Diploma in Human Nutrition Final Exams

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Food and Nutrition Final Assignments

Nutrition Final Exam

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Abstract

**Vitamin A deficiency** (VAD) affects ocular tissue in two ways: by slowing the regeneration of the visual pigments following exposure to bright light and by disrupting epithelial integrity.

It causes night blindness or xerophthelimia (Blindness) and It involves drying (xerosis) and thickening of the conjunctivae and corneas. Superficial foamy patches composed of epithelial debris and secretions on the exposed bulbar conjunctiva (Bitot spots) develop. In advanced deficiency, the cornea becomes hazy and can develop erosions, which can lead to its destruction (keratomalacia).

**Malnutrition** is a condition resulting from nutrient deficiency or over consumption and includes undernutrition and over nutrition, both of which can lead to health problems and nutrient deficiencies if not addressed. Symptoms of undernutrition include weight loss, fatigue, irritability and micronutrient deficiencies while overnutrition can result in overweight and a lower intake of certain vitamins and minerals

**Carbohydrates in the diet** provide the major exogenous source for glucose, which is the primary energy source for cells. They account for 40-60% of the calories in the western diet and higher percentages in protein scarce diets. Each gram of carbohydrate provides 4 calories. Carbohydrates are hydrophilic and require a series of reactions to digest them to monosaccharides which are absorbed in the small intestine.

**Nutrition** is the science of food, the nutrients, and other substances therein, their action, interaction, and balance in relation to health and disease and the processes by which the organism ingests, digests, absorbs, transports, utilizes, and excretes food substances.

**Calcium** is a nutrient categorized among the minerals and its function in the human body is to give bones and teeth rigidity and strength.

**Carbohydrates**are referred to as energy-giving foods. They provide energy in the form of calories that the body needs to be able to work, and to support other functions in the body.

**Lipids** are important fats that serve different roles in the human body. A common misconception is that fat is simply fattening. However, fat is probably the reason we are all here. Throughout history, there have been many instances when food was scarce. Our ability to store excess caloric energy as fat for future usage allowed us to continue as a species during these times of famine.

The rate of nutrient absorption is called **“bioavailability,”** it refers to the proportion of a nutrient that is absorbed from the diet and used for normal body functions and it’s a measure of how much of each mineral our body is able to process.

**Fat** is the body's most concentrated source of energy, providing more than twice as much potential energy as carbohydrate or protein (9 calories per gram versus 4 calories each per gram). During exercise, stored fat in the body (in the form of triglycerides in adipose or fat tissue) is broken down into fatty acids. These fatty acids are transported through the blood to muscles for fuel.

**Chylomicron** is a small globule composed of protein and lipid. Before triglycerides leave the epithelial cells, they're coated by proteins, which results in the formation of chylomicrons.

Keywords

Community, Vitamin A, Iodine, Disorder, Iron, Anaemia, Deficiency, Malnutrition, Digestion, Absorption, Carbohydrates, Nutrition, Nutrients, Calcium, Iron, Body, Diet, Protein, Lipids, Fats, Bioavailability, Energy, Chylomicron, Bile salts, Triacylglycerols and Phospholipids

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1. **Introduction**

This final exam;

1. Addresses the problems of people who have been identiﬁed in a community who are suffering from vitamin A deﬁciency, iodine deﬁciency disorder and iron deﬁciency anaemia.
2. Examines the impact of malnutrition on communities and How to help prevent some of the negative effects of malnutrition
3. Describes and explains the digestion and absorption of carbohydrates
4. Defines nutrition and lists the main functions of nutrients
5. Explains the importance of calcium, names and explains the two factors that enhance and that interfere with the absorption of iron in the body
6. Discusses two reasons why it is essential to include carbohydrates in our diet and explains why is it necessary for the body to spare protein
7. Discusses the role of lipids in our diet and their critical functions in the body
8. Explains the importance of fats to the bioavailability of other nutrients
9. Discusses the role of fats as an energy source for the body
10. Defines chylomicron and describes the role of bile salts in the digestion of triacylglycerols and phospholipids

**Qn. 1. Imagine you have identiﬁed people in your community who are suffering from vitamin A deﬁciency, iodine deﬁciency disorder and iron deﬁciency anaemia. What can you do to address these problems?**

**Addressing problems of vitamin A deficiency in a community**

Vitamin A deficiency (VAD) affects ocular tissue in two ways: by slowing the regeneration of the visual pigments following exposure to bright light and by disrupting epithelial integrity.

