



Uttar Pradesh Rajarshi Tandon Open University

UGHN 101- Fundamentals of Food and Nutrition

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Uttar Pradesh Rajarshi Tandon Open University

UGHN 101- Fundamentals of Food and Nutrition

Block I: Introduction of Food and Food Groups

Block II: Introduction to Milk, Poultry Products and Facts and Oils

Block III: Methods of Cooking and Cereals Utility

Block IV: Nutrient, Functions, Vitamins and Minerals

BLOCK - I INTRODUCTION

The most fundamental need for survival is food sources. Everyone consumes food, and most individuals do it with pleasure. Scientists have always been interested in the food people eat, how it moves through the body, and what consequences it has. The science of nutrition was developed as a result of this curiosity. The scientific study of food and its relationship to health is referred to as nutrition. It may also be described as the branch of science that studies how the body uses food for growth, energy, and health maintenance. Nutritional therapy is widely practiced in our nation either alone or in combination with medication for centuries. Today, food plays a significant role in our lives. We now understand that the level of our physical wellness is influenced by the nutrition we provide our bodies. But a variety of circumstances affect our eating behaviors. This block is made up of seven units, which are listed following:

UNIT-I Introduction of Food and Functions Of Food

UNIT II Selection, Nutritional Contribution and Changes During Cooking Of Cereals

UNIT III Selection, Nutritional Contribution and Changes During Cooking Of Pulses

UNIT IV Selection, Nutritional Contribution and Changes During Cooking of Fruits And
Vegetables

BLOCK II Introduction to Milk, Poultry Products and Facts and Oils

UNIT V Milk and Milk Products

UNIT-VI Eggs, Meat, Poultry and Fish

UNIT VII Fats and Oils

We anticipate that the following details will be useful in helping you adhere to the nutritional and food-safety needs of those you love, and the community as a whole.

UNIT-I INTRODUCTION OF FOOD AND FUNCTIONS OF FOOD

You will learn the definitions of nutrients, food science, food and nutrition in the current unit. You will additionally learn about the way we feel towards food are affected by societal and physiological variables.

Structure

1.0 SCOPE

1.1 OVERVIEW

1.2 INTRODUCTION OF FOOD

1.2.1 BASIC CONCEPTS IN FOOD AND NUTRITION

1.2.2 Learning about the relation between Nutrition, Diet and Health

1.3. FUNCTIONS OF FOOD

1.3.1 Physiological, Psychological and Social

1.3.2 Food Groups

1.3.3 Food Pyramid

1.3.4 Definitions and terms used in Food Science and Nutrition Health, Food, Nutrition and Nutrients

1.4 LET US SUMMERISE

1.5 GLOSSARY

1.6 EXERCISES TO CHECK YOUR PROGRESS ANSWERS

1.0 SCOPE

You will be able to do the following after studying this unit:

- Discuss Basic concepts in food and nutrition
- Describe Understanding relationship between food Nutrition and Health
- Explain Functions of Food, food groups, food pyramid
- Definitions and terms used in Food Science and Nutrition Health, Food ,Nutrition and Nutrients

1.1 OVERVIEW

Every living thing needs food. Food is what we consume to maintain our health, growth, and ability to work, play, and grow. Foods can be viewed as a composite mixture of different chemical components that, when consumed, satisfy both hunger and taste. One of our fundamental needs is food. Our existence has always depended on Nourishment. As you learn more about the science behind foods and nutrition, you have to carefully evaluate your beliefs about food and choose either to accept or reject them. You should use whatever you study in the course in daily life.

1.2 INTRODUCTION OF FOOD

All of the food that is present in nature is not consumed by civilized people. Before eating, they chop, smash, cool, prepare, and change in a number of ways to provide diversity to the diet. You can determine the nutritional value of foods by studying dietary composition. You may have heard that some meals are essential for sustaining good health. We now have a plethora of knowledge about how to utilize food to guarantee kids and young people grow, in order to stay healthy throughout life, to meet the unique demands of nursing and motherhood, as well as for usage in using it to heal from illness.

1.2.1 BASIC CONCEPTS IN FOOD AND NUTRITION

Nutritional science investigates how food interacts with a person to maintain and improve health. All bodily parts obtain and utilize the nutrients necessary for their tasks, as well as for the growth and regeneration of every component (rejuvenation), through a series of processes known as nutrition.

Food may be a substance which is consumed for the nutritional, growth, and reproductive purpose.

The definition of optimal nutrition involves getting and using vital nutrients in the right amounts as needed by the body, but also maintaining a "reserve."

"State of complete physical, mental and social well being and not merely the absence of disease and infirmity" definition given by WHO (World Health Organization)

The following are some of the main requirements (or qualities) of "health":

- Obtaining optimal growth and development while fully expressing one's hereditary ability.
- Maintaining the structural uprightness and functional productivity of the body tissue required for a healthy and constructive life. The capacity to age with minimum disability and impairment in function, and
- The capacity to fight illness, including
 - (a) The ability to fend off infections (immune competence),
 - (b) The ability to halt the progression of cancer and degenerative diseases, and
 - (c) The capacity to fend off the effects of environmental poisons and pollutants.
- Mental Health
- Happiness in society is the capacity to coexist peacefully with other people.

Vital nutrients are the component in food which might be provided to the physique in sufficient quantity such as Carbs, Fats, Proteins, Vitamins and minerals as well as Water.

A person's nutritional status is their state of health as it relates to how well they use their nutrients. It can only be established by comparing the data gathered through a rigorous medical and nutritional history, a thorough physical examination, and the right scientific analysis.



Fig1.1 Essential Nutrients

1.2.2 LEARNING ABOUT THE RELATION BETWEEN NUTRITION, DIET, AND HEALTH

The foods we eat affect our health. Consuming a diet rich in the right nutrients in the right levels is crucial for maintaining good health. A balanced diet comprises various kinds of food in enough amounts as well as proportion which are requirement for energy, fats, proteins, vitamins and minerals is sufficiently supplied, and a small amount of supplements prevent short-term weight gain.

In promoting health, diet has always had a vital role to play. The general welfare of human beings is strongly influenced by the quality of nutrition. The foods we eat have an influence on our state of health and wellness. Malnutrition occurs when there is a deficiency in the intake and use of nutrients. Lack of nutrition may have an impact on energy levels, alertness, mobility, stability and healing. An imbalance in nutritional intake due to large quantities of one or more food types leading to obesity, protein energy malnutrition etc. or specific, i.e. excess nutrients that are possibly caused by poor eating habits or underlying disease such as vitamin C deficiency, iron deficiency anemia etc.

The deficiency in nutrients caused by the lack of food intake is called undernutrition. This has a major effect on how much of the nutrients in your body are balanced. Serious health and nutritional problems, like weakened immunity, recurrent infections, hormone changes, decreased body fat index, reduced efficiency of work, lower growth in children, higher costs for medical treatment or even a decline in quality of life can result from the absence of adequate nutrition when combined with an unhealthy diet.

Overnutrition is the opposite of undernutrition, which is caused by the frequent or habitual consumption of nutrients by eating too much food that is dangerous to health. Even if most nutrients are harmful in excess, the risk of overnutrition is mainly due to carbohydrates and fats. Obesity, which occurs because of the accumulation of an excessive amount of body fat, is a serious form of malnutrition.

Obesity increases the chance of developing chronic diseases that include high blood pressure, Type 2 diabetes, cancer, stroke, coronary artery disease, joint pain, problems with the liver, breathing problems, and restricted movement. The health effects of these disorders vary from premature mortality to disability.

Consequently, correct eating choices that result in excellent nutrition might provide the following benefits:

- Promotion of children's optimum prospective growth and development
- The risk of developing chronic diseases like Heart disease, Cancer, Diabetes, Obesity, Osteoporosis, Iron deficiency, and Dental Caries (Cavities) has decreased.
- Have healthy, productive life.

ASSESS THE PROGRESS OF YOUR SESSIONS 1

1) What do you understand by basic principles in Nutrition?

2) What are the basic relationships between Food, Nutrition and Health?

3) How do you understand the term “Under nutrition” and “over nutrition”?

PHYSICAL ACTIVITY 1

- 1) Create a poster illustrating the signs and measures to prevent obesity.

1.3. FUNCTIONS OF FOOD

All living things require food to survive. Food may be categorized based on its functions in the body.

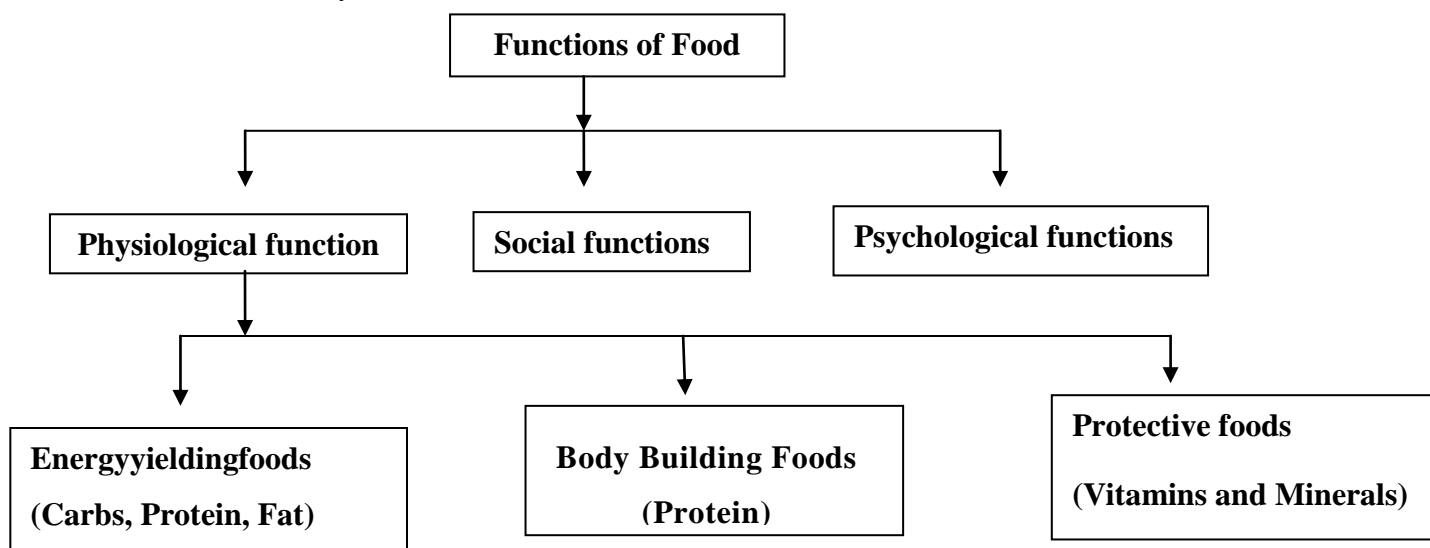


Fig 1.2 Functions of Food

What we consume, which nourishes our bodies, is referred to as "food." It consists of solids, semi-solids, and liquids. It should be palatable, or 'edible' and nourish our body also. The food we consume needs to be harmless and include all of the nutrients our bodies require. We must consume a broad range of meals and do so on a regular basis, throughout the day. Keep in mind that the food we eat must taste good and look, odour,

and be enjoyable. Inadequate nutrition, kids as well as teenagers may not reach their full potential, and elderly struggle to perform at their best.

