



CARBOHYDRATES AND ENERGY

Carbohydrates are widely distributed in plants in which they are formed from CO_2 of the atmosphere by photosynthesis. Carbohydrates are the preferred source of energy for most of the body functions. As long as carbohydrates are available, the human brain depends exclusively on it as an energy source. They are the cheapest and most important source of energy for the vast majority of people in the tropics.

Our body needs energy to grow and repair themselves, keep warm and do physical activity. Energy comes from food and drink, in particular from carbohydrate, protein and fat (collectively known as

macronutrients). The amount of each macronutrient in the food will determine its energy content.

In this lesson the students will be able to:

- understand the importance of carbohydrates as an economical source of energy
- know the significance of complex carbohydrates
- understand the importance of basal metabolism and basal metabolic rate
- create an awareness about the benefits of physical activity as part of a healthy lifestyle.



Carbohydrates and Energy

9.1 Composition of carbohydrates

Carbohydrates are so called because they contain carbon with hydrogen and oxygen in the same proportion as in water (2:1). The general formula is $C_nH_{2n}O_n$.

9.2 Classification of carbohydrates

Carbohydrates are classified according to the number of saccharide (sugar) groups present. They are broadly classified as simple carbohydrates and complex carbohydrates. The simple carbohydrates include monosaccharides (Single sugar) and disaccharides (Double sugars). Complex carbohydrates include starch, glycogen and fibers. The classification of carbohydrates is schematically represented below:

9.2.1 Simple Carbohydrates

A) Monosaccharides

They have one saccharide group and are the simplest form of carbohydrates. All

carbohydrates are reduced to this state before absorption and utilization. They contain 3-6 carbon atoms and are accordingly termed triose, tetrose, pentose or hexose.

- (i) **Biase:** $C_2H_4O_2$ (e.g.) Glycolic aldehyde
- (ii) **Triose:** $C_3H_6O_3$ (e.g.) Glyceraldehyde and Dihydroxyacetone. They occur in plant and animal tissues in small amounts and are derived from the breakdown of glucose.
- (iii) **Tetroses:** $C_4H_8O_4$ (e.g.) Erythrose, Threose
- (iv) **Pentoses:** $C_5H_{10}O_5$ (e.g.) Arabinose, Xylose, Ribose and Deoxyribose.
- (v) **Hexoses:** $C_6H_{12}O_6$. They are further sub-divided into 2 groups (i.e) Aldoses or sugars containing aldehyde group (e.g.) Glucose,

