minerals that leach out are still consumed, minimizing overall loss.
- Breaks down tough connective tissue in meats, making them very tender.
- Develops rich, complex flavors due to slow cooking and browning.

- **Disadvantages (Nutrient Retention):**
  - Long cooking times, which can degrade some heat-sensitive vitamins (e.g., Vitamin C, some B vitamins) over extended periods.
  - Can be higher in fat if meats are not trimmed or if fat is not skimmed off the broth.

- **4. Poaching:**
  - **Description:** Cooking food gently in a liquid (water, broth, wine) that is kept just below simmering point (160-180°F or 71-82°C), with no bubbles.
  - **Dish Example:** Poached Eggs, Poached Chicken Breast, Poached Fish (e.g., salmon)
  - **Advantages (Nutrient Retention):**
    - **Good nutrient retention:** Gentle heat minimizes damage to heat-sensitive nutrients compared to boiling. Minimal leaching as the liquid is often served with the food or consumed.
    - Preserves delicate textures and flavors.
    - Requires no added fat.
  - **Disadvantages (Nutrient Retention):**

- Not suitable for tough cuts of meat that require more aggressive tenderization.
- Does not produce any browning or rich, developed flavors like searing or roasting.

Question 6: (b) Discuss the role of dietary diversification in combating nutritional problems.

- Dietary diversification, which involves consuming a wide variety of foods from different food groups and even within the same food group, plays a crucial and multifaceted role in combating various nutritional problems, particularly micronutrient deficiencies (hidden hunger) and chronic diseases.
- **1. Prevents Micronutrient Deficiencies (Hidden Hunger):**
  - **Broad Spectrum of Nutrients:** No single food contains all essential nutrients in optimal amounts. A diversified diet ensures intake of a wide range of vitamins (A, C, D, E, K, B-complex), minerals (iron, zinc, calcium, iodine, selenium), and trace elements from different food sources. This directly addresses deficiencies like Iron Deficiency Anemia, Vitamin A Deficiency, and Iodine Deficiency Disorders.
  - **Complementary Nutrients:** Different foods offer complementary nutrient profiles. For example, dark leafy greens provide iron and Vitamin A, while citrus fruits provide Vitamin C which enhances non-heme iron absorption.
- **2. Reduces Reliance on Staple Foods:**
  - Many populations in developing countries rely heavily on one or two staple foods (e.g., rice, maize, wheat) which are often low in essential micronutrients. Diversifying the diet by including pulses, fruits, vegetables, and animal products reduces this over-reliance and the associated nutrient gaps.
- **3. Provides a Balance of Macronutrients:**

- A diversified diet naturally promotes a balanced intake of carbohydrates, proteins, and fats. This helps prevent energy deficits (underweight/stunting) and excesses (overweight/obesity), and ensures adequate protein for growth and tissue repair.

- **4. Enhances Bioavailability of Nutrients:**
  - Certain food combinations (mutual supplementation) improve the absorption of nutrients. For example, combining legumes and grains provides complete protein; pairing iron-rich foods with Vitamin C-rich foods enhances iron absorption. A diverse diet naturally increases the chances of such beneficial interactions.

- **5. Incorporates Bioactive Compounds and Fiber:**
  - A varied diet, rich in fruits, vegetables, and whole grains, provides abundant fiber, which aids digestion, prevents constipation, and helps regulate blood sugar and cholesterol levels.
  - It also supplies numerous non-nutrient bioactive compounds (e.g., antioxidants, phytochemicals) that protect against chronic diseases like heart disease, certain cancers, and diabetes.

- **6. Reduces Exposure to Toxins/Antinutrients:**
  - While some foods contain antinutrients, a diversified diet means that no single antinutrient is consumed in excessive amounts from one source, thereby minimizing its overall negative impact on nutrient absorption. Different preparation methods for diverse foods also help to neutralize these compounds.

- **7. Promotes Healthy Gut Microbiota:**
  - A diverse intake of plant-based foods (fiber, prebiotics) fosters a healthy and diverse gut microbiome, which is essential for

nutrient synthesis (e.g., some B vitamins, Vitamin K), immune function, and overall gut health.

- **8. Addresses Food Security and Resilience:**
    - Promoting dietary diversity at a national or community level can reduce vulnerability to crop failures or price fluctuations of a single staple crop, contributing to food security. It encourages the cultivation and consumption of a wider range of indigenous and resilient crops.
- **9. Supports Healthy Growth and Development:**
    - Adequate and diverse nutrient intake during critical periods of growth (infancy, childhood, adolescence, pregnancy) is vital for optimal physical and cognitive development, preventing stunting, wasting, and impaired cognitive function.
- In essence, dietary diversification is a cornerstone of public health nutrition strategies, moving beyond single-nutrient supplementation to a holistic approach that leverages the synergistic benefits of various foods to build robust nutritional well-being and resilience against health challenges.

Question 7: Write short notes on any three: (i) Nutritive value of milk (ii) Gelatinization of starch (iii) Effect of heat, acid and alkali on pigments in beetroot (iv) Changes in coffee beans during roasting (v) Role of spices in cooking

- **(i) Nutritive Value of Milk:**
    - Milk is considered a nearly complete food, especially for infants, due to its rich and balanced nutrient profile.
    - **Proteins:** It is an excellent source of high-biological-value protein, containing all essential amino acids. Casein (about 80%) and whey proteins (about 20%) are the main proteins. These are crucial for growth, tissue repair, and enzyme/hormone production.