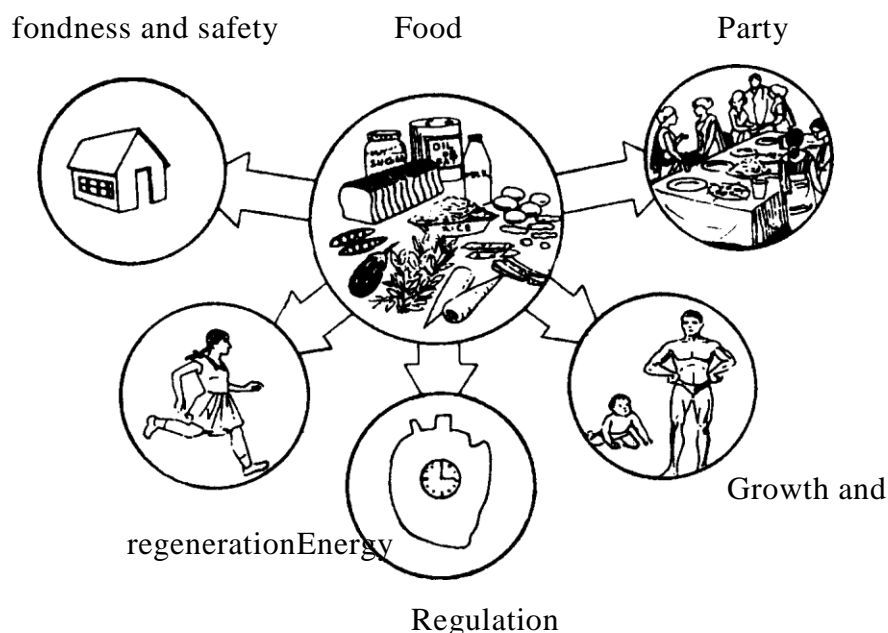


Fig 1.3 Various functions of Food

i. Energy yielding foods

That category contains foods overwhelming in carbohydrate, fats as well as protein. 1 gram of carbohydrate has 4 calories. 1 gram of protein has 4 calories. 1 gram of fat has 9 calories. These could be classified into two different categories such as:

- Cereals, Pulses, Roots and tubers
- Carbohydrate like sugars, Oils and Fats

Grains of cereals contribute good quantities of proteins, minerals, and vitamins to the food along with energy. Along with providing energy for the body, pulses also include protein and B vitamins. Despite the fact that roots and tubers primarily give energy, which also contribute less amount of minerals and vitamins. Simple carbohydrates, such as sugar, solely contain energy (i.e., empty calories) but fats also include concentrated

energy sources.

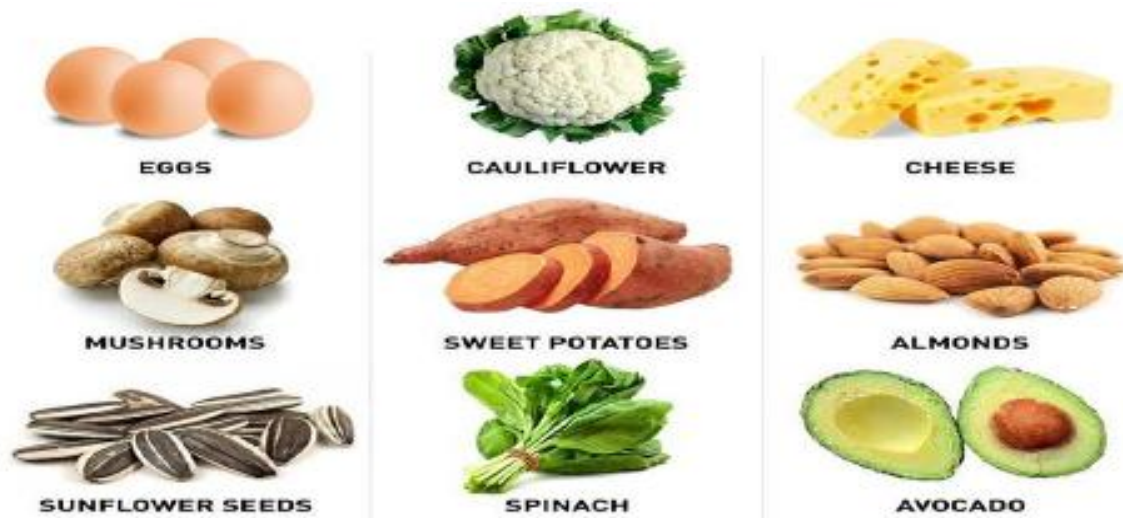


Fig 1.4 Energy giving foods

ii)Body Building Foods

Protein-rich diets are known as "body building foods." These are divided into two categories.

- Milk, meat, eggs and seafood:

They include a lot of proteins with significant biological importance. These kinds of proteins contain all of the necessary proteins needed in the appropriate amounts towards the formation of body tissues.

- Pulses, nuts, and oil seeds:

Despite having high protein content, they are unable to supply the entire range of amino acids needed for the body of a person to function properly.

ASSESS THE PROGRESS OF YOUR SESSIONS 2

- 1) Fill in the blanks.**

- Body building foods are those that are high in _____.
- _____ are good in protein of high biological value.
- 1 gram of carbohydrate provide _____ calories.
- 1 gram fat provide _____ calories.
- Nuts and oilseeds are rich in _____.



Fig 1.5 Body building foods

iii) Protective foods

Food that contains vitamins, protein as well as minerals serve as regulators in the body as keep the body's temperature, water balance, and heartbeat are roughly divided into two categories.

- Vitamin and high in minerals foods, as well as high-biological-value proteins, such as milk, eggs, salmon, and liver.
- Foods those are particularly high in a certain vitamin or mineral, such as some fruits and green leafy vegetables.

Table1.1 Function of foods

Food Groups	Food sources
Energy Giving	Wheat, Rice, Millets, Potatoes, Yam,

Foods	Sweet Potatoes
Body building foods	Lentils, Beans, Peas, Green grams, Meat, Eggs, Ground Nuts, Fish, Milk
Protective foods	Vegetables and fruits

ASSESS THE PROGRESS OF YOUR SESSIONS 3

1) Give the names of five foods that help us stay healthy.

- a) _____
- b) _____
- c) _____
- d) _____
- e) _____

2) List five foods that give us energy.

- a) _____
- b) _____
- c) _____

1.3.1 PHYSIOLOGICAL, SOCIAL AND PSYCHOLOGICAL FUNCTIONS

- **Physiological functions of food.**

The body's initial purpose is to give you energy. The body requires energy to support the natural functions required for life to continue, to perform professional, home, and leisure activities, to transform food taken into useable nutrients in the body, to develop, and to remain warm. The process of oxidation of the nutrients ingested provides the required energy. What we eat becomes a part of us. Thus, one of the more significant roles of eating is body formation. If the proper types and quantities of food are consumed via birth until adulthood, a newborn infant weighing 2.7-3.2 kg may grow to its full adult size of 50-60 kg. Daily dietary intake contributes to the maintenance of the adult body's composition and the replacement of the body's worn-out cells.

The key role of food is to control bodily activity. It governs a wide range of activities, including:

- Heart beating
- Keeping the body temperature stable
- contraction of muscle
- water balance controls
- blood clotting
- Elimination of waste through the body
- The 4th purpose of eating is to increase our body's ability to fight against illness.

• **Social Functions of Food**

Our social existence consistently has been focused on food. Our community's social, cultural, and religious lifestyle has included it. At religious events held in homes, temples, and churches, special delicacies are given out as *prasad* or a blessing. Celebrations are held at particular life's stages, including birth, naming ceremony, anniversaries, marriages, etc. The majority of religious occasions require that certain groups of people be fed at feasts. Most of these feasts are connected with specific cuisine in each location.

Food has long been used to communicate affection, camaraderie, and acceptance by society. *Pedha* are given out for a successful exam or the birth of a child, *laddus* are connected with Deepawali festivals and weddings, desserts are mostly served in birthdays parties, and *tilgul* is linked to with the occasion of happiness. *Sankranti* is also celebrated with friendship and happiness.

Because food is such a crucial component of our societal existence and its role is essential in routine lifestyle. A comfortable mood is produced by the provision of refreshments during gatherings. The food for such a gathering should draw people together rather than separate them. This fundamental component must be addressed while creating menus for such events.

• **Psychological Functions of Food**

Foods help people with their emotional demands in addition to their bodily and social needs. They consist of acceptance, affection, and a feeling of security. Making delectable meals for family members, for instance, is a sign of care as well as affection.

Each of us has emotional needs, such as the desire for safety and love. Food can be crucial in satisfying these demands. Making the child's favourite food is one way a mother may show her child how much she cares. Giving food away as a kind of punishment for bad behaviour is also an option. When given food they are accustomed to eating, people feel confident and at ease. Many people utilize food as a way to relieve stress and irritation, whereas others who are sad and lonely may eat less or refuse meals. Sago *kheer* and *Khichdi* are two dishes that may be connected to illness, whereas *Pedha* is connected to good news. As a result, eating is closely related to feeling and mood.

ASSESS THE PROGRESS OF YOUR SESSIONS 4

- 1) Explain the body-building function of food.

- 2) Mention the societal significance of food.

PHYSICAL ACTIVITY 1

- 1) Which foods are commonly linked with the following types of events/situations that are made in your family's house?
 - a) Birthday party
 - b) Marriage
 - c) Holi, Deepawali, Makar Sankranti

1.3.2FOOD GROUPS

Because they contain equivalent amounts of the necessary nutrients, foods are arranged together in order to meet your body's dietary needs for optimum health, you must eat a variety of foods through each of the five categories of food each day in the given quantities.

For the convenience of preparing meals, foods have been divided into distinct groups based on their nutritional content. Meals can be planned according to convenience using food groupings like "Basic Four," "Basic Five," or "Basic Seven."



