AFRICAN INSTITUTE FOR PROJECT MANAGEMENT STUDIES

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COURSE : HUMAN NUTRITION

ASSIGNMENT FINAL EXAM

**Question 1**

Imagine you have identified people in your community who are suffering from vitamin A deficiency, iodine deficiency disorder and iron deficiency anemia. what can you do to address these problems?

The Plan of Action for Nutrition is to undertake the following strategies to control and prevent specific micronutrient deficiencies:

Formulate and implement programs to correct micronutrient deficiencies and prevent their occurrence, promoting the dissemination of nutrition information and giving priority to breastfeeding, and other sustainable food-based approaches that encourage dietary diversification through the production and consumption of micronutrient-rich foods, including appropriate traditional foods. Processing and preservation techniques allowing the conservation of

micronutrients should be promoted at the community and other levels, particularly when micronutrient-rich foods are available only on a seasonal basis.

Ensure that sustainable food-based strategies are given first priority, particularly for populations deficient in vitamin A and iron, favoring locally available foods and taking into account local food habits. Supplementation of intakes with vitamin A, iodine and iron may be required on a short-term basis to reinforce dietary approaches in severely deficient populations, utilizing primary health care services when possible. Supplementation should be directed at the appropriate vulnerable groups, especially women of reproductive age (iodine and iron), infants and young children, the elderly and refugees and displaced persons. Supplementation should be progressively phased out as soon as micronutrient-rich food-based strategies enable adequate consumption of micronutrients.

**Question 2.**

What is the impact of malnutrition on communities? How can you help prevent some of the negative effects of malnutrition?

Malnutrition can be a consequence of energy deficit (protein-energy malnutrition - PEM) or a micronutrient deficiency. In any case, it is still a major burden in developing countries and is considered the most relevant risk factor for illness and death, affecting particularly hundreds of millions of pregnant women and young children.

Vitamin A deficiency reduces immunity and increases the incidence and gravity of infectious diseases resulting in increased school absenteeism. Child malnutrition impacts on economic productivity. The mental impairment caused by iodine deficiency is permanent and directly linked to productivity loss.

**To improve one's nutrition, try some of the following:**

Encourage healthier food choices.

Snacking on healthy foods is a good way to get extra nutrients and calories between meals. ...

Make food taste good again.

Consider adding supplements to your diet.

Encourage exercise.

Plan social activities.

**Question 3.**

Describe and explain the digestion and absorption of carbohydrates.

Digestion is to break down all disaccharides and complex carbohydrates into monosaccharides for absorption, although not all are completely absorbed in the small intestine for example fiber. Digestion begins in the mouth with salivary amylase released during the process of chewing.

**Digestion and Absorption of Carbohydrates**

**From the Mouth to the Stomach;**

The mechanical and chemical digestion of carbohydrates begins in the mouth. Chewing, also known as mastication, crumbles the carbohydrate foods into smaller and smaller pieces. The salivary glands in the oral cavity secrete saliva that coats the food particles. Saliva contains the enzyme, salivary amylase. This enzyme breaks the bonds between the monomeric sugar units of disaccharides, oligosaccharides, and starches. The salivary amylase breaks down amylose and amylopectin into smaller chains of glucose, called dextrin’s and maltose. The increased concentration of maltose in the mouth that results from the mechanical and chemical breakdown of starches in whole grains is what enhances their sweetness. Only about five percent of starches are broken down in the mouth. (This is a good thing as more glucose in the mouth would lead to more tooth decay.) When carbohydrates reach the stomach no further chemical breakdown occurs because the amylase enzyme does not function in the acidic conditions of the stomach. But mechanical breakdown is ongoing—the strong peristaltic contractions of the stomach mix the carbohydrates into the more uniform mixture of chyme.

**From the Stomach to the Small Intestine;**

The chyme is gradually expelled into the upper part of the small intestine. Upon entry of the chyme into the small intestine, the pancreas releases pancreatic juice through a duct. This pancreatic juice contains the enzyme, pancreatic amylase, which starts again the breakdown of dextrin’s into shorter and shorter carbohydrate chains. Additionally, enzymes are secreted by the intestinal cells that line the villi. These enzymes, known collectively as disaccharides, are sucrase, maltase, and lactase. Sucrase breaks sucrose into glucose and fructose molecules. Maltase breaks the bond between the two glucose units of maltose, and lactase breaks the bond between galactose and glucose. Once carbohydrates are chemically broken down into single sugar units they are then transported into the inside of intestinal cells.

