

Unit -2

ENERGY

DEFINITION

Energy is defined as the ability to do work. The first and foremost function of food is to supply energy to the body. When food is digested, the complex nutrient like carbohydrates, fat and proteins are broken down into monosaccharide, fatty acids+ glycerol and amino acids respectively. These simple forms are absorbed into the bloodstream and supplied to the millions of cell in the body to be oxidized to release energy.

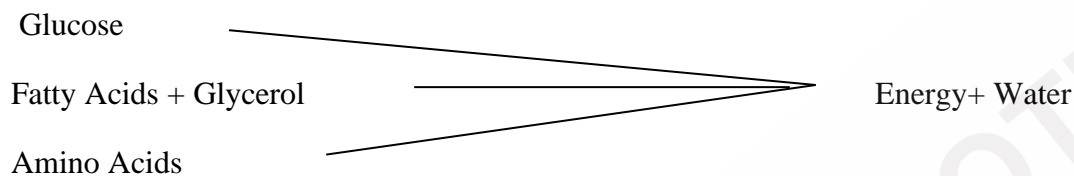


FIG 1: OXIDATION OF NUTRIENTS TO RELEASE ENERGY

On oxidation of nutrients energy is released. This energy is used to perform various activities in the cell such as synthesis of protein, maintaining warmth and contraction of muscles.

- The energy from the breakdown of food is stored in the body in the form of high energy compound, adenosine triphosphate (ATP).
- ATP acts as a store of energy rich phosphate bonds.
- Living cell can use energy only in the form of energy rich phosphate bonds.
- When energy is required ATP is converted to ADP.
- One mole of ATP provides 8 kcals of energy.



FIG 2: RELEASE AND TRANSFER OF ENERGY

UNITS OF MEASUREMENT OF ENERGY

The energy present in food the energy needed by the body is measured in units call joules or calories. Calories are also known as kilocalorie in nutrition. Kilocalries is defined as the amount of heat required to raise the temperature of 1 kg of water by 1° C.

A joule is defined as the energy required to move 1kg mass by 1 meter by force of 1 Newton acting on it. One Newton is the force needed to accelerate 1kg mass by 1 metre per second.

1Kcal = 4.184 KJ

The energy content of various foods can be measured in two ways by bomb calorimeter and proximate composition

carbohydrates yield 4kcal protein yield 4 fat yield 9 kcal
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The energy requirement of an individual is the level of energy intake from food that will balance energy expenditure.

FACTORS CONTRIBUTING TO ENERGY REQUIREMENT

The total energy required by a person is sum total of basal energy needs, activity. Energy is needed for growth, for maintenance, for many processes continuously taking place, for maintaining body temperature and for physical and mental activity.

Activities that need energy are:

Voluntary activities – activities which are under ones control such as walking, sitting.

Involuntary activities – these activities which take place by body itself. They are not under our control, thus vital for our survival eg. Body temperature, heartbeat,

These involuntary activities need energy and referred to as basal metabolism

Total energy needed by body = Basal Metabolic Rate +Specific Dynamic Action +Physical activity
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The amount of energy required by the body for carrying out involuntary work is known as basal metabolic rate (BMR)

The involuntary work includes the functioning of various organs and systems which continuously to keep body processes going such as heart and blood circulation.