Fig 1.6 Five Basic Food Groups

- **BASIC FOUR**

S.No.	Group	Nutrients
1.	Cereals, Millets and Pulses	Energy, Protein, B-Vitamins
2.	Vegetables and Fruits	Vitamins, Minerals and Fibre

3.	Milk, Milk products, and animal foods	Protein, Calcium B-vitamins
4.	Oils,Fats, Nuts and Oilseeds	Energy ,Protein (Nuts and oil seeds)

II Basic Five: ICMR

Group	Nutrients
Cereals, Grains and Products: Rice,Wheat,Ragi,Maize, Bajra,Jowar,Riceflakes, puffed rice	Energy, Protein, Invisible Fat,Thiamine, Folic Acid,Riboflavin, Iron and Fibre
Pulses and Legumes: Bengal gram, Black gram, Cow pea, peas(dry) Rajma, Soya,Beans	Energy, Protein, Invisible Fat,Thiamine, Folic Acid,Riboflavin, Calcium, Iron and Fibre
Milk and Meat Products i) Milk,Curd, Skimmed Milk, Cheese ii) Chicken,Liver,Fish,Egg And Meat	Protein, Fat, Riboflavin, Calcium,Protein, Fat, Riboflavin
Fruits and Vegetables: Fruits : Mango, Guava, Tomato Ripe,Papaya, Orange. Sweet Lime,Watermelon. Vegetables (Green Leafy) : Amaranth, Spinach, Gogu,Drumstickleaves, Coriander leaves, Mustardleaves, Fenugreek leaves . Other Vegetables : Carrots, Brinjal, Ladies finger, Capsicum, Beans, Onion,Drumstick, Cauliflower.	Carotenoids, Vitamin –C, Riboflavin,Folic Acid, Iron, Fibre. Riboflavin,Folic Acid, Calcium,Fiber,Iron, Carotenoids, Carotenoids,Folic Acid, Calcium And Fibre
Fats and Sugars : Fats :Butter, Ghee, Hydrogenated Oils,Cooking Oils like Groundnut,Mustard, Coconut. Sugars :Sugar, Jaggery	Energy, Fat, EssentialfattyAcids and Fat Soluble Vitamins Energy, Iron (From Jaggery)

III. BASIC SEVEN

Groups	Nutrients
Green and Yellow Vegetables	Carotenoids, Ascorbic acid, and Iron
Oranges, Grape Fruit, Tomatoes or Raw Cabbage	Ascorbic acid
Potatoes, Other Vegetables And Fruits	Vitamins and Minerals in general and Fibre of Cellulose
Milk and Milk Products	Calcium, Phosphorus, Protein and Vitamins
Meat, Poultry, Fish and Eggs	Proteins, Phosphorus, Iron and B Vitamins
Bread, Flour and Cereals	Thiamine, Niacin, Riboflavin, Iron, Carbohydrate and Fibre
Butter or Fortified Margarine	Vitamin A and Fat

While planning a balanced diet, include dishes from each category in sufficient amounts. You should consume enough grains and pulses, various fruits and vegetables, good amounts of animal products, and little to no oils and sweets.

PRACTICAL ACTIVITY 2

- 1) You group foods and discuss about their nutritional value.

ASSESS THE PROGRESS OF YOUR SESSIONS 5

- 2) Which nutrients do cereals, millets, and pulses give us when we eat them?

1.3.2 Nutrient Density

It is the amount of a variety of nutrients provided by a food in relation to its actual amount of calories. When comparing the proteins content of isocaloric servings of dhal, bread, and dairy products, you will find that dhal has the greatest nutritional density for protein, followed by milk, while bread has the lowest. Therefore, nutritional density should be taken into account while choosing foods that are suitable for the diets of youngsters, pregnant women, nursing mothers, and patients on diets for therapeutic purposes.

1.3.3 Function of Nutrients

We consume a variety of foods on a regular basis, including grains such as wheat and rice, dal, fruits and vegetables, eggs, dairy products, meat, fish, sugar, fat, and oils. These various foods include a various types of chemical substances referred as nutrients. These nutrients are categorized referring to their chemical constituents. Although every component category serves a distinct purpose, every nutrient requires cooperation together to be successful. Carbohydrates, proteins, lipids, mineral, vitamins as well as water are the nutrients that are present in food. Another crucial element of our daily meals is fibre.

Carbohydrates: Foods that include carbs include the starch from grains and sugar from sugarcane and fruits. The major function of carbohydrates' is give energy to our body. Those which are not used immediately for this reason are retained as glycogen or converted to fat and preserved, to be used for supply of energy whenever required.

Fat: Examples of fats that may be present in diet include lard by beef, cream from milk as well as the oils contained in seeds. In addition to serving as transporters for vitamins that are fat-soluble and being a supplier of important fatty acids, fats constitute significant as suppliers of energy. Excessive fats in foods are retained as fat accumulated within the body. Extra energy consumed than the body requires becomes deposited as fat.

Protein: Casein from dairy products, albumin from eggs, globulins from legumes, while gluten from wheat are all kind of proteins that are present in the diet. Proteins are mostly used in the

the growth of new tissues in addition to maintaining and making repairs of previously established tissues. Additionally, the manufacture of regulatory and defense-related molecules including enzymes, hormones, and antibodies involves the use of dietary proteins. Ten percent of the total amount of energy utilized by the diet comes from proteins. Protein that is taken in surplus of what the body needs is converted into fats and carbohydrates and retained as fat in the body.

Minerals: Minerals such as phosphorus, iron, calcium, iodine, salt, potassium, and many more can be identified in a range of foods that include both inorganic and organic ingredients. Minerals are necessary for the development of the muscles, bones, teeth, and structural elements of tissues that are soft. It also helps to regulate a variety of biological processes, such as blood clotting, neuron activation, contractions of muscles, and several more.

Vitamins: Diet includes both water-soluble vitamins C and B group and fat-soluble vitamins A, D, E, and K. These are essential for development, healthy bodily operation, and regular bodily functions.

Water: We obtain water via the meals and drinks we consume, as well as from the water we drink directly. Our bodies are mostly made up of water, which makes up around 60% of our total body weight. Water is required for the body to utilize nutrients as well as to eliminate waste. It regulates biological activities such as controlling temperatures.

Everyone needs similar nutrients to live a life of wellness. The sole difference is the amount of every nutrient required based on characteristics such as age, size, activity level, and so on. Everyone needs energy for work, although a man who carries goods may need more than a man who sits at a desk in a work environment.

You probably already know that we get our nutrients from the food and drinks that we consume. The majority of diets contain the nutrients at various levels.

ASSESS THE PROGRESS OF YOUR SESSIONS 6

- 1) Why are nutrients crucial to maintaining our health?

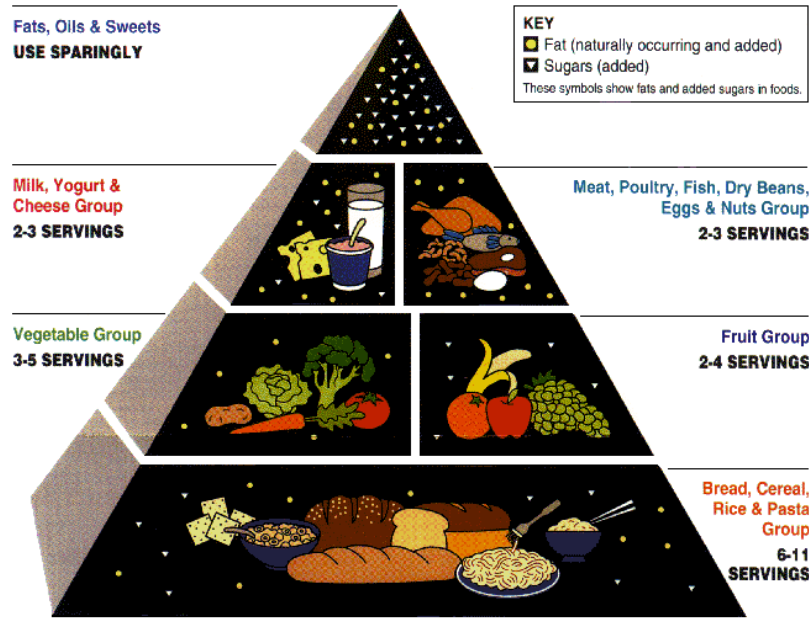
1.3.3FOOD PYRAMID

The food pyramid is designed to be used by the majority of healthy people as a reference for the kinds of foods and their proportions to be present in a routine diet. The food pyramid has been created to help for choosing foods from each dietary group. To maintain excellent health, the food pyramid makes it very explicit that we should eat something from all five food categories. In addition, it advises us to take fewer of the foods at the high of the food pyramid, like as sugars and lipids, in comparison to the cereals and pulses at the base of the pyramid. The food pyramid may be used to design a balanced diet and make it easier to choose substitute foods. It also promotes optimum health.

The US Department of Agriculture produced the Food Guide Pyramid in 1992. It has six food categories and was created to reflect changing consumer eating patterns and to provide the department's official advice on what is healthy for humans. The pattern gradually becomes narrower as it ascends from a wide base. The six food categories are arranged in the pyramid according to their daily portions and importance:

1. 6 to 11 serving of bread, cereal and pasta
2. 3to5portionofvegetables
3. 2to4servingsoffruits
4. 2to3servingsofmilk,yogurtandcheese
5. 2to3servingsofmeat,poultry,fish,beans,eggsandnuts
6. Oils, fats, and sugars are at the top of the pyramid and take up the least amount of space.

The "my pyramid" version, which was revised in 2005, helped people pick the proper foods and servings to balance their physical activity. Any healthy person over the age of two is intended to use it.



Source: https://commons.wikimedia.org/wiki/File:USDA_Food_Pyramid.gif

Fig 1.7 Food Pyramid (Source: Food guide pyramid, USD)

1.3.4 DEFINITIONS AND TERMS USED IN FOOD SCIENCE AND NUTRITIONHEALTH, FOOD, NUTRITION AND NUTRIENTS

Food Science: Food science is a synthesis of several distinct chemical substances. Food science is the study of the changes that present in these nutrients while preparing food which are organic or produced through handling processes. When food is prepared, numerous physical and chemical reactions take place. Understanding the nutritional content of various foods and how to preserve them during cooking are also important aspects of food science studies.

Nutrition: The process through which living beings obtain the nourishment they need to be healthy is known as nutrition. The study of all bodily functions that depend on the breakdown and assimilation of food, as well as the analysis of that food, is known as nutrition.

Health: The WHO defines health as "a state of complete physical, mental, and social well-being, rather than merely the absence of disease or infirmity."

Food: The substance consumed through food helps the body satisfy its demands for growth, energy, maintenance of health, and reproduction.

Nutrients: Nutrients are essential for the body to grow, reproduce and live a healthy life. Nutrients are dietary ingredients. Proteins, water, lipids, carbs, vitamins and minerals comprise the nutrients.