When people do not have enough of the enzyme lactase, lactose is not sufficiently broken down resulting in a condition called lactose intolerance. The undigested lactose moves to the large intestine where bacteria are able to digest it. The bacterial digestion of lactose produces gases leading to symptoms of diarrhea, bloating, and abdominal cramps. Lactose intolerance usually occurs in adults and is associated with race. The National Digestive Diseases Information Clearing House states that African Americans, Hispanic Americans, American Indians, and Asian Americans have much higher incidences of lactose intolerance while those of northern European descent have the least.Most people with lactose intolerance can tolerate some amount of dairy products in their diet. The severity of the symptoms depends on how much lactose is consumed and the degree of lactase deficiency.

**Absorption: Going to the Blood Stream;**

The cells in the small intestine have membranes that contain many transport proteins in order to get the monosaccharides and other nutrients into the blood where they can be distributed to the rest of the body. The first organ to receive glucose, fructose, and galactose is the liver. The liver takes them up and converts galactose to glucose, breaks fructose into even smaller carbon-containing units, and either stores glucose as glycogen or exports it back to the blood. How much glucose the liver exports to the blood is under hormonal control and you will soon discover that even the glucose itself regulates its concentrations in the blood.

**Question 4.**

What is nutrition? List the main functions of nutrients.

**Nutrition** is the process by which an organism procures its nourishment, the supply of nutrients required by its body and cells to stay alive. Nutrition is of two types namely, autotrophic and heterotrophic mode of nutrition.

**Nutrients** are the substances found in food which drive biological activity, and are essential for the human body. They are categorized as proteins, fats, carbohydrates (sugars, dietary fiber), vitamins, and minerals, and perform the following vital.

There are seven major classes of nutrients: carbohydrates, fats, fiber, minerals, protein, vitamins, and water.

**Carbohydrates** - our main source of energy.

**Fats** - one source of energy and important in relation to fat soluble vitamins.

**Roughage (Fiber)** - the fibrous indigestible portion of our diet essential to health of the digestive system.

**Minerals** - those inorganic elements occurring in the body and which are critical to its normal functions.

**Proteins** - essential to growth and repair of muscle and other body tissues.

**Vitamins** - water and fat soluble vitamins play important roles in many chemical processes in the body.

**Water** - essential to normal body function - as a vehicle for carrying other nutrients and because 60% of the human body is water.

**Question 5.**

What is the importance of calcium? Name and explain the two factors that enhance and that interfere with the absorption of iron in the body.

**Calcium** also plays an important role in muscle contraction, transmitting messages through the nerves, and the release of hormones. If people aren't getting enoughcalcium in their diet, the body takes calcium from the bones to ensure normal cell function, which can lead to weakened bones.

A proper level of calcium in the body over a lifetime can help prevent osteoporosis.Calcium helps your body with: Building strong bones and teeth. Clotting blood.

**Two factors that enhance and that interfere with the absorption of iron in the body.**

Absorption enhancing factors are ascorbic acid and meat, fish and poultry; inhibiting factors are plant components in vegetables, tea and coffee (for example polyphenols, phytates), and calcium. After identifying these factors their individual impact on iron absorption is described

**Dietary and non-dietary factors affecting iron absorption**

Dietary factors contribute a significant role in the development of iron deficiency and then iron deficiency anemia. Iron absorption by the gut enterocytes controls iron balance but there is no route of controlled iron excretion. This means that iron absorption is regulated by dietary and systemic factors. Dietary iron is largely non-heme iron with about 5%–10% in the form of heme iron in diets containing meat. Even though heme iron constitutes a smaller part of dietary iron, it is highly bioavailable and 20%–30% of heme iron is absorbed. Contrary, the absorption of non-heme iron is much more variable and significantly affected by other components of the diet; with 1%–10% of non-heme iron absorbed.

Moreover, iron in the environment and the diet is primarily ferric iron (Fe3+) which is insoluble and so not bioavailable. Thus, before it can be absorbed the non-heme iron has to be reduced from ferric (Fe3+) to ferrous (Fe2+) iron by dietary reducing agents, such as ascorbic acid or by endogenous ferri-reductases, such as duodenal cytochrome B (dcytB). Ferrous iron is transported across the apical membrane of the duodenum by the divalent metal transporter 1 (DMT1), which is localized on the brush border membrane close to dcytB. As Wang & Pantopoulos, 2011 reported, the uptake of ferrous ions by dcytB is driven by proton co-transport, so an acidic duodenal pH facilitates iron uptake, and is competitively inhibited by other divalent cations.