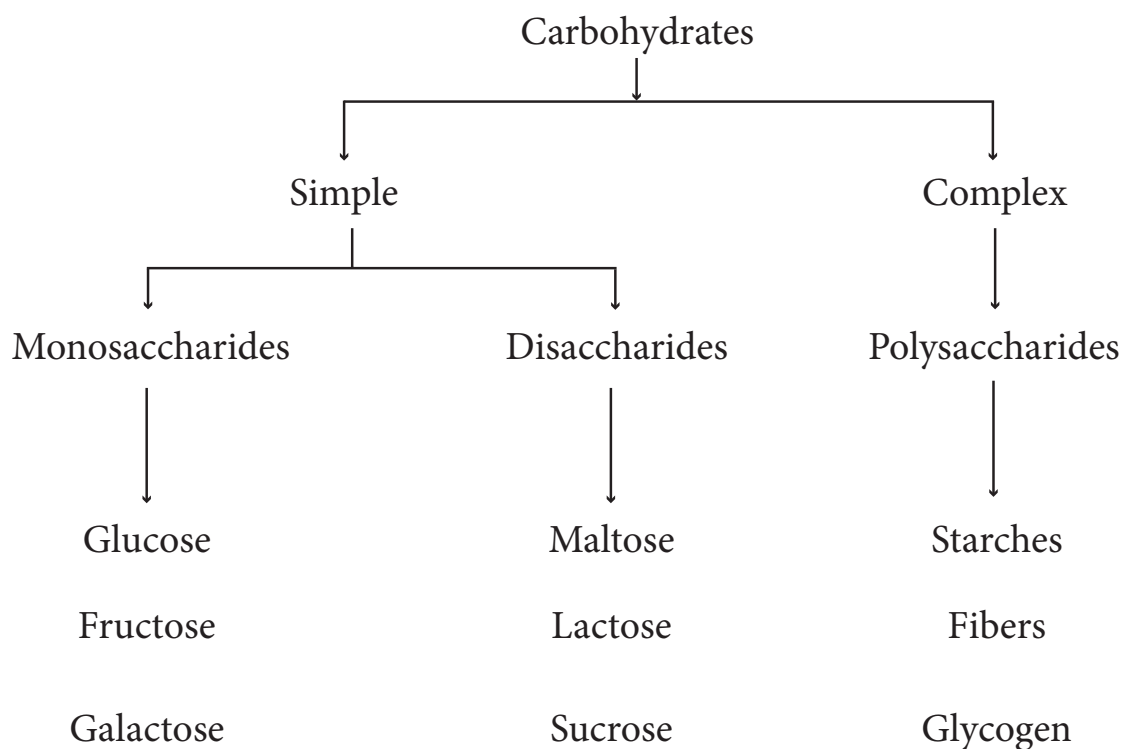


Fig 9.1: Classification of carbohydrates

galactose and mannose as well as Ketoses or sugars containing ketone group(e.g.) Fructose.

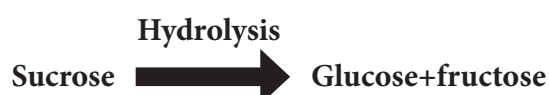
Major monosaccharides

- a) **Glucose** (Dextrose or grape sugar): It serves as the main source of energy in the body. It is abundantly found in nature. It is found in sweet fruits such as grapes, berries, oranges in vegetables like sweet corn and carrots. It is less sweet than cane sugar. It is the end product in the digestion of disaccharides and polysaccharides and is the form of carbohydrate circulating in the blood.
- b) **Fructose**(Levulose or fruit sugar): It is much sweeter than cane sugar and is found in honey,ripe fruits and some vegetables.It is also a product of the hydrolysis of sucrose.
- c) **Galactose**: It does not occur in the free state, but occurs as a constituent of lactose present in milk.

B) Disaccharides

They are formed by the combination of 2 monosaccharides. The disaccharides of nutritional importance are sucrose, maltose and lactose.

- a) **Sucrose** (Cane sugar, beetsugar, table sugar): It occurs in sugarcane (10-12%) and beetroot(12-18%).In the intestine, sucrose is broken down into monosaccharides -glucose and fructose by the enzyme sucrase present in the intestinal juice and then absorbed.



- b) **Lactose**(Milk sugar): It occurs in the milk of mammals. Cow's milk and buffalo's milk contain 4% of lactose, while human milk contains about 7% of lactose. Lactose is hydrolysed to glucose and galactose by the enzyme lactase present in the intestinal juice.



- c) **Maltose** (Malt sugar): It is found in all sprouted and malted products.It is an intermediate product formed in the process of conversion of starch into glucose. Maltose is hydrolysed to 2 molecules of glucose by the enzyme maltase present in the intestinal juice. Sprouted cereals and beer contain large amount of maltose.



9.2.2 Complex Carbohydrates

These are complex compounds with high molecular weights. Their structural formula is $(C_6H_{10}O_5)_n$, where $n > 2$. They are formed by a combination of more than 2 molecules of a monosaccharide. Unlike the sugars, which contain 3 monosaccharides – Glucose, fructose and galactose in different combinations, the polysaccharides – Starch and Glycogen are composed entirely of glucose. They differ from each other only in the nature of the bonds that link the glucose units together.

- 1) **Starch** : It is a long, straight or branched chain of hundreds of glucose units linked together. The important sources of starch are



cereals and millets(65-85%) and roots and tubers(19-35%). Starch is a polysaccharide formed in nature by the condensation of large number (4000-15000) of glucose molecules. It consists of a mixture of 2 components called amylose and amylopectin. It is the storage form of carbohydrate in the plant kingdom. Cooking facilitates the digestion of starch. Boiling causes swelling of the starch granules and rupture of the cell walls, allowing better digestion. The enzyme amylase present in the salivary and pancreatic juices, converts starch into maltose which is subsequently broken into glucose and absorbed.

- 2) **Dextrin** : It is not found in direct form in nature. They are polysaccharides formed by the partial hydrolysis of starch by acids or amylase. They are composed of large number of glucose molecules.
- 3) **Glycogen**: It is made up of chains of glucose, which are more highly branched than starch molecules. It is the storage form of carbohydrates in human beings and animals. It

is formed by the condensation of large number (5000-10000) of glucose molecules. When required by the body, glycogen is converted to glucose to give energy.