Food Technology: Food technology refers to the science and engineering of processing and preserving large quantities of food using food science principles.

ASSESS THE PROGRESS OF YOUR SESSIONS 7

1) What do you understand by the term nutrients?

2) What is food pyramid?

3) How do you apply your understanding of nutrition?

1.4 LET US SUMMRISE

The most fundamental requirement for existence is food. Everyone eats, and the majority of people prefer it. Today, nutrition plays a crucial role in our daily lives. We now understand that how well the cells in our bodies are nourished determines the quality of our health. Many people eat what they want or because it is the norm or out of habit. The fact that they are aware of a food's nutritional content has no impact on their choice of food. Few individuals are aware of how the body uses food. It's also important to understand that tasty food doesn't always mean this is healthy.

Having a healthy diet is a goal that every person can achieve. The secret to success is to adopt moderation in all we consume. It is important to make accurate choices while choosing among the many meals on the market. Convenience meals come in a wide range and are designed to make life easier for modern housewives who might also be using them. They can only be used to supplement the daily diet. Never forget that no single meal can supply all the nutrients needed for a healthy lifestyle. Choose natural meals and eat things that will meet your dietary requirements.

1.5 GLOSSARY

Food: Foods are materials that are ingested by humans for food, sustenance, and enjoyment in their naturally occurring, processed, or prepared forms.

Nutrition: People get the nutrients they need to develop and maintain their health through the processes that occur when they eat certain foods.

Culture: A community-accepted activity

Fruits: Fruits represent the part of plants delicious soft, and eatable component.

Cereals: any kind of grain which may be consumed or turned into flour

Legumes: any plant that produces elongated seed pods. Beans and peas

Meat: The edible portions of animals or birds that are consumed by humans.

Bajra: Pearl millet is a variety of millet that is widely cultivated in the northwestern region of India and can be processed into flour.

1.6 EXERCISES TO CHECK YOUR PROGRESS ANSWERS

Assess the progress of Your Sessions 1

1. The following information should be in your response:

- Fundamental requirements (or qualities) of "health"
- Basic concepts in food and nutrition

2. The following information should be in your response:

- Understanding relationship between food, Nutrition and Health

3. The following information should be in your response:

- Under nutrition and over nutrition

Assess the progress of Your Sessions 2

1) a) Protein, b) Milk, Egg, Meat c) 4 calories d) 9 calories e) energy

Assess the progress of Your Sessions 3

1) Milk, egg, Cereals and millets

2) Rice, Potatoes, Wheat

Assess the progress of Your Sessions 4

- Protein-rich food is referred to as "body building foods." High-quality proteins are abundant in dairy products, meat, eggs, and seafood. Considering the fact that nuts and pulses are rich in protein while the protein is of inferior quality. That foods support growth and support life. They also provide the energy.
- Social Functions of Food

Assess the progress of Your Sessions 5

1) Energy, Protein, B-Vitamins, fiber, carbohydrates

Assess the progress of Your Sessions 6

All humans need the same nutrients for their bodies to function properly. The amount of each

nutrient required based on variables like age, size, activity level, etc. is the sole variation. Everyone requires energy for work, but men who move heavy objects may need more than men who sit at desks all day.

Assess the progress of Your Sessions 7

- 1) Nutrients are essential for the body to develop, reproduce and live a active life. Nutrients are dietary ingredients. Proteins, water, lipids, carbs, vitamins and minerals comprise the nutrients.
- 2) The food pyramid is designed to be used by the majority of healthy people as a reference for the kinds of meals and their proportions to be present in a routine diet.
- 3) The metabolic reactions that occur when people consume certain foods provide them with the nutrients they require to grow and sustain their health.

UNIT II SELECTION, NUTRITIONAL CONTRIBUTION AND CHANGES DURING COOKING OF CEREALS

The major dietary items in our regular diet are cereals and millets. You will learn about the appropriate selection, nutritional composition and what modifications occur when grains are cooked within this unit. Students will also learn of different kinds of grains and millet that are eaten in our nation, how they are used in our diets.

Structure

2.0 SCOPE

2.1 OVERVIEW

2.2 SELECTION OF CEREALS

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2.0 SCOPE

After the students complete this course, they will be capable of:

- To know the factors to consider while choosing cereals
- list the nutrients given by grains
- Describe the changes that occur on the grains while cooking.

2.1 OVERVIEW

The seeds of the grass family are cereal grains. The term "cereal" originates from Ceres, a Roman grain goddess. The second-biggest producer of wheat, rice, and other commodities in the world is India. Rice, maize, wheat, sorghum, jowar, ragi, and the bajra are the principal cereal crops. According to The Ministry of Agriculture of India's preliminary estimate for the year

2020-21, output of main grains such as the grain rice, maize, and bajra production was 102.36 million tonnes, 19.88 million tonnes, as well as 9.23 million tonnes, respectively. The most recent information on wheat production is available for the years 2022 and 2023. During those years, the country is predicted to produce a record amount of rice, 1308.37 lakh tonnes, and wheat, 1121.82 lakh tonnes. Along with this, cereals include flour, snacks, breads and rolls, or alimentary pastes or pasta. Cereal meals are consumed widely because they are simple to prepare and store, they are inexpensive, and they provide important nutrients. The majority of people use them as a staple in their diets. Magnesium, which is abundant in millet and is crucial for decreasing blood pressure as well as the risk of heart attacks and strokes, particularly in cases of atherosclerosis, is also a key component. Additionally, millet is a fantastic source of potassium, a vasodilator that reduces blood pressure.



Fig 2.1 Cereal grains

2.2 SELECTION OF CEREALS

The primary foods of the Indian diet include cereals, millets, and their derivatives. Foods must be selected with care as they provide a significant portion of our requirements for calories, iron, protein, and thiamin. There are two factors to grain quality. Physical quality is the first, and it pertains to things like cleanliness, grain soundness, and the absence of extraneous objects. The second factor is processing quality, which refers to usability. For instance, thin long grain rice that does not form clumps during heating is said to be excellent for creating *Pulao*, while *Puran*

poli needs a certain variety of wheat. Let's think about the exact selection criteria for these dishes.

- All the factors stated above are taken into consideration while choosing wheat. The households grind whole wheat for their personal consumption. In India, bread that is unleavened (*chapatti, Puri, parantha*, etc.) is often made with whole wheat flour. There is a virtually minimal nutritional loss in these food preparations. Buyers often purchase the variant that best meets its performance demands. Little is known about how different cultivars function in native wheat preparations. As a result, consumer choice depends on their unique expertise and experience.

Prior to purchasing the cereals, it is important to make the right decision. The following recommendations must be considered in mind while selecting grains:

- Clean grains should be free of impurities like grit and pebbles etc.
- They shouldn't have any fungus, insects, or mould growing on them.
- It is preferable to purchase grains or flour from cooperative stores.
- To guarantee high-quality materials, contact GrahakSanghs or any other cooperative organizations.
- In order for families to use whole wheat, it is often ground. This aids in avoiding market purchases of infected flour.
- Insects, lumps, and mould should not be present in maida.
- Crisp, free of grit, gravel, or sand, *Chirwa* and puff rice should be served.
- Mould and bad smell are not present in high-quality Dhalia.
- Indians desire that after cooking, each rice grain maintain its own identity. This quality in the grain seems to be developed with age. It has been shown that when cooking, older grains tend to absorb more water than their initial volume, but fresher grains only absorb slightly more. As there are currently no defined visual indicators of ageing to help consumers, it is challenging to determine how much rice has aged only on how it looks.
- Choose based on your requirements. Short types of rice perform well for *Khichri*, idli, dosa, and other dishes, whereas long, thin varieties are used to make pulao. Suji in fine forms suits adequately for *Halwas*, whereas upma requires larger Suji particles.
- Fresh bread should be packaged in a manner that is clean. Bread of good quality is soft and has a baked taste.

- Bajra, jowar, ragi, corn, and various other millets are other grains that are utilized as staples. The standards for selection are similar among all grains: soundness of grain, cleanliness, lack of mingling with different grains, and absence of garbage.

ASSESS THE PROGRESS OF YOUR SESSIONS 1

- 1) List the elements to take into account while choosing both rice and wheat grains.

2.3 NUTRITIONAL CONTRIBUTION OF THE CEREALS

- **Energy:** With a contribution of 70–80%, cereals constitute the primary source of energy.
- **Carbohydrate:** In grains, carbohydrates constitute about 80% of the dry matter. Both soluble and crude fibres are types of the two types of carbohydrates that are present. Cellulose, hemicellulose, and pentosans are the constituent of fibre. Starch is the most significant soluble carbohydrate in all grains, and it is also the most numerous. Also present are small amounts of sugar and dextrin. Simple sugars such as glucose as well as disaccharides like sucrose and maltose are among the free sugars that are present. Among all the grains, whole wheat, ragi, and bajra have the highest fibre content.
- **Protein:** Different cereals have varying amounts of protein. Compared to other cereals, rice has lower protein content. Rice has lower protein content than other grains. The protein composition of various cereal kinds differs as well. Proteins are present in all tissues of cereal grains. Protein in cereals ranges from 6–12%, however it commonly lacks lysine. Due to their extensive consumption, they meet more than 50% of the daily protein requirements. Rice protein is of higher quality than the other grain proteins. Due to reciprocal replenishment, when cereals are eaten with pulses, the protein quality is increased. Methionine is abundant and lysine is lacking in cereals. Pulses are high in lysine and low in methionine. As a result, the quality of the protein of both proteins improves.

- **Lipids:** The amount of lipids in wheat, rice, and maize is 1-2% and 3%, respectively. In comparison to other grain components, germ and bran contain more lipids. Lipids make about 6–11% of the wheat germ, together with bran at 3-5% and endosperm at 0.8–1.5%. Maize germ has 35% lipid content, whereas bran has 1% lipid content. The main lipids are triglycerides of palmitic, oleic, and linoleic acids. Phospholipids and lecithin can also be found in cereals.

According to estimates based on cereal consumption, our diet's fat content can provide more than 50% of our demands for critical fatty acids. Legumes and cereals together can satisfy an adult's need for critical fatty acids.

- **Minerals:** Approximately 95 percent of all minerals are made up of magnesium phosphates and sulphates, potassium, along with calcium. In cereals, phytin makes up a sizeable amount of the phosphorus content. In phytin, there is calcium but not phosphorus, which makes them unavailable for absorption. Cereals' phytate content hinders the absorption of iron. Phytate levels in unrefined grains are higher than in refined or polished cereal. The phytate level is decreased during seed germination owing to enzymatic breakdown, while iron availability is increased. Additionally, grains contain extremely trace levels of particular elements which include zinc, copper, and manganese. Cereals are weak suppliers of calcium and iron, with rice perhaps being a particularly inadequate source of those two minerals. The level of polishing affects the content. Calcium and iron may be abundant in ragi. Millets (ragi, bajra, and jowar) are full in fibre and nutrients. Wheat is milled using iron rollers, which increases the iron content of the grain.