It causes night blindness or xerophthelimia (Blindness) and It involves drying (xerosis) and thickening of the conjunctivae and corneas. Superficial foamy patches composed of epithelial debris and secretions on the exposed bulbar conjunctiva (Bitot spots) develop. In advanced deficiency, the cornea becomes hazy and can develop erosions, which can lead to its destruction (keratomalacia). **(Bryce, J., 2008).**

The population most vulnerable to vitamin A deficiency are preschool children and pregnant women

***Prevention of vitamin A deficiency will involve the following:***

* Promoting behavior modification through dietary counseling and nutrition education.
* Treatment for subclinica**l** VAD with encouraging the consumption of vitamin A–rich foods, such as liver, beef, chicken, eggs, fortified milk, carrots, mangoes, sweet potatoes, and leafy green vegetables.
* For VAD syndromes, treatment includes distribution of daily oralsupplements, as follows: Children aged 3 years or younger - 600 mcg (2000 IU). **(Barbara. A, National Eye Institute)**

**Addressing problems of iodine deficiency disorder in a community:**

**Vulnerability iodine deficiency disorder**

* Iodine is essential component of the hormones produced by the thyroid gland.
* Thyroid hormones regulate many key biochemical reactions, especially protein synthesis and enzymatic activity.
* Major target organs are the developing brain, muscle, heart, pituitary, and kidney.

Iodine deficiency disorder is caused by lack of iodine in natural food and presents consequences including: goiter, birth defects, increased risk for abortions and stillbirths, retarded physical growth, impaired mental functioning, cretinism and hypothyroidism

The population most vulnerable to iodine deficiency in the community includes: pregnant women, people who live in countries where there is very little iodine in the soil, people who don’t use iodized salt and people who follow vegetarian or vegan diet.

***Prevention of iodine deficiency will involve the following:***

* Promoting behavior modification through dietary counseling and nutrition education.
* Salt iodization is the most cost-effective intervention to prevent iodine deficiency disorders
* By eating foods high in iodine, particularly dairy products, seafood, meat, some breads and eggs, and by taking a multivitamin containing iodine
* Iodine Supplementation. **(Bruno de Benoist, 2009).**

**Addressing problems of Iron deficiency anaemia in the community**

**Vulnerability to iron deficiency anaemia**

Iron deficiency anaemia is caused by a lack of the mineral iron which is a necessary component of the blood and is lost during each menstrual period. Much iron is needed during childbirth and pregnancy due to the child growth.

The population most vulnerable to iron deficiency anaemia in the community are children and pregnant women.

***Prevention of vitamin A deficiency will involve the following:***

* Promoting behaviour modification through dietary counselling and nutrition education.
* Educate victims to seek treatment of the cause of blood loss.
* Encourage victims to talk to the doctor if they have heavy menstrual periods or if have digestive system problems, such as frequent diarrhea or blood in stool.
* Promote eat of foods with iron. Good sources of iron include lean meat and chicken, dark, leafy vegetables, and beans.
* Promote eating and drinking foods that help our body absorb iron, like orange juice, strawberries, broccoli, or other fruits and vegetables with vitamin C.
* Educate communities to make healthy food choices. Most people who make healthy, balanced food choices get the iron and vitamins their bodies need from the foods they eat.
* Avoiding drinking coffee or tea with meals. These drinks make it harder for our body to absorb iron. **(Kaushansky K, et al, 2016)**

**Qn. 2. What is the impact of malnutrition on communities? How can you help prevent some of the negative effects of malnutrition?**

Malnutrition is a condition resulting from nutrient deficiency or over consumption and includes undernutrition and over nutrition, both of which can lead to health problems and nutrient deficiencies if not addressed. Symptoms of undernutrition include weight loss, fatigue, irritability and micronutrient deficiencies while overnutrition can result in overweight and a lower intake of certain vitamins and minerals **(Ball GD, et al. Can J Appl Physiol. 2003).**

A research conducted by **Ball GD, et al. Can J Appl Physiol. 2003** on ‘Childhood obesity in Canada: a review of prevalence estimates and risks factors for cardiovascular diseases and type 2 diabetes has linked undernutrition in childhood with a higher risk of developing high blood pressure and obesity later in life. Overnutrition may also increase your likelihood of developing chronic diseases, such as type 2diabetes and heart diseases.

The majority at risk or affected by malnutrition live in the community, the growth of our older population suggests that the burden of community malnutrition will increase.