9.3 Functions of carbohydrates

The functions of carbohydrates in the body are as follows:

1) **Energy**: The principle function of carbohydrates is to serve as a major source of energy for the body. Each gram of carbohydrate yields 4kcal of energy regardless of its source. They provide an economical and quick source of energy. Excess carbohydrates in the body is stored as glycogen and can be converted to glucose for energy production when required .

2) **Protein Sparing Action**: Carbohydrates exert a protein sparing action. If sufficient amounts of carbohydrates are not available in the diet, the body will convert protein to glucose in order to supply energy. Hence, in order to spare proteins for tissue building and repair, carbohydrates must be supplied in optimum amounts in the diet. This is called the protein sparing action of carbohydrates.

3) **Fat Metabolism**: Adequate supply of carbohydrates determines the amount of fat to be metabolized for energy, which in turn affects the formation and disposal rate of ketones (intermediate products in fat metabolism). In the absence of adequate supply of carbohydrates, more fat is used because of which ketones accumulate in the body and this results in a disorder called Ketosis or Acidosis. This shows that carbohydrates have an anti-ketogenic effect which prevents harmful



ACTIVITY - 1

Match the right answer

- | | | |
|----------------|---|------------------------------|
| a) Fruit sugar | - | Lactose |
| b) Grape sugar | - | Maltose |
| c) Milk | - | Starch |
| d) Malt sugar | - | Storage form of carbohydrate |
| e) Dextrin | - | Sucrose |
| f) Glycogen | - | Fructose |
| g) Cane sugar | - | Glucose |

effect of ketone accumulation in the body.

4) **Synthesis of Body Substances:** Carbohydrates aid in the synthesis of non-essential aminoacids, glycoproteins (which function as antibodies) and glycolipids (which form a part of cell membrane in body tissues especially brain and nervous system). Lactose encourages the growth of favourable intestinal bacteria. It has laxative properties and enhances the absorption of calcium.

5) **Detoxification:** Glucuronic acid, a metabolite of glucose serves as a detoxifying agent. It combines with harmful substances containing alcohol or phenolic group converting them to harmless compounds which are later excreted. Adequate hepatic (Liver) glycogen storage enhances normal liver detoxification ability.

6) **Roughage in the Diet:** Insoluble fibres (Cellulose) known as complex carbohydrates can absorb water and give bulk to the intestinal contents which aids in the elimination of waste products by stimulating peristaltic movements of the gastrointestinal tract.

7) **Central nervous system (CNS):** Glucose alone can work as a source of energy for the central nervous system. Prolonged deprivation of glucose to the CNS may cause irreversible damage to the brain.

9.4 Food sources of carbohydrates

The important sources of carbohydrates in the diets of children and adults are cereals, millets, root, tubers, pulses, sugar and jaggery, while milk and sugar are important sources in diets of infants.

The types and sources of Carbohydrates are given in table 9.1

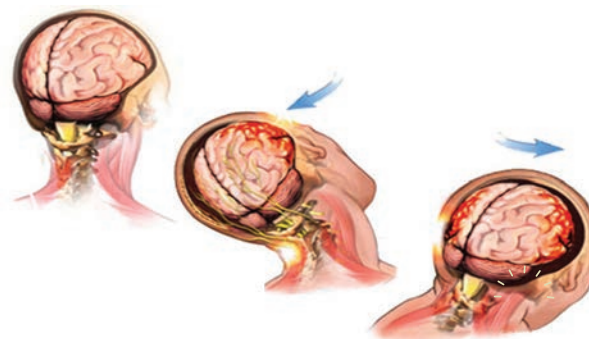
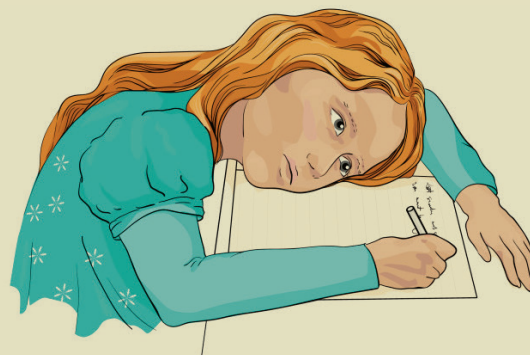


Fig 9.1: Central nervous system (CNS)

DO YOU KNOW...?

Why do people usually faint when they skip breakfast???



