**PGD004: Post Graduate Diploma in Nutrition**

**Course Assignment Module 1**

**By ADEDE ROSE**

**Qn 1: Giving two examples for each, define the following terms:**

a) **Food**

According to Carlos A. Monteiro (2012) food is any substance intended to be, or reasonably expected to be, ingested by humans, which provides nutrients needed to maintain life. It includes solids, semi-solids and liquids. In addition, food is an essential part of everyone’s lives. It gives us the energy and nutrients to grow and develop, be healthy and active, to move, work, play, think and learn.

According to FAO (2012) and the Codex Alimentarius (11th edition) defines food as “any substance, whether processed, semi-processed, or raw, which is intended for human consumption, and includes drink, chewing gum and any substance which has been used in the manufacture, preparation or treatment of "food" but does not include cosmetics or tobacco or substances used only as drugs.

The overall goal of eating food is to grow, glow and go and all food eaten should contain nutrients such as protein, carbohydrate, fat, vitamins and minerals. Protein (grow food) is needed to maintain and repair muscle, blood, skin and bones and other tissue and organs in the body. Carbohydrates (go food) provide body with its main source of energy weather starch or sugars. Fat provides more energy/calories per gram than any other nutrient, Vitamins and minerals (glow food) are needed in very small amounts and are sometimes called micronutrients, but are essential for good health.

**a. Nutrients**

According to M. Zimmerman and B. Snow (2012), Nutrients are substances required by the body to perform its basic functions. Nutrients must be obtained from diet, since the human body does not synthesize them. Nutrients are used to produce energy, detect and respond to environmental surroundings, move, excrete wastes and respire**.**

Prof. Navpreet from GMCH Chandigarhrom explains that nutrients are Organic and inorganic complexes contained in food. Alternatively, Nutrients are molecules in food that all organisms need to make energy, grow, develop, and reproduce. Nutrients are digested and then broken down into basic parts to be used by the organism; some nutrients are water soluble, meaning that they dissolve in aqueous solutions. Other nutrients are fat soluble, meaning that they dissolve in fatty tissues and oils

Astley, Sian & Finglas, Paul (2016) explains the classification of Nutrients into macronutrients (Proteins, Fats, and carbohydrates) and micronutrients: (Vitamins, minerals). Macronutrients are needed in larger quantities (in gram range). They normally include water, carbohydrates, fat and protein. Macronutrients (except water) are also called energy-providing nutrients. Energy is measured in calories and is essential for the body to grow, repair and develop new tissues, conduct nerve impulses and regulate life process.

However, Micronutrients include minerals and vitamins. Unlike macronutrients, these are required in very minute amounts. Together, they are extremely important for the normal functioning of the body. Their main function is to enable the many chemical reactions to occur in the body. Micronutrients do not function for the provision of energy (fao.org/elearning/Course)

C**. Nutrition**

M. Zimmerman and B. Snow (2012) define nutrition as the sum of all processes involved in how organisms obtain nutrients, metabolize them, and use them to support all of life’s processes. The Authors as well delved in to the history of nutrition, stating that, the word comes from the Latin word nutrire, meaning, “to nourish.” And the word first appeared in 1551.

According to WHO (2000 progress report), Nutrition is the intake of food, considered in relation to the body’s dietary needs. In addition, Nutrition is a fundamental pillar of human life, health and development across the entire life span. From the earliest stages of fetal development, at birth, through infancy, childhood, adolescence, and into adulthood and old age, proper food and good nutrition are essential for survival, physical growth, mental development, performance and productivity, health and well-being. It is an essential foundation of human and national development.

Nutrition is a vital component to overall wellness and health. Diet affects energy, wellbeing and many disease states. There is a connection between lifetime nutritional habits and the risks of many chronic diseases such as cardio vascular diseases, diabetes, and cancer. A well-balanced diet can prevent such conditions and improve energy levels and overall health and wellness. The basis of nutrition is eating digestion absorption transportation and utilization (http://www.fao.org/3/i3261e/i3261e05.pdf)

2. **Distinguish between dispensable and indispensable nutrients**

Borman et al (1946) put it that indispensable” and “dispensable” originally defined not only in dietary terms but also in relation to the role of amino acids in supporting protein deposition and growth. He further argues that indispensable amino acids are of the 20 amino acids used to build body proteins, and cannot be synthesized by the body and must be supplied in food .This include histidine, isoleucine, leucine, lysine, methionine, phenyl line, threonine, and tryptophan.