Disease-related malnutrition has detrimental physiological, psychosocial, and clinical effects impairing quality of life, delaying recovery from illness and surgery, plus increasing morbidity and mortality. Malnutrition is costly, triggering more GP (General Practitioners) contacts than well-nourished individuals, and correlating directly with increased length of hospital stay, treatment costs, time to return to usual life, and rates of hospital readmission. Overall, malnutrition leads to socioeconomic dysfunction due to lack of productivity. **(Richmond Vale, June 2007**

Preventing and treating malnutrition involves addressing the underlying causes.

Government agencies, independent organizations and schools can play a role in preventing malnutrition**.**

Research conducted by **Bhutta ZA, et al. Lancet. 2008,** a ‘Maternal and Child Undernutrition Study Group’, 2008, suggests that some of the most effective ways to address malnutrition include: providing iron, zinc, and iodine pills, food supplements and nutrition education to populations at risk of undernutrition.

In addition, interventions that encourage healthy food choices and physical activity for children and adults at risk of overnutrition may help prevent overweight and obesity.

**Qn. 3. Describe and explain the digestion and absorption of carbohydrates**

Carbohydrates in the diet provide the major exogenous source for glucose, which is the primary energy source for cells. They account for 40-60% of the calories in the western diet and higher percentages in protein scarce diets. Each gram of carbohydrate provides 4 calories. Carbohydrates are hydrophilic and require a series of reactions to digest them to monosaccharides which are absorbed in the small intestine. Carbohydrates consist of three main groups, simple carbohydrates (monosaccharides), disaccharides and complex carbohydrates (starch, glycogen, and fiber). The common monosaccharides include glucose, fructose, galactose, xylose and ribose. The varying molecular arrangements result in varying degrees of sweetness, with fructose being the sweetest. Disaccharides are created by the condensation of two monosaccharides and require hydrolysis for separation at the time of absorption. Examples of disaccharides include - lactose (glucose and galactose), sucrose (glucose and fructose) and maltose (glucose and glucose). Complex carbohydrates include starch (amylose and amylopectin), fiber, glycogen (straight and branched chains of glucose), and glycolipids. **(Barrett K, 2013)**

**Digestion:**

The goal of carbohydrate digestion is to break down all disaccharides and complex carbohydrates into monosaccharides for absorption, although not all are completely absorbed in the small intestine (e.g., fiber). Digestion begins in the mouth with salivary amylase released during the process of chewing. There is a positive feedback loop resulting in increased oral amylase secretion in people consuming diets high in carbohydrates. The amylase is synthesized in the serous cells of the salivary glands. Amylase breaks starches into maltose and polysaccharides. Amylase is sensitive to pH and thus is inhibited in the acidic environment of the stomach. Only 5% of starch is broken down by salivary amylase due to limited exposure. Salivary amylase has increased importance in two groups; infants with decreased pancreatic amylase production in the first 9 months and children with pancreatic insufficiency from cystic fibrosis or other etiologies. Minimal carbohydrate digestion occurs in the stomach due to the inactivation of amylase in the acidic environment. Pancreatic amylase is released from acinar cells into the small intestine in concert with other enzymes under the stimulus of secretin and CCK and continues the process of carbohydrate digestion. Amylase targets the α-1,4 bonds of complex carbohydrates and is unable to break terminal bonds or α-1,6 bonds. Starch is digested in the small intestine to simple components derived from branched amylopectin (maltose, maltotriose and α-limit dextrins). Oligosaccharides and disaccharides are digested by specific enzymes in the microvillus membrane (brush border). Brush border enzymes are synthesized in the endoplasmic reticulum and glycosylated in the Golgi apparatus of the enterocyte. They are then trafficked to the apical membrane where they are anchored at the surface by a transmembrane segment. The anchored enzymes are active following cleavage of a small residue at the extracellular N-terminal end. Disaccharidases are protected from proteolysis by glycosylation and are found in higher concentration in villus enterocytes of the proximal small bowel. These enzymes include maltase (digests maltose to glucose and glucose), sucrase (digests sucrose to fructose and glucose), trehalase (digests trehalose to glucose and glucose), lactase (digests lactose to galactose and glucose) and isomaltase (de-branching enzyme digests α1,6 bonds of limit dextrin to produce glucose). Glucose does not require any additional digestion.

**Absorption:**

Once carbohydrates are digested, the products must be absorbed and transported to the portal circulation. Digestion and absorption are typically coupled, with the enzymes closely located to the appropriate transporters.