ACTIVITY - 2

Display any 5 food sources of simple and complex carbohydrates

| |
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| |
| |
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| |
| |
| |

| Table 9.1 Types and Sources of Carbohydrates | |
|--|---|
| Type of Carbohydrates | Food Sources |
| 1.Monosaccharides | |
| Glucose | Fruits, honey, corn-syrup. |
| Fructose | Fruits, honey. |
| Galactose | These do not occur in free form in foods. |
| 2.Disaccharides | |
| Sucrose | Cane and beet sugar |
| Lactose | Milk and milk products. |
| Maltose | Malt and Cereal products. |
| 3.Polysaccharides Digestible: | |
| Starch and Dextrin | Grains, vegetables especially roots& tubers, legumes, Meat products and sea foods |
| Glycogen | |
| Indigestible: | |
| Cellulose | Stalks and leaves of vegetables, outer coat of seeds |
| Pectins, Gums | Fruits, Plant secretions and seeds. |



Fig 9.2: Food sources of Carbohydrates

9.5 Requirements of carbohydrates

The body has a specific need for carbohydrates as a source of energy for the brain and other tissue cells, for the synthesis of lactose in milk (lactating women) and galactose and other sugars present in the cerebroside and muco-polysaccharides. The percentage of calories derived from carbohydrates in diets consumed by a vast majority of people in the developing countries is as high as 60 – 70%. The carbohydrate calories should be at least 40% in well-balanced diets. The optimal levels of carbohydrates in the diet, taking into account the physiological needs for proteins and fats are given in table 9.2

9.6 Dietary fibers

Dietary fiber is defined as that portion of plant material ingested in the diet that is resistant to digestion by gastro intestinal secretions. It consists of cellulose,

hemicellulose, pectins, gums and mucilages as well as non-polysaccharide lignin. Some bacteria in the large intestine can degrade some components of fibre releasing products, that can be absorbed into the body and used as energy source.

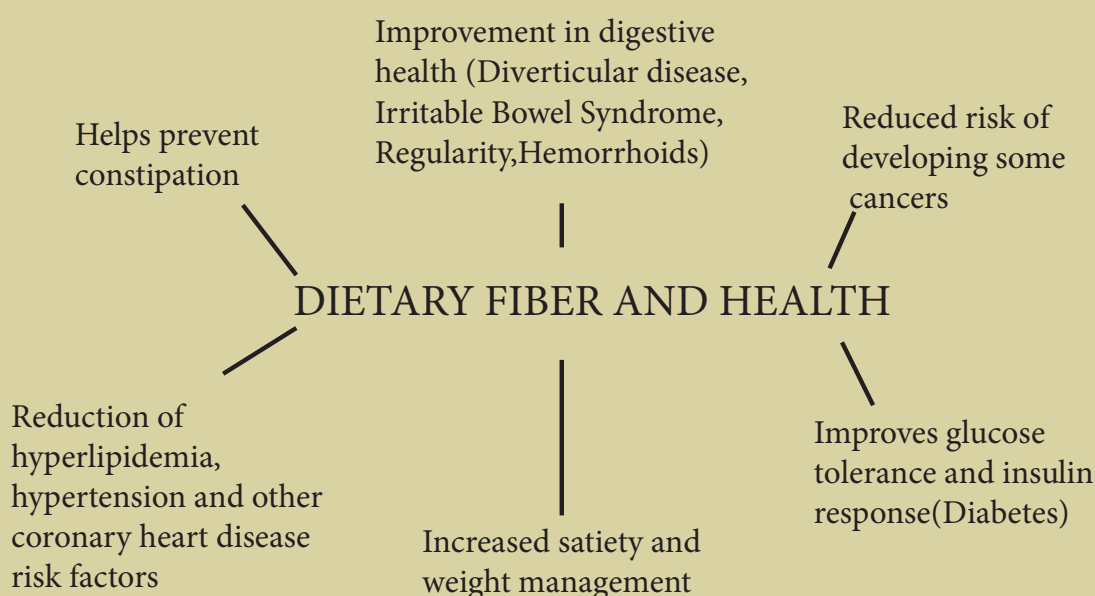
Table 9.2 Optimal level of carbohydrates in the diet

| Age group | Optimal level of carbohydrate calories as percent of total calories |
|--------------------------------|---|
| Adults | 50- 70 |
| Pregnant and lactating women | 40-60 |
| Infants(1-12 months) | 40-50 |
| Preschool (1-5 years) | 40-60 |
| Older children and adolescents | 50-70 |

Dietary fibers

In a nutshell.....

