

For BioResire students



Life sciences Material

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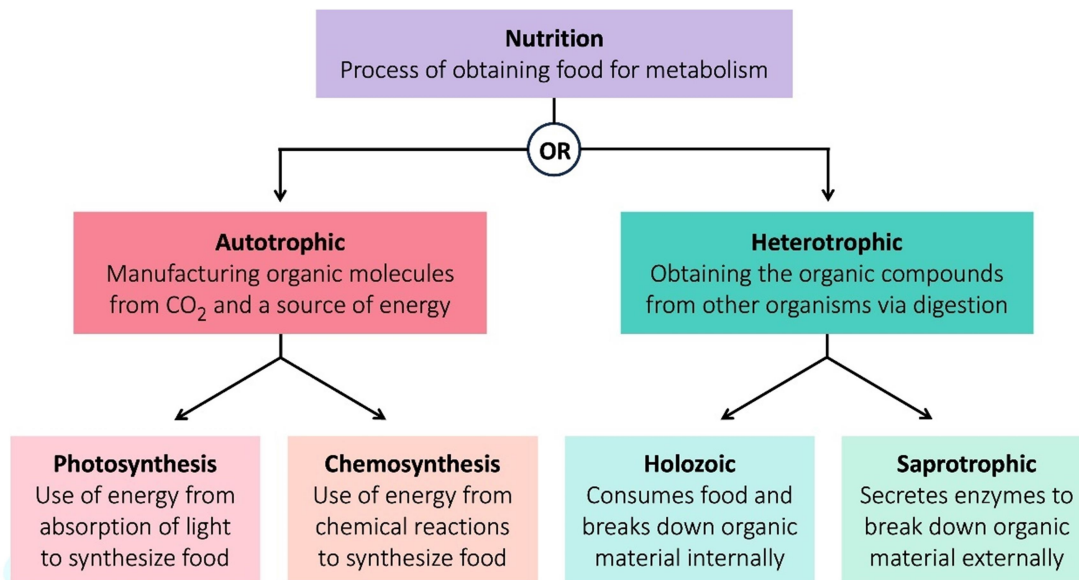
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NUTRITION: A CSIR NET PERSPECTIVE

Nutrition is the science of how organisms obtain and use food to support life processes, including growth, maintenance, and repair.

Types of Nutrition

Nutrition is classified based on the source of energy and carbon.



. Protein Nutrition & Quality

The quality of a protein is determined by its ability to provide the essential amino acids in the proportions required for human growth and maintenance.

- **Essential Amino Acids:** Amino acids that cannot be synthesized by the human body and must be obtained from the diet. The 9 essentials are: **Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan, Valine.**
- **Non-Essential Amino Acids:** Can be synthesized by the body.
- **Limiting Amino Acid:** The essential amino acid present in the smallest quantity in a food protein, which limits the body's ability to use that protein for synthesis.

Measures of Protein Quality:

1. **Biological Value (BV):**

- **Definition:** The percentage of absorbed nitrogen that is retained by the body for growth and maintenance.
 - **Formula:** $BV = (\text{Nitrogen Retained} / \text{Nitrogen Absorbed}) \times 100$
 - **Interpretation:** A higher BV indicates a higher proportion of absorbed protein is utilized.
 - **Egg white and whey protein** have a BV close to **100** (considered the gold standard).
 - **Plant proteins** generally have a lower BV (e.g., wheat ~60, beans ~70) due to limiting amino acids (e.g., Lysine in cereals, Methionine in legumes).
2. **Net Protein Utilization (NPU):** Measures the percentage of ingested nitrogen that is retained. It combines digestibility with BV.
 3. **Protein Efficiency Ratio (PER):** Weight gain per gram of protein consumed.
 4. **Protein Digestibility Corrected Amino Acid Score (PDCAAS):** The current gold standard method. It compares the amino acid profile of a protein to human requirements and corrects for its digestibility. A score of 1.0 is the highest.

Protein Complementarity: Combining plant proteins with different limiting amino acids (e.g., eating rice [low in Lys, high in Met] with beans [high in Lys, low in Met]) creates a complete protein profile, increasing the overall BV of the meal.

III. Protein-Energy Malnutrition (PEM) Disorders

PEM results from inadequate intake of protein and/or calories, most commonly affecting children in developing countries.