- **Carbohydrates:** Lactose, a disaccharide (glucose + galactose), is the primary carbohydrate. It provides energy and aids in calcium absorption.
- **Fats:** Milk fat varies depending on the type of milk (whole, skimmed). It provides energy, carries fat-soluble vitamins (A, D, E, K), and contributes to flavor and satiety. It contains saturated, monounsaturated, and polyunsaturated fatty acids.
- **Minerals:** An outstanding source of calcium, vital for bone and teeth health, nerve function, and blood clotting. It also provides significant amounts of phosphorus, potassium, magnesium, and zinc.
- **Vitamins:** Rich in B vitamins, particularly riboflavin (B2) and Vitamin B12, important for energy metabolism and red blood cell formation. It is also a good source of Vitamin A (especially in whole milk) and often fortified with Vitamin D, both essential for vision and bone health, respectively.
- **Water:** Constitutes about 87% of milk, contributing to hydration.
- **Note:** While highly nutritious, milk lacks significant amounts of iron and Vitamin C.

- **(ii) Gelatinization of Starch:**
  - Gelatinization is a physical and chemical process that occurs when starch granules are heated in the presence of water. It is a critical process in cooking starchy foods like rice, pasta, and in preparing sauces and gravies.
  - **Process:**
    - When starch granules are heated in water, they begin to absorb water.
    - As the temperature rises (typically between 50-70°C, depending on the starch type), the hydrogen bonds

holding the starch molecules (amylose and amylopectin) together weaken.

- Water then penetrates the amorphous regions of the granule, causing it to swell significantly and lose its crystallinity.
- The granules continue to swell, becoming more translucent and increasing the viscosity of the suspension.
- Eventually, some amylose molecules leach out of the granules into the surrounding water, further contributing to thickening.

- **Result:** The suspension transforms from a cloudy liquid to a viscous, translucent gel or paste. This process improves the digestibility of starch and changes the texture of the food.
- **Factors Affecting Gelatinization:** Temperature, water availability, pH (acid inhibits, alkali promotes), presence of sugar (delays), and fat (delays).

- **(iii) Effect of Heat, Acid, and Alkali on Pigments in Beetroot:**
  - The primary pigments responsible for the vibrant red-purple color of beetroot are **betalains**, specifically betacyanins (red-violet) and betaxanthins (yellow-orange). Unlike anthocyanins found in other fruits/vegetables, betalains are not pH indicators and react differently to processing.
  - **Effect of Heat:**
    - Betalains are relatively heat-sensitive. Prolonged heating or high temperatures can cause them to degrade, leading to a loss of color and a duller appearance.
    - Overcooked beetroot can turn brownish or grayish as the pigments are destroyed.

- To minimize color loss, beetroot should be cooked gently (e.g., steaming, roasting, or boiling for minimal time) and skins often left on during cooking.

- **Effect of Acid (e.g., lemon juice, vinegar):**
  - Acids have a stabilizing effect on betalains. In acidic conditions, the red-purple color of betacyanins becomes more vibrant and intense.
  - Adding a splash of acid to cooked beetroot or dressings can enhance its color.

- **Effect of Alkali (e.g., baking soda, hard water):**
  - Alkaline conditions are detrimental to betalains. In the presence of alkali, betacyanins degrade rapidly, turning the beetroot a dull bluish-brown or yellowish color.
  - Therefore, alkaline ingredients like baking soda should be avoided when cooking beetroot if preserving its color is desired. Hard water (which is alkaline) can also negatively impact the color.

- **(v) Role of Spices in Cooking:**
  - Spices are dried parts of plants (roots, bark, seeds, fruits, flowers) primarily used to flavor, color, or preserve food. Their role in cooking extends far beyond simple taste enhancement.
  - **Flavor and Aroma Enhancement:** This is the primary role. Spices contain volatile aromatic compounds that impart unique and complex flavors and aromas to dishes, transforming bland ingredients into culinary delights. (e.g., cinnamon, cumin, cardamom, cloves).
  - **Coloring Agents:** Many spices contribute vibrant colors to food, enhancing visual appeal. (e.g., turmeric for yellow, paprika for red, saffron for golden-yellow).

- **Preservative Properties:** Some spices possess antimicrobial and antioxidant properties, which can help inhibit the growth of spoilage microorganisms and slow down oxidation, thus extending the shelf life of food. (e.g., cloves, cinnamon, rosemary, oregano).
- **Digestive Aids:** Traditionally, many spices are believed to aid digestion by stimulating digestive enzymes or reducing flatulence. (e.g., ginger, carom seeds, cumin).
- **Nutritional Value (Minor):** While consumed in small quantities, some spices contribute trace amounts of vitamins and minerals, and many are rich in antioxidants.
- **Medicinal Properties:** Many spices have long been used in traditional medicine for their therapeutic benefits (e.g., anti-inflammatory properties of turmeric, pain relief from capsaicin in chili peppers).
- **Masking Undesirable Odors/Flavors:** In historical contexts and in some cuisines, spices were used to mask the off-flavors of food that was not perfectly fresh.
- **Cultural and Ritual Significance:** Spices often hold deep cultural, religious, and ceremonial significance in various cuisines and traditions worldwide.