* Glucose absorption occurs in the small intestine via the SGLT-1 transporter (sodium glucose co-transporter).
* Fructose absorption is completed via the GLUT5 transporter by facilitated diffusion.
* Glucose and galactose are actively transported from the small intestine lumen by the sodium glucose transporter (SGLT-1) located in the brush border of the small intestine.

The transporter is more prevalent in the duodenum and jejunum. Glucose transport is driven by a sodium gradient across the apical cell membrane generated by the Na+, K+ -ATPase pump located in the basolateral membrane of the enterocyte. The Na+, K+ -ATPase pump creates a low intracellular sodium concentration by transporting 3 Na+ ions out of the cell and 2 K+ ions into the cell. The SGLT-1 transporter utilizes the sodium gradient. Two Na+ ions bind to the outer face of the SGLT-1 transporter which results in a conformational change permitting subsequent glucose binding. The two Na+ ions and the glucose molecule are then transferred to the cytoplasmic side of the membrane following another conformational change that involves rotation of the receptor. The glucose is released first followed by the sodium ions. The sodium is transported from high to low concentration (with concentration gradient) and at the same time allows the carrier to transport glucose against its concentration gradient. The Na+ ion is subsequently expelled by Na+, K+ -ATPase pump to maintain the gradient. The SGLT-1 transporter undergoes another conformational change resulting in the binding sites again being exposed at the apical surface. This action can occur one thousand times per second. Much of the glucose transported into the cell passes out of the cell at basolateral surface by facilitated diffusion via GLUT-2. Sodium ions and accompanying anions and water follow the glucose, maintaining iso-osmolarity. A small portion of the glucose is utilized by the cell. Facilitated diffusion is the mechanism for fructose transport. Facilitated diffusion utilizes a carrier protein to achieve transport at rates greater than simple diffusion and does not rely on concentration gradients. GLUT-5 is present on the apical membrane of the brush border throughout the small intestine with increased density in the proximal small intestine. Little fructose is metabolized in the cell. Both GLUT-2 and GLUT-5 are present at the basolateral membrane to transport fructose to the portal circulation. Fructose malabsorption can be minimized by simultaneous glucose administration suggesting there is another glucose responsive system in the enterocytes. There continues to be debate about passive glucose absorption. Recent data suggests passive glucose absorption does exist, but that it is a facilitated system mediated by glucose-dependent activation. The GLUT-2 facilitative glucose transporter can be recruited to the brush border membrane to assist with glucose transport.

**Qn. 4. What is nutrition? List the main functions of nutrients.**

Nutrition is the science of food, the nutrients, and other substances therein, their action, interaction, and balance in relation to health and disease and the processes by which the organism ingests, digests, absorbs, transports, utilizes, and excretes food substances. In addition, nutrition must be concerned with certain social, economic, cultural, and psychological implications of food and eating. **(Council on Foods and Nutrition, 1963).**

Carbohydrates, proteins, fats, vitamins, minerals, water and fibre are the main groups of nutrients which together, but in variable amounts, make up a balanced diet.

Nutrients are grouped into macronutrients and micronutrients. Carbohydrates, proteins, fats and water are macronutrients, and vitamins and minerals are micronutrients.

Main functions of nutrients include:

1. **Carbohydrates:** These are referred to as energy-giving foods. They provide energy in the form of calories that the body needs to be able to work, and to support other functions. Carbohydrates are needed in large amounts by the body. Indeed, up to 65% of our energy comes from carbohydrates. They are the body’s main source of fuel because they are easily converted into energy. This energy is usually in the form of glucose, which all tissues and cells in our bodies readily use.

For the brain, kidneys, central nervous system and muscles to function properly, they need carbohydrates. These carbohydrates are usually stored in the muscles and the liver, where they are later used for energy.

The main sources of carbohydrates are bread, wheat, potatoes of all kinds, maize, rice, cassava, ‘*shiro*’, pasta, macaroni, ‘*kocho*’, banana, sweets, sugar cane, sweet fruits, and honey. Other foods like vegetables, beans, nuts and seeds contain carbohydrates, but in lesser amounts.

1. **Proteins:** About 10–35% of calories should come from protein. Proteins are needed in our diets for growth (especially important for children, teens and pregnant women) and to improve immune functions. They also play an important role in making essential hormones and enzymes, in tissue repair, preserving lean muscle mass, and supplying energy in times when carbohydrates are not available.

Pregnant women need protein to build their bodies and that of the babies and placentas, to make extra blood and for fat storage. Breastfeeding mothers need protein to make breastmilk. The main sources of proteins are meats, chicken, eggs, breastmilk, beans, ground nuts, lentils, fish, cheese and milk.