Ascorbic acid is one of the most effective enhancer of non-heme iron absorption. Other dietary factors such as citric acid and other organic acids, alcohol and carotenes similarly enhance non-heme iron absorption. Furthermore, animal based proteins such as meat, fish, and poultry, enhance iron absorption but the bioactive component of the “meat factor” has yet to be identified. Meat also promotes non-heme iron absorption by activating gastric acid production. Conversely, absorption of non-heme iron is inhibited by phytic acid (inositol hexaphosphate and inositol pentaphosphate) in grains and cereals and by polyphenols in some vegetables, coffee, tea, and wine. These inhibitors bonded to non-heme iron so it is not available for uptake. Dietary factors influencing iron absorption are outlined in Table.

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| **Table Below:** |
| Haem iron absorption   * Amount of haem iron present in meat (high haem iron content boost iron absorption) * Content of calcium in meal (high calcium content reduce iron absorption) * Food preparation (time, temperature): may cause leaching of haem iron   Nonhaem iron absorption   * Iron status of the individuals * Amount of bioavailable nonhaem iron * Balance between dietary factors enhancing and inhibiting iron absorption   Factors enhancing iron absorption   * Ascorbic acid * Meat, fish and seafood * Certain organic acids (citric, lactic, malic, tartaric)   Factors inhibiting iron absorption   * Presence of anti-nutrients (example phytates and tannin) in cereal based food products * Iron binding phenolic compounds in tea, coffee, red wine, * some leafy vegetables, herbs, nuts and legumes * Calcium * Soy protein |

**Question 6.**

Discuss two reasons why it is essential to include carbohydrates in your diet. Why is it necessary for the body to spare protein?

The two main functions of **carbohydrates in the body** are to provide energy for all cells and spare the use of protein from the muscles and organs. **Carbs** help maintain blood glucose during exercise and restore muscle glycogen during rest and recovery from exercise.

**Protein sparing** (amino acid sparing) is the process by which the body derives energy from sources other than protein. Such sources can include fatty tissues, [dietary fats](https://en.wikipedia.org/wiki/Dietary_fats) and [carbohydrates](https://en.wikipedia.org/wiki/Carbohydrates). Protein sparing conserves muscle tissue. The balance between digestible protein (DP) and digestible energy (DE) in the diet is a key factor. Decreasing dietary DP/DE ratio results in an increase of protein conservation. The amino acids are not catabolized for energy, and are conserved in the body in a greater ratio.

The amount of protein used in the body is influenced by the percentage that is digestible by the body, and the total quantity of protein fed to the body. [Bodybuilding](https://en.wikipedia.org/wiki/Bodybuilding) and other [strength training](https://en.wikipedia.org/wiki/Strength_training) promotes the utilization and conservation of protein's amino acids in the body. Using alternate energy sources lessens the amount of amino acids that will be metabolized for energy. An increase of protein in the diet does not lead to greater protein efficiency, more protein will be lost, but a greater amount of protein will be conserved in the body through sheer volume, staying a step ahead of the metabolization of amino acids for energy.

**Question 7.**

Discuss the role of lipids in our diet and their critical functions in the body.

Lipids are synthesized in the body using complex biosynthetic pathways. However, there are some lipids that are considered essential and need to be supplemented in diet.

**Role of lipids in the body;** Lipids have several roles in the body, these include acting as chemical messengers, storage and provision of energy and so forth.

**Chemical messengers;** All multicellular organisms use chemical messengers to send information between organelles and to other cells. Since lipids are small molecules insoluble in water, they are excellent candidates for signaling. The signaling molecules further attach to the receptors on the cell surface and bring about a change that leads to an action. The signaling lipids, in their esterified form can infiltrate membranes and are transported to carry signals to other cells. These may bind to certain proteins as well and are inactive until they reach the site of action and encounter the appropriate receptor.

**Storage and provision of energy;** Storage lipids are triacylglycerol’s. These are inert and made up of three fatty acids and a glycerol. Fatty acids in non-esterified form, that is as free fatty acids are released from triacylglycerol’s during fasting to provide a source of energy and to form the structural components for cells. Dietary fatty acids of short and medium chain size are not esterified but are oxidized rapidly in tissues as a source of ‘fuel”. Longer chain fatty acids are esterified first to triacylglycerol’s or structural lipids.