- **Vitamins:** Whole grain is a key component of B vitamins that we need in our daily meals. B vitamins are reduced when grains are refined or polished since the outer bran contains almost all of such vitamins. The vitamins in the grain's outer layer penetrate into the grain during parboiling, which involves soaking in water and heating paddy. So, a large portion of the B vitamins are retained in milled and polished parboiled rice. Whole wheat flour has more B vitamins than maida. All cereals, with the exception of maize, lack of vitamin A or C. Vitamin E is abundant in oils derived from cereals grains.

- **Enzymes:** The oxido-reductases, lipases, amylases, and proteases are among the numerous enzymes found in certain grains, and they are significant. An increase in amylase activity

occurs with germination. In comparison, the germ has more proteases. The fatty acids that develop during grain storage and their derivatives are caused by cereal lipases.

Table 2.1 Nutritional composition of Cereals and millets

Food	Energy (Kcal)	Protein (g)	Fat (g)	CHO (g)	Calcium (mg)	Phos-phorus (mg)	Iron (mg)	Thiamin (mg)
Wheat flour (Whole)	341	12.1	1.7	69.4	48	355	4.9	0.49
Wheat flour(refined)	348	11	0.9	73.9	23	121	2.7	0.12
Rice raw (milled)	345	6.8	0.5	78.2	10	160	0.7	0.06
Maize (dry)	342	11.1	3.6	66.2	10	348	2.30	0.42
Bajra	361	11.6	5.0	67.5	42	296	8.0	0.33
Ragi	328	7.3	1.3	72.0	344	283	3.9	0.42

Source: Gopalan et al. (2004)

ASSESS THE PROGRESS OF YOUR SESSIONS 2

1) Name the vitamins and minerals are present in the whole-grain cereal?

2.4 COMMON CEREAL GRAINS

a) WHEAT

One of the oldest and most significant cereal crops is wheat. There are 30,000 species of this kind of plant, which is part of the genus Triticum. The average wheat kernel is between 1/8 and 1/4 of an inch in size. Some varieties of wheat have stiff hairs called "brushes" covering the tips

of each kernel. Wheat grains have rounded in both ends and an ovoid shape. Aleurone is folded in half, and all of the covering layers are creased along one side of the grain.

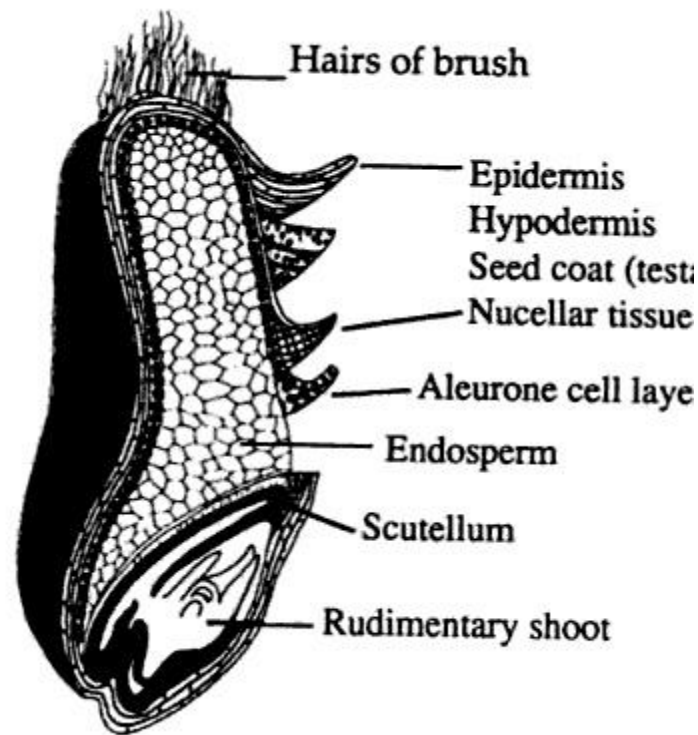


Fig 2.2 Structure of Wheat

Climate and soil variations have some impact on the nutritive value of wheat grains. Protein composition is influenced by the variety cultivated, the climate, and the soil. The percentages of various proteins relative to the total protein in wheat grains are Albumin: 5-10, Globulin : 5-10, Prolamine: 40-50 and Glutelin :40-50. Proteins which are present in wheat have a low tryptophan content and a high glutamic acid content. As glutamine and asparagine, glutamic acid and aspartic acid both are found in the amide form. The feature of the gluten is greatly affected by the high concentration of amide. The proteins in the bran and germ contain more essential amino acids compared to the proteins in the inner endosperm. Therefore, endosperm proteins have substantially lower biological value than whole wheat proteins. Wheat flour includes the

proteins glutelin and gliadin, which are generally referred to as gluten. The grade of the gluten utilised determines the strength of the wheat flour.

Most wheat that is used for food must be treated. The grain is initially cleaned in order to condition it and ensure that the kernel separates correctly. The grain is cracked after which it passed through a series of rollers during the milling process. The bigger particles are transported across rollers for additional reduction while the smaller fragments get sorted. Approximately 72% of milled grain may generate white flour. The germ-oil content of flour, which is formed from the whole kernel, causes it to grow rancid when stored for a long period. Since it has no germ in white flour, it persists for longer. Animal food is made from inadequate and extra wheat, as well as different milling leftovers.

When combined with water, only wheat flour among cereal flours makes viscous-elastic dough. Wheat has a protein called gluten that is responsible for the viscoelasticity. Because the gluten proteins are water soluble, they will interact and swell. High extraction wheat flour, often known as *Atta*, is used to make *chapaties*. The capacity of the flour to absorb water is one of the main elements that determine how *chapaties* are soft and fluffy.

PHYSICAL ACTIVITY 1

- 1) Prepare any two recipes by the utilization of wheat flour.

ASSESS THE PROGRESS OF YOUR SESSIONS 3

- 1) What happens when wheat and water come into contact?

b)RICE



Fig 2.3 Rice Grain

Over 50% of people on the planet eat rice as a staple food. Asia is where it is mostly consumed. There are three types of rice: milled, hand-pounded, and parboiled. The milling and polishing levels have an impact on the nutritional content. Compared to high polished milled rice, which has few amount of thiamin, rice that has been parboiled and hand-pounded rice both have large levels. The grains of rice are known as paddy after they are harvested. They have a tough outer layer or husk that is not edible. By hand hammering or milling, this can be removed. In India, paddy is milled either by hand or in streamlined rice mills. More broken rice is found when pounding at home. The lipid in bran develops rancidity during storage, reducing the shelf life. The outer husk of the rice is removed and cleaned during milling. Then it is polished and sieved. The mineral and vitamin content of the grains is decreased during polishing. Most types of coarse rice are not polished to a high level. According to Indian government standards, polishing shouldn't go over 5 per cent. The majority of the thiamin is lost. Parboiled rice came from India originally. Parboiled rice comprises up half of the crop in India. Parboiling is especially beneficial for coarse and medium grains of soft rice since they smash excessively when handled raw. Paddy is parboiled by short soaking it in water, heating it once or twice in steam, and then drying it before milling. When compared to raw rice, parboiling increases protein efficiency ratio and enhances digestibility. The resistance of milled parboiled rice to fungi and insects is higher. When rice is washed, parboiled rice loses less water-soluble nutrients than uncooked rice. Processed rice products consist of puffed rice and rice flakes.

In India, rice products including parched rice, parched paddy, and rice flakes make up about 4-5 per cent of the country's total rice supplies. Rice that has been parboiled is used to make flakes. Paddy is soaked in water for two to three days to soften the kernel, and then the water is boiled for a short period of time before being drained. The paddy is cooked until the husks splits open in a shallow clay vessel or iron pan. The husk is removed and the kernel is flattened by using an iron roller or pestle. Winnowing is used to separate the husk. Rice that has been flaked is white and paper-thin. A rice product that is ready to eat is called *Murmura* or puffed rice. In order to raise the moisture content of parboiled rice to roughly 20%, salt water is added. Rice that has been parched is created by tossing it in hot, iron or clay-coated sand. As you stir the rice, it begins to bubble out and crackle. The dried rice and sand are then separated using a sieve once the pan's contents have been removed. Making parched rice requires the usage of parboiled rice. Parched rice is a crisp food that ranges in colour from bright white to grey. It can be purchased salted or unsalted. It can be drunk either plain or after being combined with buttermilk. In an earthen jar, sun-ripened paddy is filled and then moistened with hot water. The water is removed from the jars after two to three minutes, and they are then left upside down for eight to ten hours. The paddy is briefly exposed to the sun before being dried in hot sand (190–210°C) for 40–45 seconds. The grains swell and burst into a delicate, white product when they are parched. The dried grains are winnowed to separate the husk and sieved to eliminate sand.

PHYSICAL ACTIVITY 2

- 1) Prepare five traditional food products with the utilization of the rice flour.

ASSESS THE PROGRESS OF YOUR SESSIONS 4

- 1) How do you describe parboiled rice?

c) RICE BRAN OIL

A low-cost chemical process has been established by the Central Food Technological Research Institute in Mysore to extract edible oil from rice bran. This oil is safe to consume for humans, according to the National Institute of Nutrition in Hyderabad. It contains a lot of vitamin E, which prevents oxidation. It also lowers cholesterol more effectively than other oils. When compared to other oils, this oil has an excellent keeping quality. When compared to food fried in ground nut oil, deep-fried foods made using rice bran oil demonstrated that this oil is less absorbed or eaten in fried dishes.

Rice can be used to make a number of dishes, including *pulaos*, *khichri*, idli, dosa, sweet rice, *kheer*, and *Phirni*, among others. *Poha*, *bhelpuri*, and other dishes are frequently made with rice flakes and puffed rice.

Environmental and genetic variables both have an impact on the nutritional composition of the rice. The husk and germ of the grain are removed during milling along with the pericarp and aleurone layers contains highest amount of nutrients like protein, minerals, and vitamins in comparison to the endosperm. The type of grain used determines the amylose content of the starch. The outstanding and longer grain varieties contain up to 17.5% amylose, whereas other coarse varieties are entirely absent of it. Amylopectin constitutes the majority of glutinous rice. The free sugars glucose, sucrose, dextrin, fructose, and raffinose are also found in rice. The fibre of rice contains hemicellulose, which is composed of pentoses, arabinose, and xylose. Rice has 72–75% starch, which is the main carbohydrate. Rice has a significantly lower protein level (7%) than wheat. The main protein in rice is glutelin, also called oryzenin. Albumin, globulin, and prolamin are also found in rice in trace amounts. Compared to rice bran and rice polishing, the proteins in polished rice have a reduced biological value but a higher digestibility. Parboiling has no effect on the biological value or digestibility of the proteins. When compared to wheat and other cereal products, rice protein has a higher nutritional value. In comparison to other cereal proteins, rice proteins are higher in arginine. Lysine and threonine are lacking in rice. The pericarp and germ of the rice are where the majority of the minerals are found. Iron and calcium

are deficient in polished rice. Compared to white rice, coloured rice has higher iron content. Amylases, proteases, lipases, oxidases, peroxidases, and phenolases are all enzymes present in rice. Anthocyanins and carotenoids pigments can be found in coloured rice.