Benefits of dietary fiber



a) **Cellulose** : It is the main constituent of plant cell walls. It is found in all vegetables, fruits and legumes.

b) **Hemicellulose**: It is the main constituent of cereal fibres. It is also present in all vegetables and hulls of legumes.

c) **Pectins**: Pectins are formed by the combination of large number of galacturonic acid molecules. In the presence of sucrose and citric acid, pectin forms a gel. It is used in the food industry as an ingredient of jams and jellies.

d) **Gums and mucilages**: They are non-structural components of plant cells that are soluble in hot water. They are used as additives and stabilizers by the food industry.

e) **Lignin**: They are the tough, woody parts of plants.

Dietary fibers can also be classified as soluble and insoluble fibers based on their solubility in water. Insoluble fibers do not dissolve in water (Cellulose, hemicellulose and lignin) and soluble fibres readily dissolve in water (Pectins, gums and mucilages).

The types, sources and action of fibre in the body is summarized in **table 9.3**

Food for thought — choose wisely!

What's most important is the type of carbohydrate you choose to eat because some sources are healthier than others.



The amount of carbohydrate in the diet – high or low – is less important than the type of carbohydrate in the diet. For example, healthy, whole grains and whole wheat bread, rye and barley are better choices than highly refined white bread or french fries.

Foods high in carbohydrates are an important part of a healthy diet. Carbohydrates provide the body with glucose, which is converted to energy used to support bodily functions and physical activity. But carbohydrate quality is important; some types of carbohydrate-rich foods are better than others:

Table 9.3 Types, Sources and Action of fiber

| Types of fiber | Major food sources | Action in the body |
|--|--|--|
| Soluble fibers Gums, pectins, mucilages | Citrus fruits, apple, oats, barley, legumes | <ul style="list-style-type: none"> • Delay gastro intestinal transit • Delay glucose absorption • Lower blood cholesterol |
| Insoluble fibers Cellulose Hemicellulose | Whole wheat products, wheat bran, whole grain breads, cereals and vegetables like green peas, beans, cabbage. Skin of vegetable and fruits, grains | <ul style="list-style-type: none"> • Accelerate Gastro intestinal transit • Increase faecal weight • Slow starch hydrolysis • Delay glucose absorption |

➤ The healthiest sources of carbohydrates—unprocessed or minimally processed whole grains, vegetables, fruits and beans—promote good health by providing vitamins, minerals, fiber, and a host of important phytonutrients.

➤ Unhealthier sources of carbohydrates include white bread, pastries, sodas, and other highly processed or refined foods. These items contain easily digested carbohydrates that may contribute to weight gain, interfere with weight loss and promote diabetes and heart disease.









| <div> <div>GOOD CARBS</div> <div>VS.</div> <div>BAD CARBS</div> </div> | |
|--|---|
| Eat Most Days of the Week | Eat On Occasion in Small Amounts |
| VEGETABLES | |
|  <ul style="list-style-type: none"> • ½ cup cooked vegetables • 1 cup raw vegetables | <ul style="list-style-type: none"> • Fried Vegetables • Vegetables in butter or cream sauce • Canned vegetables  |
| GRAINS & STARCHES | |
|  <ul style="list-style-type: none"> • ½ cup cooked whole grain • 1 small potato or sweet potato • 1 medium ear of corn • ½ cup cooked beans or lentils • 100% whole wheat bread | <ul style="list-style-type: none"> • Refined grains and desserts • White bread, white rice and white pasta • Cookies, cakes and muffins • Granola bars • Cold cereal • Flavored oatmeal • Pretzels, chips and crackers  |
| FRUITS | |
|  <ul style="list-style-type: none"> • ¾ cup chopped fruit • 1 small piece of fruit (size of a tennis ball) | <ul style="list-style-type: none"> • Fruit juice • Fruit bars • Dried fruit • Canned fruit  |
| DAIRY OR DAIRY ALTERNATIVES | |
|  <ul style="list-style-type: none"> • 1 cup low-fat milk or almond, soy, rice or coconut milk • 1 cup low-fat or non-fat yogurt • 1.5 ounce/1 thin slice mozzarella, Swiss, string cheese or feta (a few times per week) | <ul style="list-style-type: none"> • Ice cream • Butter  |

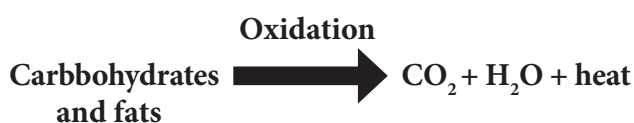
Fig 9.3: Good Carbs Vs Bad Carbs

9.7 Energy

Energy is the capacity to do work. Energy must be supplied regularly to meet the needs of the body for survival. The body needs energy for maintaining body temperature, metabolic activity, supporting growth, for physical work, to maintain constant body weight and good health.