FACTORS AFFECTING BMR

- I. **BODY SIZE** – Heat is continuously lost through the skin. A tall well built person has greater skin surface area than a shorter person will lose more heat through skin and hence has a higher BMR.
- II. **BODY COMPOSITION** – The amount of muscle tissue and adipose tissue on the body affects the BMR. Eg. Athlete with well built body has a higher BMR. The metabolic activity is much more as compared to adipose tissue.
- III. **AGE** – During periods of rapid growth , BMR increases by 15 – 20 % because the growth hormone stimulates cell metabolism and new cells are formed. It is high during infancy, preschool years, and puberty. BMR gradually declines with age at the rate of 2% for each decade, after the age of 21 years.
- IV. **SEX** – The BMR is 10% higher in males as compared to females. The difference is because of higher proportion of adipose tissue in females and hormonal variations between the sexes.
- V. **FEVER**- Fever increases the BMR by 7% for each degree Fahrenheit rise in body temperature. This is one of the reason for weight loss during fever.
- VI. **STATE OF HEALTH**- BMR is low during starvation and in state of under nutrition due to reduction in muscle tissue.
- VII. **HORMONES**- Disorders of the thyroid gland influence the BMR. Hyperthyroidism increases BMR. Hypothyroidism decreases BMR.
- VIII. **CLIMATE**– BMR rises in cold temperature in order to maintain normal body temperature. In very warm climate BMR may increase by trying to reduce body temperature.
- IX. **PSYCHOLOGICAL TENSION**– Worry and anxiety increases BMR

SPECIFIC DYNAMIC ACTION (SDA)

SDA is the effect food has in increasing the metabolic rate above

The level found when fasting. Energy is needed to digest, absorb and metabolize the food we eat. Food intake stimulates the metabolism process leading to an increase in energy expenditure. This is known as the thermogenic effect of food or SDA. Proteins have maximum effect on SDA increasing the BMR by 30% while carbohydrates and fat show smaller increase.

PHYSICAL ACTIVITY

Physical activity increases the energy requirement about the basal metabolism. Physical activity includes energy needed for work, recreation and mental activity- all voluntary activities. Physical activity can be:

Sedentary – teaching, office work, housewife role

Moderate- farming, driver, maidservant

Heavy – stone cutter, miner, and wood cutter

ENERGY BALANCE

Human body is constantly using energy which needs to replace. For this a constant supply of energy is required. The body has of energy store.

1. GLYCOGEN- carbohydrates are stored in muscle and liver.
2. PROTEIN – is stored in limited amounts in muscle
3. ADIPOSE TISSUE – fat is stored in adipose tissue

Energy balance is a condition in which the energy provided by food is nearly equal to that expended by the body resulting in steady energy expenditure, weight gain occurs initially, leading to obesity.

$$\text{BODY MASS INDEX (BMI)} = \frac{\text{Weight (in kg)}}{\text{Height (m}^2\text{)}}$$

TABLE 1: BMI CLASSIFICATION

BMI	VALUE
Normal	18.5-24.9
Overweight	25-29.9
Obesity grade I	30-34.9
Obesity grade II	35-39.9
Obesity grade III	>40

A) Overweight is a condition in which person weight 10% more than normal standards.

Obesity is 20% more than normal standards.

Health hazards- excessive calories consumption leads to accumulation as in adipose tissues leading to obesity which forms the root cause of all the problems like joint pain ,decreased efficiency of work, lethargy, heart diseases etc.

B) Under weight- When the energy intake is less than the need of the body then it leads to utilization of all the body reserves for energy, then it leads to condition of underweight.

It is caused due to under nutrition which is due to consuming insufficient quantity of food.

Other cause of underweight are poor assimilation of food due to digestive disorders , infection , intestinal problems , poor food habits, poverty , poverty and lack of nutrition knowledge.

Health hazards -----undernutrition affects growth especially in the case of children, health and other vital functions of the body.

DIETARY SOURCES OF ENERGY

All food provides energy. Carbohydrates and fat are mainly consumed for energy. Fats and oils are the concentrated sources of energy. Nuts and oilseeds contain high amount of energy. All refined carbohydrates like sugar, starch.

Eg . In order ghee / oil>Butter> walnut>coconut>groundnut roasted>soybean>sugar>rice/wheat>red gram dhal>egg

HOLLOW CALORIES also called as empty calories. Those food which are rich in energy but lack other vital nutrients provide hollow calories. E.g. Aerated soft drinks, chocolates.

NUTRIENT DENSE those foods which are rich in one or more vital nutrients apart from calories. Eg. Milk, cheese, Yoghurt, soyabeans. Pulses, sprouts, egg, amla, liver fish