PHYSICAL ACTIVITY 3

- a) Give the wheat and rice based meals you ate for breakfast today.

PHYSICAL ACTIVITY 4

- b) Prepare five dishes that you make using five different types of rice.

ASSESS THE PROGRESS OF YOUR SESSIONS 5

- 1) What considerations will you take when making *chapattis*?

- 2) How can you think about rice bran oil being excellent for your health?

c) MAIZE OR CORN

In India, maize is eaten as pop corn that has been cooked or roasted. It is transformed into food products in regions like South America, Central America, and Africa through grinding, alkali processing, boiling, heating, and fermentation. Protein makes for about 11% of maize. Tryptophan and lysine are lacking in the protein from maize. Produced in nations like America are new kinds with high lysine levels. Carotene can be found in abundance in maize. Insignificant levels of thiamine and folic acid are also present. Like all cereals, maize is high in calories and utilised in Integrated Child Development Services programmes and supplemental nutrition programmes to feed malnourished children. Similar to all cereals, maize contains a lot of calories and is used in Integrated Child Development Services initiatives and supplemental nutrition programmes to feed malnourished kids.

PHYSICAL ACTIVITY 5

- 1) Make a list of the foods that are often cooked by using maize and Jowar in your area.

d)JOWAR



Fig 2.4 Jowar

Tamil Nadu, Maharashtra, Karnataka, Madhya Pradesh, Gujarat, and Uttar Pradesh all cultivate sorghum millet, popularly known as jowar. To create roti or bhakri, it is utilised. Jowar has a high protein content compare to the rice, however the rice protein's quality is higher. Low concentrations of lysine, methionine, and cystine are found in jowar. Leucine, an amino acid, is present in high proportions in some Jowar varieties. Niacin deficit is caused by the consequent imbalance between leucine and isoleucine, which prevents the conversion of tryptophan to niacin. Since the proteins in grains and legumes complement one another, Jowar and any legume will provide superior nutritional value when they are combined in a 70:30 ratio. Jowar contains carbohydrates and B-complex vitamins. It has little vitamin A and a lot of nutritional fibre. The parched form of some jowar is eaten. According to research conducted at the Andhra Pradesh Agricultural University in Rajendra Nagar, Hyderabad, Jowar that has been popped or flaked has a five-fold increase in starch digestibility but a decrease in protein digestibility. In non-insulin dependent diabetics, whole jowar recipes significantly decreased plasma glucose levels compared to dehulled jowar recipes. Commercially, malted Jowar is used to produce a variety of baby meals.

e)RAGI



Fig 2.5 Ragi

Ragi is often referred to as finger millet. It comprises slightly more than 25% of the food grains farmed in India. Its nutritional value is comparable to or even superior to that of rice or wheat. In rural areas, finger millet or Ragi is frequently consumed unprocessed. Although low in thiamine, it is abundant in B vitamins. Calcium is especially abundant in Ragi. It is also full of fibre and a good source of iron.

f) PEARL MILLET (BAJRA):



Fig 2.6 Pearl millet

In India, pearl millet is the most common kind of millet. Protein content is equivalent with that of wheat. Prolamine makes up a significant amount of the protein, which is followed by globulin and albumin. Tryptophan level is excessive and lysine concentration is inadequate among the amino acids. Iron, thiamine, riboflavin, and niacin are abundant in bajra. Bajra may retain the majority of its germs after around 80% of the polish is removed, and its nutritional value is not much diminished. Pearling enhances the items' look and flavour. It is prepared similarly to rice after being dehusked. *Bhakri* is a flour-based dish.

PHYSICAL ACITVITY 6

- 1) Make three dishes with the incorporation of Pearl millet (*Bajra*).

G) FOXTAIL MILLET:



Fig 2.7 Foxtail millet

Foxtail millets possess a bittersweet flavour. It's a healthy meal for diabetics. It lowers the body's natural cholesterol levels. It contains lots of antioxidant. They are healthy for children as well as expectant mothers because they include a lot of fibre, protein, calcium, iron, manganese, phosphorus, magnesium, and vitamins. It functions as medicine for persons suffering from diarrhoea, feelings of burning when urination, stomachaches, and an absence of appetite. It is an effective treatment for anaemia since it is high in proteins and iron. Foxtail millet is also beneficial in the treatment of skin illnesses, oral cancer, lung cancer, stomach cancer, Parkinson's disease, and asthma.

FOXTAIL MILLET IS GOOD FOR THE STRENGTHENING OF NERVES AND MENTAL HEALTH. IT PROVIDES RELIEFFROM ARTHRITIS, PARKINSON'S DISEASE AND EPILEPSY

H) BARNYARD MILLET (SAWA):



Fig 2.8 Barnyard Millet

The flavour of barnyard millets is pleasant. Millet is used to make cuisine that is filling and simple for digestion. As a result, in North India, it's utilized in religious fasting. It contains high amount of iron. Pregnant women and newborns in Uttarakhand and Nepal consume food made from branyard millet. They think that anaemia is minimized in neonatal women, and lots of breast milk will be produced by them. The diet keeps the body temperature steady. It increases the body's ability for resistance. For individuals who spend a lot of time in a fixed posture at work without doing much physical exertion, this is a really nice meal. Due to the high fibre content of this millet, it is beneficial for both diabetes and constipation. This millet-based diet guards against the development of small intestine ulcers as well as large intestine cancer.

BARNYARD MILLET IS HEALTHY FOR THE LIVER, KIDNEY, AND ENDOCRINAL GLANDS. IT HELPS IN LOWERING CHOLESTEROL AND JAUNDICE.

ASSESS THE PROGRESS OF YOUR SESSIONS 6

1) Why diabetic sufferers should eat barnyard millet?

i)LITTLE MILLET: They have a sweet flavour. Many health problems are resolved by eating little amounts of millet. This works as medicine if you get a burning feeling in your chest after eating, sour belching, or tightening in your stomach as a result of a gastrointestinal condition, etc. This is beneficial for people with sexually transmitted infections, diarrhoea, and indigestion, as well as to increase sperm count in men and resolve period issues in women. It contains plenty of fibrecontent; it is also beneficial for people who have constipation. This is a nourishing dish for people with cardiac issues, obesity, and joint discomfort. Nature has blessed us with little millets including foxtail millet, tiny millet, barnyard millet, and kodo millet. Those constitute the cereal grains with therapeutic qualities. It contaminates health supplements. All ailments can be cured by consuming them regularly for six to two years. Small grains not just offer nutrition but also help to detoxify the body and eliminate impurities that might cause sickness. Consequently, they guarantee our well-being. They aid in the treatment of reproductive system problems among

men and women. It also helps women with PCOD. By consuming a little millet, men's sperm counts can be enhanced. They also help to clear out the lymph nodal system and manage cancers of the brain, throat, blood, the thyroid, and pancreas.

J) KODO MILLET:



Fig 2.9 Kodo millet

Kodo millet has a sweet, bitter, and acerbic flavour. It is abundant in nutrients and is thus a healthy diet for children. It has a lot of vitamins and minerals. It is helpful for digestion. It prevents deadly diseases like cancer, has excellent antioxidant activity, regulates blood sugar and cholesterol levels, gives sprinters good energy, and provides the body with the nutrients it needs. You can receive all the nutrients your body needs if you combine them with other legumes like Bengal gram or cowpea. It is also good for weight loss because of its high fibre content. This is beneficial for blood purification, bone marrow function, and the treatment of asthma, renal difficulties, prostate, blood cancer, and tumours of the gut, thyroid, throat, pancreas, or liver. Kodo millet is beneficial for diabetic people. They are also beneficial in the recovery of individuals who have been weakened due to dengue fever, Typhoid fever or viral fevers.

ASSESS THE PROGRESS OF YOUR SESSIONS 7

1) What kind of millets ought to be consumed for health issues?

PHYSICAL ACTIVITY 7

2) Specify four excellent nutrients of millets that you regularly utilize.

2.5 CHANGES DURING COOKING OF CEREALS

Cereals exhibit significant changes throughout the cooking process.

Lump prevention

Unwanted lumps may form if dry starch or flour is added immediately to a hot liquid. When dry flour is mixed with hot liquid, the outside flour particles gelatinize and become sticky; the inside flour particles are unable to gelatinize and remain dry, resulting in lump formation. Gelatinization is slowed down because the lump's starch is not available for thickening.

Agitation: Slowly adding the flour and thoroughly combining it will help prevent lumps by ensuring that the flour is equally distributed before it gelatinizes.

Flakes and granules: When flakes and granules are utilized instead of flour, formation of lump is reduced. No lumps develop because the particles are bigger and do not instantly gelatinize when submerged in hot water.

Paste: Before adding hot water, flour is used to make a cold water paste. All particles are surrounded by water, which has already begun to gelatinize each particle.

Below the boiling point: Before gelatinizing, cereal flour should be mixed to below the boiling point in order to disperse all of the particles.

Fat Addition: When the particles are fried in oil, they all get a fat coating that keeps them from sticking together and forming lumps.

Adding Sugar: Sugar reduces gelatinization and lump formation by mixing with water.

Through dry roasting: Dextrinization occurs when starch granules are heated, which prevents gelatinization of external particles and prevents lump formation.

2.5.1 EFFECT OF COOKING ON NUTRITIONAL COMPOSITION OF THE CEREALS

B vitamins are lost through the baking technique by 30%, although this loss can be made up for by fortification. Baking biscuits and cakes leads in vitamin losses of around 10-15%. Thiamin,

riboflavin, and niacin losses during rice washing are around 20-40%, 10-30%, and 15-25%, respectively. Excessive washing is avoided. Cooking losses are usually less serious than washing losses. The method of cooking that promotes moist depletion is one in which extra water is used and excess water is discarded. This can result in the loss of around 30% of the remaining thiamin. This water can be consumed or used to prevent cooking in big volumes of water.

PHYSICAL ACTIVITY 8

- 1) How can you evaluate the factors that prevent lump formation?

ASSESS THE PROGRESS OF YOUR SESSIONS 8

- 1) Describe the effect of cooking on nutritive value of the cereals.