1. **Fats and oils:** These are concentrated sources of energy and so are important nutrients for young children who need a lot of energy-rich food. Fats can also make meals tastier and satisfying. Fat is found in meat, chicken, milk products, butters, creams, avocado, cooking oils and fats, cheese, fish and ground nuts.

Fats are classified into saturated and unsaturated fats. The classification is important to enable you to advise your community about which fats can be consumed with less risk to people’s health. Saturated fats are not good for a person’s health. *Saturated fats* are usually solid at cool temperatures. Eating too much saturated fat is not good for a person’s health, as it can cause heart and blood vessel problems. *Unsaturated fats* are usually liquid at room temperature. These types of fats are healthy fats. Examples include fats from fish, oil seeds (sesame and sunflower), maize oil, ground nut oil and breastmilk.

As a general rule, plant sources of fats are better for a person’s health than the animal sources, because animal fats contain more saturated fats.

1. **Water:** 50 kg adult contains about 31 litres of water and a one year old, 10 kg child contains nearly 8 litres of water. Almost every part of our body contains large amounts of water. People can live without solid food for a few weeks, but we cannot live without water for more than a few days. An adult need about 2–3 litres of water each day. That is why giving drinks are so important when people lose a lot of water, such as when they have diarrhea.

Water is essential for life. We need water for the following reasons:

* For the body to make cells and fluids such as tears, digestive juices and breastmilk
* For the body to make sweat for cooling itself
* For essential body processes - most take place in water
* For keeping the lining of the mouth, intestine, eyelids and lungs wet and healthy
* For the production of urine, which carries waste from the body.

1. **Fibre:**  It is a mixture of different carbohydrates which are not digested like other nutrients but pass through the gut nearly unchanged. Foods rich in fibre are; vegetables like cabbage, carrots, cassava; fruits like banana and avocado; peas and beans; whole-grain cereals like wheat flour and refined maize or sorghum.

Fibre should be included in the diet for the following reasons:

* Fibre makes food bulky or bigger — this can help a person who is overweight to eat less food
* Fibre makes the faeces soft and bulky; this can help prevent constipation
* Fibre slows the absorption of nutrients, so it helps nutrients to enter the blood stream slowly. This is important for patients with diabetes mellitus.

1. **Vitamins:** These are substances present in small amounts in foodstuffs and are necessary for the body to function normally. Vitamins are also called protective foods.

Vitamins can be found in the following sets of foods: Breastmilk, tomatoes, cabbage, lettuce, pumpkins, mangoes, papaya, carrots, liver, kidney, egg yolk, milk, butter, cheese and cream (Vit. A), Ultra violet light from the sun, eggs, butter, fish, fortified oils, fats and cereals (Vit. D), Green leafy vegetables, fruits, cereals, meat and dairy products (Vit. K), Milk, egg yolk, liver, kidney and heart, whole grain cereals, meat, whole bread, fish and bananas (Vit. B-Complex) and Fresh fruits (oranges, banana, mango, grapefruits, lemons, potatoes) and vegetables (cabbage, carrots, pepper, tomatoes), Breastmilk (Vit. C).

1. **Minerals**: These are the substances that people need to ensure the health and correct working of their soft tissues, fluids and their skeleton. Examples of minerals include calcium, iron, iodine, fluorine, phosphorus, potassium, zinc, selenium, and sodium.

Some of these important minerals can be found in the following sources of food for each of these: Milk, cheese and dairy products, foods fortified with calcium (Calcium), meat and meat products, eggs, bread and green leafy vegetables (Iron), iodized salt, sea vegetables, yogurt, cow's milk, eggs, and cheese, fish and plants grown in iodine (Iodine), maize, fish, breastmilk, meat and beans (Zinc) and water (Fluorine).

**Qn. 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 is a nutrient categorized among the minerals and its function in the human body is to give bones and teeth rigidity and strength.

Iron homeostasis is regulated at the level of intestinal absorption, and it is important that adequate but not excessive quantities of iron be absorbed from the diet. Inadequate absorption can lead to iron-deficiency disorders such as anemia. On the other hand, excessive iron is toxic because mammals do not have a physiologic pathway for its elimination. (**Andrews NC, 1986/1999).**

The rate of nutrient absorption is called “bioavailability,” and it’s a measure of how much of each mineral our body is able to process. Some minerals compete against each other for our body’s digestive resources. *Iron absorption can be enhanced by:*

* The presence of vitamin C which helps our body absorb iron into our bloodstream efficiently.
* Efficient absorption requires an acidic environment, and antacids

*While iron absorption can be interfered with by:*

* Presence of large amounts of zinc in our diet that will lower the absorption
* lack of acidic environment and antacids or other conditions that interfere with gastric acid secretion can interfere with iron absorption.