**Maintenance of temperature;** Layers of subcutaneous fat under the skin also help in insulation and protection from cold. Maintenance of body temperature is mainly done by brown fat as opposed to white fat. Babies have a higher concentration of brown fat.

**Membrane lipid layer formation;** Linoleic and linoleic acids are essential fatty acids. These form arachidonic, eicosapentaenoic and docosahexaenoic acids. These for membrane lipids. Membrane lipids are made of polyunsaturated fatty acids. Polyunsaturated fatty acids are important as constituents of the phospholipids, where they appear to confer several important properties to the membranes. One of the most important properties are fluidity and flexibility of the membrane.

**Cholesterol formation;** Much of the cholesterol is located in cell membranes. It also occurs in blood in free form as plasma lipoproteins. Lipoproteins are complex aggregates of lipids and proteins that make travel of lipids in a watery or aqueous solution possible and enable their transport throughout the body. The main groups are classified as chylomicrons (CM), very low density lipoproteins (VLDL), low density lipoproteins (LDL) and high density lipoproteins (HDL), based on the relative densities. Cholesterol maintains the fluidity of membranes by interacting with their complex lipid components, specifically the phospholipids such as phosphatidylcholine and sphingomyelin. Cholesterol also is the precursor of bile acids, vitamin D and steroidal hormones.

**Prostaglandin formation and role in inflammation;** The essential fatty acids, linoleic and linoleic acids are precursors of many different types of eicosanoids, including the hydroxyeicosatetraenes, prostanoids (prostaglandins, thromboxanes and prostacyclins), leukotrienes (and lipoxins) and resolvins among others. these play an important role in pain, fever, inflammation and blood clotting.

**The "fat-soluble" vitamins;** The "fat-soluble" vitamins (A, D, E and K) are essential nutrients with numerous functions.Acyl-carnitines transport and metabolize fatty acids in and out of mitochondria.Polyprenols and their phosphorylated derivatives help on transport of molecules across membranes.Cardiolipins are a subtype of glycerophospholipids with four acyl chains and three glycerol groups. They activate enzymes involved with oxidative phosphorylation.

**Question 8.**

Explain the importance of fats to the bioavailability of other nutrients.

**Definition** of **bioavailability** is the proportion of thenutrient that is digested, absorbed and metabolized through normal pathways. A common belief regarding bioavailability of dietary supplements is that they have to be in solution to be absorbed in the body.

**The importance/role influence by food processing and preparation practices on nutrient bioavailability**

**Thermal processing;**

Destroys heat-labile vitamins such as thiamin, vitamin C, and riboflavin Releases some vitamins from poorly digested complexes Inactivates heat-labile antinutritional factors May degrade phytate, depending on temperature, but losses are modest Gelatinizes starch Reduces amount in final product Enhances bioavailability of vitamin B6, niacin, folate, certain carotenoids May enhance bioavailability of vitamin B1, iodine, biotin, among others, depending on food item Possibly small improvements in bioavailability of zinc, iron, calcium Enhances starch digestibility

**Baking;**

Induces Maillard browning in foods containing reducing sugars Destroys basic essential amino acids: lysine, arginine, methionine; reduces protein quality and protein digestibility (specific to baking)

**Boiling;**

Reduces oxalate content Some leaching of water-soluble components Enhances calcium and possibly iron bioavailability Some loss of water-soluble vitamins and inorganic nutrients (specific to boiling)

**Extrusion;**

May degrade phytic acid, causing modest losses Induces starch gelatinization Induces Maillard browning Possibly small improvements in bioavailability of zinc, iron, calcium Enhances starch digestibility Destroys basic essential amino acids; reduces protein quality (specific to extrusion).

**Milling or home pounding;**

Reduces phytate content of those cereals with phytate localized in outer aleurone layer: (rice, wheat, sorghum) or in germ (maize) Reduces B-vitamin content May enhance bioavailability of zinc, iron, and calcium, although mineral content simultaneously reduced.

**Malting, also known as germination;**

Increases phytase activity via de novo synthesis or activation of endogenous phytates Reduces polyphenol content of some legumes (Vicia faba) Increases α-amylase content of cereals: sorghum and millet Induces hydrolysis of phytate to lower inositol phosphates and hence may increase zinc, iron, and calcium bioavailability May enhance nonheme iron absorption Facilitates starch digestion; may increase nonheme iron absorption through a change in consistency

**Microbial fermentation;**

Induces hydrolysis of phytate by microbial phytate Increases content of organic acids Microbial enzymes may destroy protein inhibitors that interfere with nitrogen digestibility May enhance bioavailability of zinc, iron, calcium May form soluble ligands with iron and zinc and enhance bioavailability May improve protein quality in maize, legumes, groundnuts, pumpkin, millet seeds.