9.7.1 Energy yielding food factors

The energy yielding food factors are (i) carbohydrates (ii) fats and (iii) proteins. Within the body, these are oxidised in the cells. The process is one of continuous utilization of O_2 and production of CO_2 , H_2O and heat.



9.7.2 Units of energy – calorie and joule

The energy value of foods can be expressed in terms of kilocalories (KCal) or megajoules (MJ). The International Union of Nutritional Sciences has suggested the use of megajoule as the energy unit in place of Kcal. These units are defined as follows:

Kilocalorie: One kilogram calorie is the quantity of heat required to raise the temperature of 1 kg of water through $1^\circ C$.

Joule: A joule is defined as the energy required to move 1 kg mass by 1 metre by a force of 1 Newton acting on it.

Newton: One Newton is the force needed to accelerate 1 kg mass by less than a second.

$$1 \text{ Kcal} = 4.184 \text{ KJ}$$

$$1000 \text{ Kcal} = 4.184 \text{ Megajoule (MJ)}$$

$$1 \text{ MJ} = 240 \text{ Kcal}$$

9.7.3 Energy value of foods

The energy in various foods is measured by calorimetry. Calorimetry is the measurement of heat loss. The energy value of foods is determined using the instrument called Bomb calorimeter.

9.7.4 Gross Energy value of foods

When samples of carbohydrate, fat, protein are burned, the amount of heat produced is always the same for each of these nutrients. The average gross energy value of carbohydrates, fats and proteins determined with bomb calorimeter is as follows:

$$1 \text{ g of Carbohydrate} = 4.1 \text{ kcal}$$

$$1 \text{ g of fat} = 9.45 \text{ kcal}$$

$$1 \text{ g of protein} = 5.65 \text{ kcal}$$

9.7.5 Physiological energy value of foods

In the utilization of carbohydrates, fats and proteins in the body a certain percentage of these nutrients is lost in digestion and the nitrogen of protein is excreted in urine as urea which still contains some energy value. The average losses in digestion in human subjects have been estimated to be 2.0% for carbohydrates, 5.0% for fats and 8.0% for proteins. The loss of energy in urea is estimated to be 1.2 kcal per gram of protein oxidised. The physiological energy values of foods calculated from the gross energy values after allowing for the losses in digestion and metabolism are as follows: Carbohydrates 4.0; fats 9.0 and proteins 4.0.

These values are known as 'Atwater Bryant factors' or physiological fuel values.

9.7.6 Coefficient of digestibility

The coefficient of digestibility is used to express the proportion of an ingested nutrient that ultimately becomes available to the body cells. The coefficient of digestibility for carbohydrate, fat and protein are 0.98, 0.95 and 0.92 respectively. It is observed that carbohydrate and fat are metabolized almost completely, whereas protein metabolism is incomplete due to the presence of nitrogen.

The physiological fuel value, Co-efficient of digestibility and digestibility percent of carbohydrate, fat and proteins is presented in **table 9.4**.

9.8 Basal metabolism

Basal Metabolism is the minimum amount of energy needed by the body for maintenance of life when the person is at complete physical and mental rest and having normal body temperature and in the post-absorptive state (12 hours after the intake of last meal). Basal Metabolic Rate (BMR) is a measure of the energy required by the activities of resting tissue.

The Basal Metabolic rate can be measured directly from the heat produced

(using a Respiration Calorimeter and Metabolic Chamber) or indirectly from O_2 intake and CO_2 expenditure when the subject is at rest.

9.8.1 Basal Metabolic Rate (BMR)

The rate of energy use for metabolism under basal metabolism is usually expressed as kcal/kg body weight per hour. The factors affecting BMR is presented in **table 9.5**



ACTIVITY - 3

List the energy, protein and fat value of any 4 commonly consumed foods (per 100g):

a) cereals

b) fruits

c) nuts

d) dairy products

Table 9.4 Types and Sources of Carbohydrates

| Nutrient | Heat of combustion (kCal) | Co-efficient of digestibility | Digestibility percent | Physiological fuel value |
|--------------|---------------------------|-------------------------------|-----------------------|--------------------------|
| Carbohydrate | 4.1 | 0.98 | 98 | 4.0 |
| Fat | 9.45 | 0.95 | 95 | 9.0 |
| Protein | 5.65 | 0.92 | 92 | 4.0 |