**Qn. 6. Discuss two reasons why it is essential to include carbohydrates in your diet. Why is it necessary for the body to spare protein?**

Carbohydrate**s** are referred to as energy-giving foods. They provide energy in the form of calories that the body needs to be able to work, and to support other functions including the following examples:

* Carbohydrates provide our body with energy. Our cells convert carbohydrates into the fuel molecule ATP (Adenosine Triphosphate) through a process called cellular respiration.
* Carbohydrates helps preserve muscles: During periods of starvation when carbohydrates aren’t available, the body can convert amino acids from muscle into glucose to provide the brain with energy. Consuming at least some carbs can prevent muscle breakdown in this scenario.

As a nutrient, protein performs many functions in the body. An adequate dietary protein intake is important for building, maintaining and repairing body tissues. The body’s structural components such as skin, muscles, bones and organs are made up in large parts by protein. Many hormones and enzymes that function to regulate body processes and chemical reactions are made of protein. Protein is also used to make antibodies to fight disease. If you do not consume enough carbohydrates and fats, protein can also supply your body with energy.

**Qn. 7. Discuss the role of lipids in our diet and their critical functions in the body.**

Lipids are important fats that serve different roles in the human body. A common misconception is that fat is simply fattening. However, fat is probably the reason we are all here. Throughout history, there have been many instances when food was scarce. Our ability to store excess caloric energy as fat for future usage allowed us to continue as a species during these times of famine. So, normal fat reserves are a signal that metabolic processes are efficient and a person is healthy.

Lipids play the following significant roles in our diet:

1. HIGH ENERGY SOURCE: Fat-rich foods naturally have a high caloric density. Foods that are high in fat contain more calories than foods high in protein or carbohydrates. As a result, high-fat foods are a convenient source of energy. For example, 1 gram of fat or oil provides 9 kilocalories of energy, compared with 4 kilocalories found in 1 gram of carbohydrate or protein. Depending on the level of physical activity and on nutritional needs, fat requirements vary greatly from person to person. When energy needs are high, the body welcomes the high-caloric density of fats. For instance, infants and growing children require proper amounts of fat to support normal growth and development. If an infant or child is given a low-fat diet for an extended period, growth and development will not progress normally. Other individuals with high-energy needs are athletes, people who have physically demanding jobs, and those recuperating from illness. **(in The Nutrition Source)**

When the body has used all of its calories from carbohydrates (this can occur after just twenty minutes of exercise), it initiates fat usage. A professional swimmer must consume large amounts of food energy to meet the demands of swimming long distances, so eating fat-rich foods makes sense. In contrast, if a person who leads a sedentary lifestyle eats the same high-density fat foods, they will intake more fat calories than their body requires within just a few bites. Use caution—consumption of calories over and beyond energy requirements is a contributing factor to obesity.

1. SMELL AND TASTE: Fat contains dissolved compounds that contribute to mouth-watering aromas and flavors and increase palatability of food. Fat also adds texture to food. Baked foods are supple and moist. Frying foods locks in flavor and lessens cooking time.

Fat plays another valuable role in nutrition. Fat contributes to satiety, or the sensation of fullness. When fatty foods are swallowed the body responds by enabling the processes controlling digestion to retard the movement of food along the digestive tract, thus promoting an overall sense of fullness. Oftentimes before the feeling of fullness arrives, people overindulge in fat-rich foods, finding the delectable taste irresistible. Indeed, the very things that make fat-rich foods attractive also make them a hindrance to maintaining a healthful diet.