Peter J. Reeds (2018) defines dispensable Amino Acid as those that can be synthesized by the animal organism out of materials ordinarily available to the cells at a speed commensurate with the demands for normal growth. It is important because a number of nutritionally essential amino acids, e.g., the branched-chain amino acids, phenylalanine and methionine, can be synthesized by transamination of their analogous α-keto acids.

However, these keto acids are not normally part of the diet and hence are not “ordinarily available to the cells.” The phrase “at a speed” is important because there are circumstances in which the rate of synthesis of an amino acid can be constrained, e.g., by the availability of appropriate quantities of metabolic nitrogen. Indeed, the rate of synthesis becomes of specific importance when we consider a group of amino acids, exemplified by arginine, cysteine, proline and perhaps glycine that are frequently described as conditionally essential ( Journal of Nutrition- oxford - Volume 130, Issue 7, July 2000)

3. **Suggest a reason why protein deficiency/inadequacy would interfere with the process of digestion.**

Protein is an English word that originated from the Greek word “proteios”, meaning prime or primary. It is an important component, because protein is the most fundamental component of tissues in animals and humans (P. J. Reeds, D. G. Burrin 2000). Additionally, Protein is a macronutrient that is basic for the development, upkeep and repair of all body's cells. Body cannot make develop without this supplement. Neglecting to devour enough protein can have various negative symptoms and eventually prompts demise. (Khan, Alamgir & Khan, Salahuddin. (2017)

According to Rosendaal (1999), Khan, Alamgir & Khan, Salahuddin. (2017) protein deficiency is a disorder of blood coagulating. The individual with the protein deficiency are at high risk of developing abnormal blood coagulation. The person with moderate protein deficiency is at risk of deep veins of extremities

Proteins like Gluten are dangerous to people with celiac disease. Glutens a protein found in wheat, rye and barley. When gluten is eaten, the immune e system reacts by damaging the lining of the small intestines. Because of this damage, nutrients cannot be observed properly. Some people with celiac disease have no symptoms. Others may have diarrhea, constipation, fatigue, or abdominal pain and bloating. If it is not treated, the disease can increase the risk of serious health problems, including osteoporosis, anemia, and cancer

Additionally, some of the disease caused by protein deficiency is; Kwashiorkor, which is characterized by an extended liver, a swollen midriff, pedal oedema (swollen feet), skin depigmentation, skin aggravation, diminishing hair and tooth misfortune. Marasmus, which is a kind of protein inadequacy that can prompt weakness, muscle squandering, and lessened muscle versus fat levels, decreased vitality levels and weight reduction. Thirdly is impaired mental health, which is a Long-term protein inadequacy that can influence psychological well-being in various ways. Oedema not getting enough protein can prompt oedema (liquid maintenance). This can cause swelling in various zones of the body, for example, the feet, hands and stomach. Lastly is Organ failure Protein is required for the growth and maintenance of various body function. Deficiency of protein can cause the improper function of different body organs. Wasting and shrinkage of muscle tissues when you don't get enough protein in your eating regimen the body begins to source it from somewhere else.

In conclusion, one of the byproducts of protein metabolism is ammonia. In high levels, ammonia is extremely dangerous to the body and so is converted into urea. This water-soluble chemical is collected by the kidneys and eliminated from the body in our urine. The more protein we eat each day, in excess of our needs, the more work our kidneys must do to get rid of the ammonia. Weight trainers and bodybuilders believe that high-protein diets lead to increased muscle mass. High protein diets promote intakes of protein of between 200 and 400 g per day, which equates to approximately 5 g/kg each day (more than five times the RDI).

4. **Giving specific examples, explain what you understand by the term enzyme specificity**

Enzymes are specialized proteins that catalyze or speed up chemical reactions within cells, the substance upon which an enzyme acts is the substrate (small molecules).Most enzymes are proteins with unique three-dimensional configurations based on their amino acid sequence. Hence, the specificity of an enzyme can be attributed to the compatibility between the shape of the enzyme’s active site and the shape of the substrate. In addition, Enzymes are specific in their action and their specificity lies in the fact that they may act on one specific type of substrate molecule on group of structurally related compounds on only one of the two optical isomers of a compound or on only one of the two geometrical isomers. (Dr. Bhushan R. Kavimandan)

According to The 3D molecular designs, (2013) Enzyme specificity refers to the tendency for enzymes to catalyze a specific set of chemical reactions. On the other hand, Enzyme Specificity is the ability of enzymes to bind with specific substrate or catalyze a specific set of chemical reactions.