<p>Kwashiorkor</p> <ul style="list-style-type: none"> • Symptoms: Swelling, stunted growth, fatigue. • Prevention: Balanced diet, fortified cereals. 	<p>Marasmus</p> <ul style="list-style-type: none"> • Symptoms: Weight loss, muscle wasting. • Prevention: Protein-rich food, breastfeeding.
<p>Growth Retardation</p> <ul style="list-style-type: none"> • Symptoms: Delayed growth, low height/weight. • Prevention: Add tofu, quinoa, fish. 	<p>Weakened Immunity</p> <ul style="list-style-type: none"> • Symptoms: Frequent illnesses, slow healing. • Prevention: Natural protein, Protein Powder for Kids.
<p>Fatty Liver</p> <ul style="list-style-type: none"> • Symptoms: Enlarged liver, fatigue. • Prevention: Balanced protein, avoid processed foods. 	

Vitamins: Chemistry & Physiological Role

Vitamins are organic micronutrients required in small amounts for essential metabolic reactions. They are classified as water-soluble or fat-soluble.

A. Fat-Soluble Vitamins (A, D, E, K)

Stored in the liver and adipose tissue. Risk of hypervitaminosis (toxicity).

B. Water-Soluble Vitamins (B-Complex & C)

Not stored significantly; excess is excreted in urine.

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Chemical Name or Common Name	Source or Synthesis	Basic Ring	Daily Requirement	Biological Role	Deficiency Cause	Toxicity
Vitamin A	Carrot, mangoes, papaya, green leafy vegetable, and fish liver oil	β -ionone ring (p-ionone derivatives with retinol activity)	RDA for adults is 1000 RE for males and 800 RE for females [7]	Regulates the protein synthesis and thus shows involvement in the processes like cell growth and differentiation. It is essential for maintaining healthy epithelial tissue. Carotenoids (especially β -carotene) functions as antioxidants and reduces the risk of cancers induced by free radicals and strong oxidant. Cholesterol synthesis requires vitamin A.	Night blindness, xerophthalmia, keratomalacia and keratinisation of epithelium	Dry, headache, itchy skin, nausea, loss of appetite, dizziness, blurred vision and slowed growth. Its toxicity also can cause severe birth defects and may elevate the risk for hip fractures.
Vitamin D (pro-hormone); 1,25-dihydroxy cholecalciferol	Synthesize from 7-dehydro cholesterol in the malpighian layer of epidermis, by the action of ultra violet rays	Steroid	5-10 μ g	Raises the absorption of calcium from intestine, and it also enhances the mineralization of bone	Rickets in children and osteomalacia in adults.	High doses may lead to accumulations in the liver and develop signs of poisoning, poor mental and physical growth, reduced appetite, nausea and vomiting.
Vitamin E; Alpha tocopherol	Vegetable oils are rich sources of Vitamin E, e.g. wheat germ oil, sunflower oil, safflower oil, cotton seed oil, and palm oil	6-hydroxy chromane (tocol) ring	5 mg (7.5 IU) / day and an additional 0.6 mg for each gram of polyunsaturated fatty acid consumed may be sufficient	It functions as a membrane antioxidant. It is closely associated with reproductive functions and prevents sterility. It increases the synthesis of heme protein by enhancing the activity of enzymes 6-aminolevulinic acid (ALA) synthase and ALA dehydratase.	Sterility, degenerative changes, alterations in central nervous system	No significant toxicity
Vitamin K; K1: phyloquinone and K2: menaquinones (Menadione is synthetic water soluble Vitamin K)	Bacteria in the gastrointestinal tract naturally make vitamin K. Green leafy vegetables: collards, green leaf lettuce, kale, mustard greens, parsley, romaine lettuce, spinach, Swiss chard and turnip greens as well as vegetables such as broccoli, Brussels sprouts, cauliflower and cabbage [18].	Naphthoquinone	30 μ g/ day	Synthesis of clotting factors by acting as co-enzyme for carboxylation of glutamic acid	The blood clotting time is increased	Breakdown of red blood cells and liver damage