**CRITICAL FUNCTIONS OF LIPIDS IN THE BODY:**

Lipids are a family of organic compounds that are mostly insoluble in water. Composed of fats and oils, lipids are molecules that yield high energy and have a chemical composition mainly of carbon, hydrogen, and oxygen. Lipids perform three primary biological functions within the body: they serve as structural components of cell membranes, function as energy storehouses, and function as important signaling molecules. Lipids functions in the human body as detailed below:

1. STORING ENERGY: The excess energy from the food we eat is digested and incorporated into adipose tissue, or fatty tissue. Most of the energy required by the human body is provided by carbohydrates and lipids. "Carbohydrates", glucose is stored in the body as glycogen. While glycogen provides a ready source of energy, lipids primarily function as an energy reserve. Glycogen is quite bulky with heavy water content; thus, the body cannot store too much for long. Alternatively, fats are packed together tightly without water and store far greater amounts of energy in a reduced space. A fat gram is densely concentrated with energy—it contains more than double the amount of energy than a gram of carbohydrate. Energy is needed to power the muscles for all the physical work and play an average person or child engages in. For instance, the stored energy in muscles propels an athlete down the track, spurs a dancer’s legs to showcase the latest fancy steps, and keeps all the moving parts of the body functioning smoothly.

Unlike other body cells that can store fat in limited supplies, fat cells are specialized for fat storage and are able to expand almost indefinitely in size. An overabundance of adipose tissue can result in undue stress on the body and can be detrimental to your health. A serious impact of excess fat is the accumulation of too much cholesterol in the arterial wall, which can thicken the walls of arteries and lead to cardiovascular disease. Thus, while some body fat is critical to our survival and good health, in large quantities it can be a deterrent to maintaining good health.

1. REGULATING AND SIGNALING: Triacylglycerols control the body’s internal climate, maintaining a constant temperature. Those who don’t have enough fat in their bodies tend to feel cold sooner, are often fatigued and have pressure sores on their skin from fatty acid deficiency. Triacylglycerols also help the body produce and regulate hormones. For example, adipose tissue secretes the hormone leptin, which regulates appetite. In the reproductive system, fatty acids are required for proper reproductive health; women who lack proper amounts may stop menstruating and become infertile. Omega-3 and omega-6 essential fatty acids help regulate cholesterol and blood clotting and control inflammation in the joints, tissues, and bloodstream. Fats also play important functional roles in sustaining nerve impulse transmission, memory storage, and tissue structure. More specifically in the brain, lipids are focal to brain activity in structure and in function. They help form nerve cell membranes, insulate neurons, and facilitate the signaling of electrical impulses throughout the brain.
2. INSULATING AND PROTECTING: Up to 30 percent of body weight is comprised of fat tissue. Some of this is made up of visceral fat or adipose tissue surrounding delicate organs. Vital organs such as the heart, kidneys, and liver are protected by visceral fat. The composition of the brain is outstandingly 60 percent fat, demonstrating the major structural role that fat serves within the body. You may be most familiar with subcutaneous fat, or fat underneath the skin. This blanket layer of tissue insulates the body from extreme temperatures and helps keep the internal climate under control. It pads our hands and buttocks and prevents friction, as these areas frequently come in contact with hard surfaces. It also gives the body the extra padding required when engaging in physically demanding activities such as ice- or roller skating, horseback riding, or snowboarding.
3. AIDING DIGESTION AND INCREASING BIOAVAILABILITY: The dietary fats in the foods we eat break down in our digestive systems and begin the transport of precious micronutrients. By carrying fat-soluble nutrients through the digestive process, intestinal absorption is improved. This improved absorption is also known as increased bioavailability. Fat-soluble nutrients are especially important for good health and exhibit a variety of functions. Vitamins A, D, E, and K—the fat-soluble vitamins—are mainly found in foods containing fat. Some fat-soluble vitamins (such as vitamin A) are also found in naturally fat-free foods such as green leafy vegetables, carrots, and broccoli. These vitamins are best absorbed when combined with foods containing fat. Fats also increase the bioavailability of compounds known as phytochemicals, which are plant constituents such as lycopene (found in tomatoes) and beta-carotene (found in carrots). Phytochemicals are believed to promote health and well-being. As a result, eating tomatoes with olive oil or salad dressing will facilitate lycopene absorption. Other essential nutrients, such as essential fatty acids, are constituents of the fats themselves and serve as building blocks of a cell.

**Qn. 8. Explain the importance of fats to the bioavailability of other nutrients.**

The rate of nutrient absorption is called “bioavailability,” it refers to the proportion of a nutrient that is absorbed from the diet and used for normal body functions and it’s a measure of how much of each mineral our body is able to process. Some minerals compete against each other for our body’s digestive resources. For example, large amounts of zinc in our diet will lower the absorption rate of iron and copper. Other minerals work together. Calcium, phosphorus and magnesium combine to give rigidity to our teeth and bones**. (**[**American Chiropractic Association: Internal Body Factors Can Affect Mineral Bioavailability**](http://www.acatoday.org/content_css.cfm?CID=1347)**).**