One of the properties of enzymes that makes them as important as diagnostic and research tools is the specificity they exhibit relative to the reactions they catalyze. A few enzymes exhibit absolute specificity; that is, they will catalyze only one particular reaction. Other enzymes will be specific for a particular type of chemical bond or functional group. However, it is important to understand the five distinct types of specificity; Absolute specificity(high or substrate) are enzymes, which act only on one substrate, The group specificity (Moderate or structural), which is the enzyme that acts only on molecules that have specific functional groups, such as amino, phosphate and methyl groups. The third type is relative (low or bond) specificity, which is the type of enzyme that act on a particular type of chemical bond regardless of the rest of the molecular structure. Lastly is Stereo (Optical) chemical specificity, that is and enzyme that acts on a particular steric or optical isomer.

Prof. Subhash Chanda and Dr Bhushan R. Kavimandan describes absolute specificity as enzyme that can only recognize one substrate, meaning it will catalyze only one reaction. Absolute specificity are enzymes, which act only on one substrate. For instance, urease acts only on urea to produce ammonia and maltase only acts on maltose, sucrose only acts on sucrose. Enzyme specific to one substrate and one reaction products are two alpha D glucose or one alpha and one beta D glucose due to mutarotation.

The bond Specificity are enzymes the act on substrate that are similar in structure and have same type of bond. i.e. Alpha-amylase can cleave glyosidic bond (alpha 1-4) of starch and glycogen additionally, Lipases can hydrolyze the ester bonds in tri-acyl-glycerol

Group Specificity are Enzyme, which is not only specific to structure but also specific to surrounding chemical groups. E.g. Pepsin hydrolyze peptide bonds where amino groups are from aromatic amino acids-phenylalanine, tyrosine, tryptophan. They catalyze same type of reaction for similar substrates and their action is group specific. e.g.; methyl group, phosphate group. Hexokinases transfer phosphates to hexoses

Optical specificity, this are enzyme is not only specific to substrate but also specific to optical configuration. Additionally, some of the enzymes only react with one of the two optical isomers e.g. arginase acts only on L-arginine and not on its D-isomer (D-arginine), starch can be digested with alpha glycosidase but the same enzyme cannot digest cellulose. As the sugars in cellulose are in beta orientation to the cellulose digestion needs beta glycosidase. Specificity is very high. For example: L-Amino Acid Oxidase only acts on L-Amino Acid. (Dr Bhushan R. Kavimandan)

Dual Specificity, this enzymes act on two substrate by same type of reaction Hypoxanthine Xanthine Uric acid, Xanthine oxidase Xanthine oxidase. Enzyme acts on substrate with two reaction types. On the other hand, the enzyme is iso-citrate dehydrogenase Oxidation Decarboxylation Removal of Hydrogen is oxidation

In conclusion, enzymes are often very specific in the type of reaction they catalyze, and even the particular substance that will be involved in the reaction. –Strong acids catalyze the hydrolysis of any amide or ester, and the dehydration of any alcohol. The enzyme urease catalyzes the hydrolysis of a single amide, urea, an enzyme with absolute specificity catalyzes the reaction of one and only one substance. An enzyme with relative specificity catalyzes the reaction of structurally related substances (lipases hydrolyze lipids, proteases split up proteins, and phosphatases hydrolyze phosphate esters). An enzyme with stereo chemical specificity catalyzes the reaction of only one of two possible enantiomers (D-amino acid oxidase catalyzes the reaction of D-amino acids, but not L-amino acids). More Importantly, Enzyme Specificity depends on active site orientation based on its atomic configuration Bond breaking and forming reacting groups are in the active site of the enzyme.