2.6 THE UTILIZATION OF CEREALS IN COOKING

Due to their relative low cost, cereals comprising the primary food source help to satisfy majority of the energy and fifty percent of the dietary protein needs. Foods such as cereal enhance the protein content of pulses. The main food item has been made by utilising cereal grains. Cereal is a need for all of our meals.

- Foods such as cereal are employed as a thickening substance in a variety of dishes, including desserts and sauces.
- Cereals are utilised as a covering agent, such as crumbs of bread.
- Cereals grains are utilized to make drinks, such malted beverages.
- Cereals are utilized in sweets, such as Kheer and Halwa.

- Cereals are employed for the development of ready-to-eat food products like as macaroni, corn flakes, and puffed rice.
- Cereals can be utilized to make filling for *parathas* and puran poli.
- Fermented cereal products, including dosa and idli, are eaten for breakfast as well as refreshments.
- For making unleavened bread (roti), the majority of nutritious millets such as bajra, Ragi, maize are crushed, and the whole grain flour is then utilised. Minor nutritional loss occurs since flour made from whole grains is used in the majority of recipes.

2.6.1.CEREALS PROVIDE BENEFITS FOR HEALTH

- Cereal is the main supplier of energy in the human diet.
- Significant levels of minerals present millets like ragi, jowar, and *Bajra*. Ragi and *Bajra* are excellent sources of calcium and iron
- Foods made from whole grains may lower the risk of developing breast cancer.
- Insoluble and soluble fibres including pectin, cellulose, and hemicellulose are found in cereals that reduces constipation.
- Cereals contains good amount of B vitamins.
- The fibre content present in cereal slows down the food's release of glucose, keeping blood sugar levels balanced.

ASSESS THE PROGRESS OF YOUR SESSIONS 9

1) TRUE/FALSE

- Ragi is a good source of fat. _____
- The most significant cereals in the human diet are wheat, rice, and maize _____
- Cereals are rich sources of fibre, vitamins and minerals. _____
- Rice is a good source of minerals especially iron and calcium. _____
- The key rice grain constituents that influence cooking and eating quality are starch, protein, and lipids. _____
- Maize is a low-cost starch that is an important source of energy for animal feed. _____
- Whole grains are not good for fibre. _____

2.7 LET US SUMMERISE

In Indian diets, cereals constitute the major source of energy contributing to 70-80% of the majority of Indians' daily calorie consumption. Rice, wheat, jowar, bajra, and ragi are the most widely consumed grains in India. The nutritional content of cereals varies depending on the particular portion of the grain utilised. Since all whole grain foods include carbohydrate, iron, protein, phosphorus, thiamin, and fibre, the milling process removes a few of these elements. A balanced diet that includes a variety of cereals may assist you meet your nutritional needs. Rice-based foods may be replaced with wheat dosa, rice flakes payasam, ragi-based cheela, and broken wheat upama. A blend of cereal flours may be utilized to make idli and dosa batters as well as *Chapatis* dough. This will add different nutrients to the day's diet. Beverages and weaning meals can be made with malted grains.

2.8 GLOSSARY

Idli and Dosa: Common South Indian dishes developed with fermented rice and pulse.

Poha: Rice flakes are mixed with other items such as vegetables and nuts to make this dish.

Chapatis: a flat, circular, unleavened bread from India that is often baked with whole wheat flour and griddle-cooked.

Parboiling: By steaming and soaking paddy, it is possible to ensure that the nutrients from the outer layers are absorbed by the grains and are not lost during milling.

Gelatinization : When starch is cooked in water, a transitional process called gelatinization takes place. The granules split into a mixture of polymers-in-solution during this process.

Broth: a thin, unclarified soup

Batter: a combination of wheat flour, fluid, and more substances that is sufficiently soft to be beaten or "battered." utilised to cover meals during fried to make a pancake, dessert etc.

Thickening agents: A culinary ingredient employed to give a drink or food item a thicker consistency.

2.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Assess the progress of Your Sessions 1

- 1) Dirt, grit, moulds, insects, and fungus should not be embedded in wheat and rice grains. Grains should be purchased from a trustworthy supplier to ensure high quality.

Assess the progress of Your Sessions 2

- 1) The primary elements present in whole grains include starch, proteins, minerals, fibre, and B vitamins. Due to mounting evidence that whole grains and whole-grain-based products can promote health in ways other than merely delivering energy and minerals, whole grains are now encouraged in dietary guidelines all around the world.

Assess the progress of Your Sessions 3

- 1) When combined with water, only wheat flour among cereal flours makes viscous-elastic dough. Wheat has a protein called gluten that is responsible for the viscoelasticity. Because the gluten proteins are water soluble, they will interact and swell. High extraction wheat flour, often known as *Atta*, is used to make *chapaties*.

Assess the progress of Your Sessions 4

- 1) Indian rice was the first to be parboiled. In India, half of the harvest is parboiled rice. Given that they shatter excessively when handled fresh, soft rice's coarse and medium grains benefit from parboiling in particular. By briefly soaking the paddy in water, boiling it once or twice in steam, and then drying it before milling, the paddy is parboiled. Parboiling rice improves digestibility and raises the protein efficiency ratio as compared to uncooked rice. Milled parboiled rice has a stronger resistance to fungus and insects. When rice is washed, parboiled rice loses less water-soluble nutrients than uncooked rice.
- 2) Due to the high fibre content of this millet, it is beneficial for both diabetes and constipation.

Assess the progress of Your Sessions 5

- 1) Because the gluten proteins are water soluble, they will interact and swell. High extraction wheat flour, often known as *atta*, is used to make *chapaties*. The capacity of the flour to absorb water is one of the main elements that determine how *chapaties* are soft and fluffy.
- 2) This oil is safe to consume for humans, according to the National Institute of Nutrition in Hyderabad. It contains a lot of vitamin E, which prevents oxidation. It also lowers cholesterol more effectively than other oils. When compared to other oils, this oil has an excellent keeping quality.

Assess the progress of Your Sessions 6

- 1) Due to the high fibre content of braynard millet is beneficial for both diabetes and constipation. This millet-based diet guards against the development of small intestine ulcers as well as large intestine cancer.

Assess the progress of Your Sessions 7

- 1) B vitamins are lost during the baking process by 30%, although this loss can be made up for by fortification. Baking biscuits and cakes leads in vitamin losses of around 10-15%.

Assess the progress of Your Sessions 8

- 1) Minor grains not only provide nutrients but also aid in detoxification and the removal of pollutants that might lead to illness. Asthma, renal problems, prostate, blood cancer, and cancers of the stomach, thyroid, throat, pancreas, or liver can all be treated with small millet, including Kodo millet, Little millet, Barnyard millet, Pearl millet, and Ragi.

Assess the progress of Your Sessions 9

- 1) False
- 2) True
- 3) True
- 4) False
- 5) True
- 6) True
- 7) False

UNIT III SELECTION, NUTRITIONAL CONTRIBUTION AND CHANGES DURING COOKING OF PULSES

You previously learned about the numerous essential functions which vital nutrients play in the functioning of our bodies in the Unit 1. Students will learn about pulses selection, nutritional contribution, and changes during cooking in this unit.

Structure

3.0 SCOPE

3.1 OVERVIEW

3.2 SELECTION OF PULSES

3.3 NUTRITIONAL CONTRIBUTION OF PULSES

3.3.1 DIGESTIBILITY OF PULSES

3.4 TYPES OF PULSES

3.4.1 PRODUCTS MADE FROM PULSES

3.5 CHANGES DURING COOKING OF PULSES

3.6 LET US SUMMARISE

3.7 GLOSSARY

3.8 EXERCISES TO CHECK YOUR PROGRESS ANSWERS

3.0 SCOPE

Student will be able to do the following after completing this unit:

- Identify the various types of pulse
- purchase high-quality pulses;
- list the nutrients contribution by pulses
- discuss several methods in which these foods may be incorporated in our daily diet; and
- effect of cooking on pulses

3.1 OVERVIEW

Pod-bearing plants in the leguminous family produce edible fruits or seeds that are known as pulses. You have already read in Unit I that pulses are a good source of protein. The fruit is a pod that holds two to ten seeds. Red gram dhal, bengal gram dhal, black gram dhal, green gram dhal, and masoor dhal are the key pulses that play a significant role in our diets. Certain are cooked in the form of whole grams. Rajmah, dry peas, and cow peas are all members of the leguminous family. Oilseeds and nuts are also incredibly nutrient-dense foods. Because these

foods are expensive, we might not be consuming them in large quantities. However, groundnut consumption is widespread and they give more nutrients.

The main pulses farmed in the nation are chickpea, pigeonpea (tur), mungbean, urdbean, fieldpea, and lentil, which together make up around 80.7% of the nation's pulse production. Furthermore, there are pulses that are prevalent in a certain region, such as horsegram in Kamataka, Orissa, and Bihar, moth bean in Rajasthan, and lathyrus in Bihar, Madhya Pradesh, and West Bengal. Rajma is grown in hilly areas, and cowpea is grown in Rajasthan and Kamataka. Madhya Pradesh, Uttar Pradesh, Maharashtra, Rajasthan, Kamataka, and Andhra Pradesh are the primary pulse producing states, accounting for 80% of total land and 81.1% of total pulse output. Other major pulse-producing states are Orissa, Bihar, Tamil Nadu, Gujarat, and Haryana.

Pulses are regarded as a superfood since they are rich in protein, minerals and B vitamin, less in fat, gluten free and rich in dietary fiber.



Fig 3.1 Different types of Pulses

3.2 SELECTION OF PULSES:

Your study of the dietary categories in Unit 1 was covered. Pulses come in a huge range of varieties. You may add different dhals in your diet depending on your preferences and budget. In grocery shops, pulses can be found in a variety of packages, including canned, plastic bags, and/or bulk. When purchasing pulses, check to see that the dhal is clean, free of pebbles or twigs, and insect-free. The pulse needs to be dry so as to prevent fungus from growing on it. Many times, sale-purchased pulses are contaminated with khesari (Lathyrus) dhal or other inexpensive dhals, or they are dyed with unfavourable colours to enhance their look, both of which are harmful for the consumer's health.

The most popular kind of dhal include *Urad, Tur, Mung, Chana* and lentil. In order to prevent deterioration, storage must be free from moisture. Dhals with shattered parts are less expensive than ones that are not. These more affordable ones may be used to make dishes like vadas, idlis, dhoklas, pakodas, and other things that are created after grinding (either wet or dry).