Fats can act in different ways in enhancing nutrient bioavailability such as keeping a nutrient soluble or protecting it from interaction with inhibitors. For example, since carotenoids are fat-soluble, adding small quantities of fat or oil to the meal (3-5 g per meal) improves their bioavailability**. (Gibson RS 2007)**

Chylomicrons are small globules composed of protein and lipid. Before triglycerides leave the epithelial cells, they're coated by proteins, which results in the formation of chylomicrons. The coating of protein gives the triglyceride a water-soluble coat, and this allows the chylomicron to travel outside of the cell. The newly formed chylomicrons leave the epithelial cell and enter the lymphatic which are called lacteals. The lacteals are found in the finger like projections of the intestinal wall, called the villi. The lacteals represent another unique way fat are absorbed because lipids pass through the lymphatic system before they make their way back to our bloodstream. (**Rebecca Gillaspy)**

**Qn. 9. Discuss the role of fats as an energy source for the body.**

Fat is the body's most concentrated source of energy, providing more than twice as much potential energy as carbohydrate or protein (9 calories per gram versus 4 calories each per gram). During exercise, stored fat in the body (in the form of triglycerides in adipose or fat tissue) is broken down into fatty acids. These fatty acids are transported through the blood to muscles for fuel. This process occurs relatively slowly as compared with the mobilization of carbohydrate for fuel. Fat is also stored within muscle fibres, where it can be more easily accessed during exercise. Unlike your glycogen stores, which are limited, body fat is a virtually unlimited source of energy for athletes. Even those who are lean and mean have enough fat stored in muscle fibres and fat cells to supply up to 100,000 calories - enough for over 100 hours of marathon running.

Fat is a more efficient fuel per unit of weight than carbohydrate. Carbohydrate must be stored along with water. Our weight would double if we stored the same amount of energy as glycogen (plus the water that glycogen holds) that we store as body fat. Most of us have sufficient energy stores of fat (adipose tissue or body fat), plus the body readily converts and stores excess calories from any source (fat, carbohydrate, or protein) as body fat. In order for fat to fuel exercise, however, sufficient oxygen must be simultaneously consumed. The following are some roles of fats as an energy source for the body:

* Provides a concentrated source of energy - Fat provides more than twice the potential energy that protein and carbohydrate do (9 calories per gram of fat versus 4 calories per gram of carbohydrate or protein).
* Helps fuel low - to moderate-intensity activity - At rest and during exercise performed at or below 65 percent of aerobic capacity, fat contributes 50 percent or more of the fuel that muscles need.
* Aids endurance by sparing glycogen reserves - Generally, as the duration or time spent exercising increases, intensity decreases (and more oxygen is available to cells), and fat is the more important fuel source. Stored carbohydrate (muscle and liver glycogen) are subsequently used at a slower rate, thereby delaying the onset of fatigue and prolonging the activity.

**Qn. 10. Define chylomicron. Describe the role of bile salts in the digestion of triacylglycerols and phospholipids.**

Chylomicron is a small globule composed of protein and lipid. Before triglycerides leave the epithelial cells, they're coated by proteins, which results in the formation of chylomicrons.

Foods, such as meats, dairy products, seeds, nuts, and oils, contain dietary fat. Fat is a common example of a triacylglycerols and phospholipids (lipids).

A lipid is defined as a fat-like molecule that does not have the ability to dissolve in water. This inability to dissolve in water adds an element of difficulty to fat digestion. Because fat does not like water, it tends to clump together and form large droplets called emulsion droplets as it moves through our digestive system. By the time fat reaches our small intestine, it has not been digested at all. So, dietary fat in the small intestine looks like a fairly large glob of fat**. (Rebecca Gillaspy)**

**The role of bile salts**

These globs remain until bile that is produced in the liver and stored in the gallbladder mixes with the large fat droplets. Bile contains bile salts which act as an emulsifier of lipids. The term 'emulsify' means to break large fat droplets into smaller droplets (Emulsion droplets). And, that is exactly what is seen happening in the small intestine. The bile salts break up and coat the fat to form much finer droplets. These finer droplets have more surface area, and this aids digestion because the fat-digesting enzyme pancreatic lipase can only act on the surface of the fat droplet.

The enzymes of the small intestine are responsible for almost all of the fat digestion. When pancreatic lipase acts on the lipid, it breaks it down, which results in free fatty acids and monoglycerides, the two digestive products of lipids. These products are much easier for our small intestine to handle, and they have very little trouble being absorbed out of our digestive tract.

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