5. **Explain what you understand by the term anti nutrients.**

According to A. Sian & F. Paul (2016) Anti nutrients are natural or synthetic compounds that interfere with the absorption of nutrients. Examples include the following Protease inhibitors, Lipase inhibitors, which inhibit trypsin, pepsin, and other proteases in the gut, preventing digestion and absorption of proteins and amino acid. Phytic acid in the hulls of nuts, seeds, and grains, which has a strong binding affinity for calcium, magnesium, iron, copper, and zinc, preventing their absorption, Oxalic acid and oxalates, which are present in many plants, particularly members of the spinach family, bind calcium to prevent its absorption

Many societies in the world use cereals and Legumes as their daily diet. They have adopted various traditional methods of preparing food to reduce Anti nutrients and toxins e.g., fermentation reduce anti- nutrients, such as Phyticacid; meanwhile increase the nutritional quality of plant foods, (Reddy and Pier-son, 1994). For example, cassava is fermented to reduce levels of both toxins and anti-nutrients

Additionally, Anti nutrients are substances that nourish plants and animals to grow and live, anti-nutrients earn their title because they can block the absorption of nutrients. Whereas Anti-nutrients are naturally found in animals and many plant-based foods. In plants, they are compounds designed to protect from bacterial infections and being eaten by insects.

b. **Explain three functions of bile in the digestion of lipi**ds.

According to JL.Boyer (2013) Bile is a unique and vital aqueous secretion of the liver that is formed by the hepatocyte and modified downstream by absorptive and secretory properties of the bile duct epithelium. Approximately 5% of bile consists of organic and inorganic solutes of considerable complexity. The bile-secretory unit consists of a canalicular network, which is formed by the apical membrane of adjacent hepatocytes and sealed by tight junctions.

Bile formation is a unique function of the liver, which is vital to survival of the organism. Knowledge of the mechanism of bile formation has progressed rapidly in recent years and has provided the basis for further diagnosis and treatment of cholestatic disorders.

A. Lanzini, in Encyclopedia of Food Sciences and Nutrition (Second Edition), 2003 Further defines bile as a complex aqueous secretion that originates from hepatocytes and is modified distally by absorptive and secretory transport systems in the bile duct epithelium. Bile then enters the gallbladder where it is concentrated or is delivered directly to the intestinal lumen. Bile consists of ~95% water in which are dissolved a number of endogenous solid constituents including bile salts, bilirubin phospholipid, cholesterol, amino acids, steroids, enzymes, porphyrins, vitamins, and heavy metals, as well as exogenous drugs, xenobiotics and environmental toxin. The following are the different functions of bile in the digestion of lipids.

According Dr. Martin C. Carey (2005), bile promotes exocrine” lipid secretion especially cholesterol elimination. Bile is the major excretory route for potentially harmful exogenous lipophilic substances, noted above, as well as other endogenous substrates such as bilirubin and bile salts whose molecular weights are >300 to 500 daltons and not readily filtered or excreted by the kidney.

Secondly, Bile is important for fat absorption, bile salts have been ascribed the main role although experimental results are accumulating, regarding the role of bile phospholipids in the specific uptake of sterols by the intestine. In addition, Bile salts are the major organic solutes in bile and normally function to emulsify dietary fats and facilitate their intestinal absorption; additionally it facilitates dietary lipid absorption, obligatory for fat-soluble vitamin absorption. The effect of an impaired bile flow to the intestine has been known to result in steatorrhea (fat malabsorption) and defective absorption of fat-soluble vitamins, notably vitamin K. Thus, it bile is important for fat assimilation from the intestine

Thirdly, Bile is the major route for elimination of cholesterol it also protects the organism from enteric infections by excreting immune globulin. Bile is an essential component of the cholehepatic and enterohepatic circulation it also help in the distribution of immunoglobins and antioxidants throughout the gut.

Finally, bile is important inflammatory cytokines, and stimulating the innate immune system in the intestine. Many hormones and pheromones are excreted in bile, and contribute to growth and development of the intestine in some species and provide attractants for the weaning of non-human vertebrates.

c. **Explain how proteins differ structurally from carbohydrates and lipids.**

Structurally, protein has its own unique sequence and shape held together by chemical interactions. If the protein is subject to changes in temperature, pH, or exposure to chemicals, the protein structure may change, losing its shape in what is known as denaturation However carbohydrates are able to serve the very different functions of energy storage (starch and glycogen) and structural support and protection (cellulose and chitin)

The major differences between carbohydrates and proteins include their structure and function inside the cell. Carbohydrates are made of the elements carbon, hydrogen and oxygen. They are used for quick energy inside cells, where glucose is converted to ATP during cellular respiration. They are also used to help adhere cells to the extracellular environment, and to act as a name tag, identifying the cells as self to the immune system.