Table 9.5 Factors affecting Basal Metabolic Rate (BMR)

| S.no | Factor | Effect on BMR |
|------|---|---|
| 1 | Body composition | More the lean body mass, higher is the BMR. This is due to greater metabolic activity in these tissues when compared to bones and fat. Men with a high proportion of muscle mass or lean body mass have a higher BMR than women |
| 2 | Fever | Fever raises the BMR. There is a 7% increase in BMR for each degree rise in body temperature in Fahrenheit and 13% increase for every degree Celsius rise in body temperature |
| 3 | Stress | Raises BMR. |
| 4 | Smoking and Caffeine | Increases BMR |
| 5 | Hyperthyroidism (Oversecretion of thyroxine) | The basal metabolic rate is elevated as much as 50-70%. |
| 6 | Growth | In tall people BMR is higher. |
| 7 | Pregnancy | During the last trimester of pregnancy, basal metabolic rate is increased by 15 - 25% as there is a increase in muscle mass of uterus, size of mammary gland, foetal mass and placenta, cardiac work and respiratory rate. |
| 8 | Fasting/Starvation | Lowers BMR |
| 9 | Hypothyroidism (under secretion of thyroxine) | The basal metabolic rate is decreased by 30% |
| 10 | Age | Lean body mass diminishes with age slowing the BMR. BMR is higher in infants and young children than in adults |
| 11 | Undernutrition | Prolonged undernutrition lowers the BMR. |
| 12 | Climate | In persons living in tropical climates,BMR is about 10% less than those living in temperate zones. |
| 13 | Sleep | BMR is reduced by 5%. |

9.9. Physical activity

Exercise is defined as any movement that makes the muscles work and requires the body to burn calories. There are many types of physical activity, including swimming, running, jogging, walking and dancing, to name a few. Being active has been shown to have many health benefits, both physically and mentally.



Fig 9.4: Physical activity

9.9.1 Types of Physical Activity

The four main types of physical activity are aerobic, muscle-strengthening, bone-strengthening, and stretching. Aerobic activity is the type that benefits your heart and lungs the most.

a) Aerobic Activity

Aerobic activity moves the large muscles, such as those in the arms and legs. Running, swimming, walking, bicycling, dancing, and doing jumping jacks are examples of aerobic activity. Aerobic activity is also called endurance activity. Aerobic activity makes the heart beat faster than usual and makes the person to breathe harder during this type of activity. Over time, regular aerobic activity makes the heart and lungs stronger and able to work better.

b) Other Types of Physical Activity

The other types of physical activity like muscle-strengthening, bone strengthening and stretching benefit the body in other ways.

Muscle-strengthening activities improve the strength, power, and endurance of the muscles. Doing pushups and sit-ups, lifting weights, climbing stairs, and working in the garden are examples of muscle-strengthening activities.

With bone-strengthening activities feet, legs, or arms support the body weight, and the muscles push against the bones. This helps make the bone stronger. Running, walking, jumping rope and lifting weights are examples of bone-strengthening activities.

Muscle-strengthening and bone-strengthening activities also can be aerobic, depending on whether they make the heart and lungs work harder than usual. For example, running is both an aerobic activity and a bone-strengthening activity.

Stretching helps improve flexibility and ability to fully move the joints. Touching toes, doing side stretches, and doing yoga exercises are examples of stretching.

9.9.2. Benefits of physical activity

- 1) Assists in weight control mainly by burning calories and thereby reducing body fat.
- 2) Raises self-esteem and physical awareness.
- 3) Reduces symptoms of ageing.
- 4) Allows body to use fats and sugars more efficiently.
- 5) Improves digestion and metabolism
- 6) Strengthens and improves the functioning of the heart and lungs.

- 7) Reduces risk of heart disease and vascular disease by increasing the HDL cholesterol levels (Good cholesterol) in the blood.
- 8) Strengthens the muscles, ligaments, tendons, joints and bones.
- 9) Regulates blood pressure and helps in controlling hypertension.
- 10) Preventing osteoporosis by strengthening and slowing down the loss of calcium in the bones.
- 11) Regulates hormone levels and helps to alleviate premenstrual and menopausal symptoms.
- 12) Reduces stress and combats depression.
- 13) Promotes a positive outlook in life.
- 14) Improves immunity and increases resistance to infections.
- 15) Promotes a healthy lifestyle.