**Soaking in water and decanting;**

Passive diffusion of water-soluble sodium and potassium phytates in cereal and legume flours May activate some endogenous phytates in cereals and legumes Soaking maize with lime releases niacin from niacytin May enhance bioavailability of zinc, iron, calcium, but some loss of water-soluble vitamins Some phytate hydrolysis and thus enhanced bioavailability of zinc, iron, and calcium Enhances bioavailability of niacin.

**Question 9.**

Discuss the role of fats as an energy source for the body.

**Fats**

The foods we eat contain nutrients that provide energy and other substances the body needs. Most of the nutrients in food fall into three major groups: proteins, fats, and carbohydrates.

The body uses fat as a fuel source, and fat is the major storage form of energy in the body. Fat also has many other important functions in the body, and a moderate amount is needed in the diet for good health. Fats in food come in several forms, including saturated, monounsaturated, and polyunsaturated. Too much fat or too much of the wrong type of fat can be unhealthy.Some examples of foods that contain fats are butter, oil, nuts, meat, fish, and some dairy products.

Fats typically provide more than half of the body's energy needs. Fat from food is broken down into fatty acids, which can travel in the blood and be captured by hungry cells. Fatty acids that aren't needed right away are packaged in bundles called triglycerides and stored in fat cells, which have unlimited capacity.

**Question 10.**

Define chylomicron. Describe the role of bile salts in the digestion of triacylglycerols and phospholipids.

**Chylomicron:** A small fat globule composed of protein and lipid (fat). Chylomicrons are found in the blood and lymphatic fluid where they serve to transport fat from its port of entry in the intestine to the liver and to adipose (fat) tissue. After a fatty meal, the blood is so full of chylomicrons that it looks milky.The word "chylomicron" is made up of "chylo-", milky + "micron", small. = small milky (globules). The chylomicrons are synthesized (made) in the mucosa (the lining) of the intestine.

**Roles of bile salts Bile salts are;**

Synthesized from cholesterol in hepatocytes of the liver. The main body structure of bile salts is cholic acid which is conjugated by the liver with the amino acids taurine or glycine, thereby increasing the water solubility and decreasing the cellular toxicity of the bile salts. Bile salts have detergentlike properties, and their structure provides a large, rigid, and planar molecule consisting of a steroid nucleus (hydrophobic side) with a few hydroxyl groups and a ionic head (hydrophilic side). Although PTL has no specific requirement for bile salts, the increased surface area due to the action of bile salts seems to increase the rate of triacylglycerol hydrolysis induced by pancreatic lipase. However, most likely, the main effect of bile salts is to solubilize the products of lipase action in the bulk-water phase of the intestinal contents, thereby removing them from the site of enzyme action, that’s the oil-water interface. Otherwise, if the products of this lipolytic action remained at the enzyme site, the progressing activity of the lipolytic system would be inhibited by product inhibition of the reaction. Another role of bile salts is to inhibit the re-formation of triacylglycerol from monoacylglycerol and fatty acids, probably by solubilizing these compounds and removing them from the site of lipase action, thereby pulling the lipase reaction in the direction of continued lipolysis. These mixed micelles are necessary for effective absorption of dietary lipids, and both monoacylglycerols and phospholipids greatly enhance the ability of bile salts to form the mixed micelles present within the small intestinallumen. The mixed micelles act as carrier to transport the lipolytic products from the lumen to the absorptive site, thereby overcoming the unstirred water layer present at the surface of the intestinal microvillus membrane which is thought to be the main barrier to lipid absorption. The formation of micelles depends on the concentration of bile salts in solution, and there exists a critical minimum concentration which is necessary for a detergent to form a micellar solution. In vitro, pure solutions of bile salts appear to have a CMC of about 2 mM. However, in vivo, in the presence of endogenous monoacylglycerol and phospholipid, it may be much lower and in the range of 0.75 to 1 mM. Generally, the bile salt concentration in the gut is not constant, but changes over time and in the different parts of the small intestine. According to Northfield, McColl and Heaton, after a meal, bile salt concentration sharply increases in the duodenum up to ca. 15 mmol/L and then progressively decreases to 6 mmol/L. In the jejunum, the bile salt concentration amounts to 10 mmol/L, and in the ileum, the concentration falls below 4 mmol/L due to active absorption.

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