Proteins are made of the elements carbon, hydrogen, oxygen, nitrogen and sulfur. They are used for structure and support in the body. For example, keratin is a protein that makes up our hair and nails and collagen is an important protein in building the structure of our skin. Proteins also have important jobs as enzymes inside the cell. Enzymes are protein catalysts that speed up chemical reactions. They are needed to carry out all processes inside cells, such as synthesizing DNA, making energy, and creating new structures. (Kevin A. Boudreaux- Fundamentals of Organic Chemistry Organic and Biochemistry)

Proteins include a diversity of structures, resulting in a wide range of functions nearly every dynamic function of a living being depends on proteins. In fact, the importance of proteins is underscored by their name, which comes from the Greek word proteios, meaning “first,” or “primary.” Proteins account for more than 50% of the dry mass of most cells, and they are instrumental in almost everything organisms do. Some proteins speed up chemical reactions, while others play a role in defense, storage, transport, cellular communication, movement, or structural support.

Structurally Proteins like Keratin supports the hair, horns, feathers, and other skin appendages. Insects and spiders use silk fibers to make their cocoons and webs, respectively. Collagen and elastin proteins provide a fibrous framework in animal connective tissues. However, Carbohydrates serve as fuel and building material, Carbohydrates include sugars and polymers of sugars. The simplest carbohydrates are the monosaccharides, or simple sugars; these are the monomers from which carbohydrates that are more complex are built. Disaccharides are double sugars, consisting of two monosaccharides joined by a covalent bond. Carbohydrate macromolecules are polymers called polysaccharides, composed of many sugar building blocks.)

According to Anthony Carpi (2003) Lipids are a diverse group of hydrophobic molecules Lipids is the one class of large biological molecules that does not include true polymers, and they are generally not big enough to be considered macromolecules. The compounds called lipids are grouped with each other because they share one important trait: They mix poorly, if at all, with water. The hydrophobic behavior of lipids is based on their molecular structure. Although they may have some polar bonds associated with oxygen, lipids consist mostly of hydrocarbon regions. Lipids are varied in form and function. They include waxes and certain pigments, but we will focus on the types of lipids that are most important biologically: fats, phospholipids, and steroids.

However, carbohydrates and proteins are both biological macromolecules. These large molecules make up all living things. Although they are both key components of cells, there are several important differences between these two categories of macromolecules.

In conclusion, Life would not be possible without enzymes, most of which are proteins. Enzymatic proteins regulate metabolism by acting as catalysts, chemical agents that selectively speed up chemical reactions without being consumed in the reaction. Because an enzyme can perform its function repeatedly, these molecules can be thought of as workhorses that keep cells running by carrying out the processes of life. A human has tens of thousands of different proteins, each with a specific structure and function; proteins, in fact, are the most structurally sophisticated molecules known. Consistent with their diverse functions, they vary extensively in structure, each type of protein having a unique three-dimensional shape.

**Bibliography**

1. Carlos A. Monteiro (2012) *a new food classification based on the extent and purpose of industrial food* processing-Paper presented at the eighth International Conference on Diet and Activity Methods FAO, Rome 14-17 May 2012.

2.Food.” (Codex Alimentarius Commission, Procedural Manual, 11th edition)

3. Dr. NAVPREET -*Nutrition and Health-* Department of Community Medicine GMCH Chandigarh

4. Astley, Sian & Finglas, Paul. (2016). *Nutrition and Health*- Institute of Food Research, Norwich, UK

5. Khan, Alamgir & Khan, Salahuddin. (2017)*Health complication caused by protein deficiency*-Gomal University Pakistan.

6. Rosendaal FR. (1999) *venous thrombosis*: A multicausal disease- The Lancet.

7. 3D Molecular Design (2011) *Substrate Specificity field test-*National Academies PressWashington, D.C.

8.N.R.Reddy and M.D.Pierson (1994)*Reduction in ant nutritional and toxic components in plant foods by fermentation*-USA.

9.Dr. Martin C. Carey (2005)*Functions of Bill-Harvard*-MIT Division of Health Sciences and Technology –USA.

10.Anthony Carpi (2003) The Structure of Protein, carbohydrates and Fats–US department of Agriculture.

11. Peter. J D Reeds (2018), *Criteria and Significance of Dietary Protein Sources in Humans-*

*12. Journal of Nutrition- oxford - Volume 130, Issue 7, July 2000*

*13:* Boyer JL (2013) *Bile formation and secretion. American Psychological School.*