ACTIVITY - 4

Design a physical activity fact sheet which includes the following:

- a) Definition of physical activity
- b) Any 5 benefits of physical activity
- c) 3 types of aerobic physical activity which you can do at school to be more physically active
- d) 3 types of physical activity which can be done outside school to become more physically active

***Make your move - sit less
Be active for life!***



Summary

- Carbohydrates are so called because they contain carbon with hydrogen and oxygen in the same proportion as in water (2:1). The general formula is $C_nH_{2n}O_n$.
- Carbohydrates are classified according to the number of saccharide (sugar) groups present. They are broadly classified as simple carbohydrates (sugars) and complex carbohydrates (sugars).



- The simple carbohydrates include monosaccharides (Singlesugar) and disaccharides (Doublesugars).Complex carbohydrates include starch, glycogen and fibers.
- The major monosaccharides are glucose, fructose and galactose.
- The disaccharides of nutritional importance are sucrose, maltose and lactose.
- The complex carbohydrates include starch, dextrin and glycogen.
- The principle function of carbohydrates is to serve as a major source of energy for the body.
- The important sources of carbohydrates in the diets of children and adults are cereals, millets, roots, tubers, pulses, sugar and jaggery, while milk and sugar are important sources in the diets of infants.
- The percentage of calories derived from carbohydrates in diets consumed by a vast majority of people in the developing countries is as high as 60 – 70%.
- Dietary fiber is defined as that portion of plant material ingested in the diet that is resistant to digestion by gastro intestinal secretions.
- The healthiest sources of carbohydrates—unprocessed or minimally processed whole grains, vegetables, fruits and beans—promote good health by delivering vitamins, minerals, fiber and a host of important phytonutrients.
- Energy is the capacity to do work.
- The energy yielding food factors are (i) carbohydrates (ii) fats and (iii) proteins.
- The energy value of foods can be expressed in terms of kilocalories(KCal) or megajoules(MJ).
- Basal Metabolism is the minimum amount of energy needed by the body for maintenance of life when the person is at complete physical and mental rest and having normal body temperature and in the post -absorptive state (12 hours after the intake of last meal).
- Exercise is defined as any movement that makes the muscles work and requires the body to burn calories.
- There are many types of physical activity, including swimming, running, jogging, walking and dancing, to name a few.
- Being active has been shown to have many health benefits, both physically and mentally.

Glossary

| Terms | Meaning |
|-------------------------------|--|
| Detoxification | It is the physiological or medicinal removal of toxic substances from a living organism, including the human body, which is mainly carried out by the liver. |
| Hemorrhoids | They are swollen veins in the lowest part of the rectum and anus. |
| Irritable bowel syndrome(IBS) | It is a group of symptoms—including abdominal pain and changes in the pattern of bowel movements without any evidence of underlying damage. |
| Lean body mass (LBM) | It is a component of body composition calculated by subtracting body fat weight from total body weight. |
| Osteoporosis | It is a condition of fragile bone with an increased susceptibility to fracture. |



Questions

Part - A

Choose the correct answer: (1 mark)

1) One gram of carbohydrate yields _____ kilocalories.

- a) 4
- b) 5
- c) 9
- d) 3



2) _____ is the only source of energy for the CNS.

- a) lactose b) sucrose
- c) glucose d) fructose

3) Sucrose on hydrolysis gives _____

- a) Glucose and fructose
- b) Glucose and galactose
- c) Glucose and lactose
- d) Glucose and Glucose

4) _____ is an intermediate product formed during starch hydrolysis.

- a) dextrin b) amylase
- c) lactase d) sucrose

5) Fructose is also known as _____.

- a) levulose b) dextrose
- c) sucrose d) glucose

6) BMR increases by _____ percent for every degree Fahrenheit rise in body temperature.

- a) 7 b) 13
- c) 15 d) 8

Part - B

Write short answer: (2 marks)

- 1) What are carbohydrates?
- 2) Give any 2 food sources of complex carbohydrates

3) What is malt sugar?

4) What are amylases?

5) What are pectins?

6) Define Basal metabolism.

7) List any 2 benefits of regular physical activity.

Part - C

Answer in brief: (3 marks)

- 1) What is meant by protein sparing effect of carbohydrates?
- 2) Differentiate between soluble and insoluble fibres.
- 3) What are healthy carbohydrates? Give examples.
- 4) What is glycogen? Give its functions.
- 5) What is the physiological fuel value of the macronutrients?
- 6) What is meant by gross energy value of foods?

Part - D

Answer in detailed: (5 marks)

- 1) What are the functions of carbohydrates?
- 2) What is dietary fibre? Explain the types of fibre with their food sources.
- 3) How can you determine the energy value of foods?
- 4) What are the factors affecting BMR?
- 5) What are the benefits of regular physical activity?