Vitamin	Biologically active form	Reaction	Biological function	Associated deficiency diseases
Thiamin (B ₁)	Thiamin pyrophosphate	Decarboxylation and group-transfer reactions in central carbon metabolism	Essential for several enzymes in central carbon metabolism, such as pyruvate dehydrogenase, transketolase, pyruvate decarboxylase and α -ketoglutarate dehydrogenase.	Beri-beri
Riboflavin (B ₂)	Flavin mononucleotide (FMN) Flavin adenine dinucleotide (FAD)	One-electron redox reactions	Used ubiquitously throughout the cell.	Ariboflavinosis
Niacin (B ₃)	Nicotinamide adenine dinucleotide (phosphate) [NAD(P) ⁺]	Two-electron redox reactions	Used ubiquitously throughout the cell.	Pellagra
Pantothenic acid (B ₅)	4'phosphopantetheine moiety in coenzyme A and acyl carrier protein	Acyl carrier	Cofactor for enzymes in lipid biosynthesis and catabolism, such as fatty acid synthase and pyruvate decarboxylase, and in secondary metabolite biosynthesis, e.g. lignin biosynthesis.	No known disease
Pyridoxine (B ₆)	Pyridoxal phosphate (PLP)	Decarboxylation and transamination reactions	Used ubiquitously in amino acid transformations in enzymes such as aspartate transaminase. Also used in many secondary metabolite pathways (e.g. the biosynthesis of alkaloids).	Risk factor in cardiovascular disease
Biotin (B ₇), also known as vitamin H	Biotin	Carboxylation reactions	Cofactor for a small number of enzymes, including acetyl CoA carboxylase, propionyl CoA carboxylase and pyruvate carboxylase.	Basal ganglia disease
Folic acid (B ₉)	Di- and tetra-hydrofolate polyglutamates	C ₁ group transfer	Required for several biosynthetic enzymes including methionine synthase, thymidine synthase and ketopantoate hydroxymethyltransferase.	Pernicious anaemia
Cobalamin (B ₁₂)	Adenosylcobalamin Methylcobalamin	Radical and methyl transfer reactions	Cobalamin is not present in land plants, but in algae it is required for cobalamin-dependent methionine synthase, methylmalonyl CoA mutase and type II ribonucleotide reductase.	Pernicious anaemia
Ascorbate (C)	Ascorbate	Antioxidant in ascorbate-glutathione cycle Peroxidase and oxidative enzymes	Essential antioxidant. Also a cofactor of violaxanthin de-epoxidase, prolylhydroxylase, 1-aminocyclopropane-1-carboxylate oxidase, and 9- <i>cis</i> -epoxycarotenoid dioxygenase. Substrate and cofactor of ascorbate oxidase and ascorbate peroxidases, respectively.	Scurvy



Minerals: Physiological Role

Minerals are inorganic elements essential for structural and regulatory functions.

Mineral	Some Important Functions	Food Sources
Boron Unknown	Important in bone retention.	Fruits, leafy vegetables, nuts, legumes, beans.
Calcium 1,000 - 1,300 mg.	Essential for growth and structural integrity of bones and teeth; nerve conduction; muscle contraction and relaxation.	Yogurt, milk, cheese, tofu, fortified juices, green leafy vegetables.
Chromium¹ 50 - 200 µg.	Participates in CHO and fat metabolism; muscle function; increases effectiveness of insulin.	Whole grains, cheese, yeast.
Copper¹ 1.5 - 3 mg.	Essential for red blood cell production, pigmentation, and bone health.	Nuts, liver, lobster, cereals, legumes, dried fruit.
Iron² 10 -15 mg.	Essential for the production of hemoglobin in red blood cells and myoglobin in skeletal muscle, and enzymes that participate in metabolism.	Liver, clams, oatmeal, farina, fortified cereals, soybeans, apricot, green leafy vegetables.
Magnesium 280 - 350 mg.	Essential for nerve impulse conduction; muscle contraction and relaxation; enzyme activation.	Whole grains, artichoke, beans, green leafy vegetables, fish, nuts, fruit.
Manganese¹ 2 - 5 mg.	Essential for formation and integrity of connective tissue and bone, sex hormone production, and cell function.	Nuts, legumes, whole grains.
Phosphorous 800 - 1,200 mg.	Essential for metabolism and bone development. Involved in most biochemical reactions in the body.	Fish, milk, meats, poultry, legumes, nuts.
Potassium³ 2,000 mg.	Essential for nerve impulse conduction, fluid balance, and for normal heart function.	Squash, potatoes, beans, fresh fruits (bananas, oranges) and vegetables (tomatoes).
Selenium 55 - 70 µg.	Antioxidant, works with vitamin E to reduce oxidation damage to tissues.	Meats, seafood, cereals.
Sodium⁴ 500 - 2,400 mg.	Essential for nerve impulse conduction, muscle contraction, fluid balance, and acid-	Table salt, canned and processed foods.

About us

BioResire (NEET | CSIR NET | Biotech Internships) is a life sciences research and training organization dedicated to bridging the gap between academic learning and industry skills. We provide internships, projects, and programs in Bioinformatics, Biotechnology, Molecular Biology, Cancer Research, Neuroscience, and related fields, helping students build job-oriented scientific careers.

"The future belongs to those who explore the unseen — where biology meets innovation and discovery begins."