Table 3.1 Popular Legumes with Their Hindi and Scientific Name

Legumes	Hindi Name	Scientific Name
Bengal Gram (Chick pea)	Chana	<i>Cicer arietinum</i>
Soybean	Soybean	<i>Glycine max (L.) Merrill</i>
Rajmah (Kidney bean)	Rajmah	<i>Phaseolus vulgaris</i>
Horse Gram	Kulthi	<i>Dolichos biflorus</i>
Cowpea	Lobia	<i>Vigna catjang</i>
Field Bean	Sem	<i>Dolichos lablab</i>
Red Gram (Pigeon pea)	Arhar	<i>Cajanus cajan (L.) Millsp.</i>
Moth Beans	Moth	<i>Vigna aconitifolia (Jacq.) Marechal</i>
Khesari	Khesari	<i>Lathyrus sativus</i>
Lentil	Masoor	<i>Lens esculenta</i>
Black Gram	Urd dhal	<i>Phaseolus mungo Roxb.</i>
Peas	Matar	<i>Pisum sativum</i>
Green Gram	Mung	<i>Phaseolus aureus Roxb.</i>

(Gopalan, *et al.*, 1989; Pueppke and Broughton (1999))

ASSESS THE PROGRESS OF YOUR SESSIONS 1

- 1) What aspects would you consider while purchasing pulses?

- 2) List the most common pulses consumed in India.

3.3 NUTRITIONAL CONTRIBUTION OF THE PULSES:

Pulses are abundant in vitamin A and vitamin E. On a moisture-free basis, pulses have a fat content of 1.5%. They have a high concentration of polyunsaturated fatty acids. They include calcium, magnesium, zinc, iron, potassium, and phosphorus; 80 per cent of the phosphorus is found as phytate phosphorus. Prolonged cooking time, a lack of sulphur, amino acids, and inadequate protein digestibility are examples of antinutritional characteristics like protease inhibitors, haemagglutinins, phytates, flatus factors, tannins, etc. that hinder the complete utilisation of dietary legumes. Processing techniques including heating, soaking, germination, and fermentation can significantly reduce or remove antinutritional factors like phytin content. Processed pulses have a higher nutritional value. The B complex vitamins thiamin, folic acid, and pantothenic acid are especially abundant in legume seeds. Although they lack vitamin A and C, like cereals, they do contain vitamin C in small amounts in germinating beans.

Energy: Pulse has 340 calories per 100g, which is approximately the same as cereal.

Protein: Pulses are an important source of protein in vegetarian diets. Pulses have 20-25 per cent protein. They provide two times as much protein than grains. They mainly consist of globulins. Albumins can be found in pulses too. Their nutritional value is determined not only by the quantity of protein but also by its quality, which is determined by the amino acid composition. Sulphur-containing amino acids, especially methionine and tryptophan, are low in legume proteins. All pulses include enough amounts of leucine and phenylalanine. Only groundnuts have

low lysine and threonine content. Bengal gram has a greater concentration of arginine and an adequate level of tyrosine. Pulses, on the other hand, are high in lysine. As a result, they can be used to enhance cereal protein. The best diet is one that includes both cereals grains and pulses.

The essential amino acids isoleucine, leucine, phenylalanine, threonine, and valine are better found in legumes compared to cereal grains.

PROTEIN QUALITY DECREASES IN INFECTED PULSES.
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Table 3.2 The Biological Value of Certain Legume Proteins

Legumes	Biological values
Peanut	54.5
Pigeon pea	60.0
Soyabean	65.0
Green gram	70.0
Chick pea	79.5
Pea	81.7
Cow pea	89.2

Source :B. Srilakshmi,2011

Carbohydrates: Pulses comprise between 55 - 60 per cent starch. Additionally, there are soluble sugars, fibre, and unusable carbs. Pulses contain significant amounts of oligosaccharides of the raffinose family, which cause flatulence in humans.

Lipids: On a dry basis, pulses have a 1.5% lipid content. They have a high concentration of polyunsaturated fatty acids. They fulfil the necessary fatty acid needs of an adult, together with cereal grains. In addition to linoleic acid, most legume seed oils also contain substantial levels of linolenic acid. During storage, they become oxidatively rancid, losing their nutritional value, solubility of the proteins, and developing an unpleasant odour. There is also oleic, stearic, and palmitic acid.

Minerals: They are high in minerals such as calcium, magnesium, zinc, iron, potassium, and phosphorus. Phytate phosphorus accounts about 80 per cent of the phosphorus available. Phytin

forms complexes with proteins and minerals, rendering them physiologically inaccessible to both humans and animals. Processing methods including as heating, soaking, germination, and fermentation may remove or reduce significant phytin levels. Pulses cannot significantly increase the overall quantity of minerals consumed in the amounts that are utilised.

Vitamin: Legume seeds are high in B vitamins, including thiamin, folic acid, and pantothenic acid. Although they lack vitamin A and C, like cereals, they do contain vitamin C in small amounts in germinating bean.

Table 3.3 Nutritional composition of pulses

Pulses	Energy (Kcal)	Moisture (g)	Protein (g)	Fat (g)	Mineral (g)	Carbohydrates (g)	Fibre (g)	Calcium (mg)	Phosphorus (mg)	Iron (mg)
Bengal gram (whole)	360	10	17	5	3	4	4	202	312	5
Bengal gram (dhal)	372	10	21	6	3	1	1	56	331	5
Bengal gram, (roasted)	369	11	22	5	2	1	1	58	340	9
Black gram (dhal)	347	11	24	1	3	1	1	154	385	4
Cow pea	323	13	24	1	3	3	4	77	414	9
Field bean (dry)	347	10	25	1	3	1	1	60	433	3
Green gram(whole)	334	10	24	1	3	4	4	124	326	4
Green gram (dhal)	348	10	24	1	3	1	1	75	405	4
Horse gram, (whole)	321	12	22	0	3	5	5	287	311	7
Kherasi dhal	345	10	28	1	2	57	2	90	317	6

Lentil	343	12	25	1	2	59	1	69	293	7
Moth beans	330	11	24	1	3	56	4	202	230	9
Peas green	93	73	7	0	1	16	4	20	139	1
Peas (dry)	315	16	20	1	2	56	4	75	298	7
Peas (roasted)	340	10	23	1	2	59	4	81	345	6
Rajmah	346	12	23	1	3	61	5	260	410	5
Redgram, (dhal)	335	13	22	2	3	58	1	73	304	3
Redgram(t ender)	116	65	10	1	1	17	6	57	164	1
Soyabean	432	8	43	19	4	21	4	240	690	10

Source: Gopalan. C, Rama Sastri B.V. and Balasubramanian, S.C., 2004, Nutritive Value of Indian Foods, National Institute of Nutrition, ICMR, Hyderabad.

ASSESS THE PROGRESS OF YOUR SESSIONS 2

- 1) Consider the nutritional advantages of include pulses in your diet.

- 2) List the important vitamins and mineral present in pulse.

- a) _____
b) _____
c) _____
d) _____

3.3.1 DIGESTIBILITY OF PULSES

Pulses maintain their quality well and do not degrade quickly. They are highly well-liked since they are simple to prepare, offer a wide range of foods, and are simple to digest. Chick pea

protein among legumes has a high level of digestion. Other forms of legumes, such as lentils and phaseolus, are less digestible.

**LARGE MOLECULAR WEIGHTS AND COMPACTED MOLECULES IN PULSE
PROTEINS MAKE THEM LESS DIGESTIBLE.**

3.3.2 GERMINATION

After soaking whole pulses for the recommended amount of time, the water needs to be drained, and the seeds of the pulses must be knotted in a loosely woven fabric and hung. Twice or three times every day, water should be sprayed. The process of germination happens in a day or two.

The benefits of germination

- Sprouting increases nutritional value. During sprouting, minerals including zinc, calcium, and iron get released from their binding condition. Vitamin C is produced through germination.
- Starch loses some of its ability to thicken when it is turned to sugar.
- Germination enhances flavour and texture.
- Germinated pulses provide the diet diversity.
- Cooking time is reduced by sprouting.

ASSESS THE PROGRESS OF YOUR SESSIONS 3

1) Summarize about the dietary benefit of pulses in terms of nutrition.

2) What benefits does fermentation provide?

3.4 TYPES OF PULSES

India is home to a variety of grains, including Bengal gram (chana, chickpea), tuvar dal (red gram, pigeonpea), mung dal (green gram), masur dal (lentil), urad or mash dal (black gram), kulith (horse gram), and kala tur (Indian soybean). Rajmah (kidney, haricot, or French bean), avave (field bean), chastang (broad bean), matar (green pea), babril (pink bean), lobia (cowpea), kheri (moth beans), safari (rice bean), sim (scarlet inner bean), guar (cluster beans), and bora sim (sword bean) are some additional less popular varieties. A portion of the harvested grain is processed at home, while the remainder is done in *chakkis*.

a) Bengal gram:



Fig 3.2 Bengal gram

Bengal gram, which makes about 40% of all pulse production in India, is a very extensively planted pulse crop. Bengal gram is often known as chick pea. About 10 to 11 million tonnes are produced in India, making up around 70 percent of global output. It is utilised for both human consumption and animal feed.

Freshly leafy greens are consumed as food, whereas chickpea straw is an excellent livestock fodder. Grain can be utilised as a vegetable. Gram growing nations include India, Pakistan, Ethiopia, Burma, and Turkey. In terms of output and acreage, India leads the globe, followed by Pakistan. Major gram producing states in India are Madhya Pradesh, Rajasthan, Uttar Pradesh, Haryana, Maharashtra, and Punjab.

Based upon grain size, colour, and form, gram is divided into two classes

i) Desi (also known as brown gram)

ii) Kabuli, also known as white gram. Kabuli has a lower yield potential than Desi gram.

Bengal gram is a popular substitute for animal or meat protein since it is a protein-rich dietary supplement. Consuming bengal gram on a regular basis helps to reduce protein deficiency. It also aids in the reduction of blood cholesterol levels. Chickpeas are abundant in fibre, protein, antioxidants and healthy fats, and they have a low glycemic index (GI). As a consequence, chickpeas aid in the management of triglycerides, cholesterol, blood sugar, and blood pressure levels; sustaining of an appropriate weight; and helping to maintain of gastrointestinal health. It may assist to strengthen bones. It is possible that this will aid in the improvement of brain health. It may aid in the prevention of iron deficiency. The grains are prepared in a variety of ways, including dhal, roasted grains, and fried grains. Its flour is used to make *chappatti*, soups, and other desserts such as "BeasanLadoos" and "Gajak." Grains and flour are both utilized as milch and draught animal concentrates. Chickpeas may be used to make dough for cookies, chocolate brownies, dark chocolate truffles and bark, fudge, pudding, dessert hummus and other snacks and sweets.

b) Red gram:



Fig 3.3 Red gram

The pigeon pea, *Cajanus cajan*. (L) Millsp., is a perennial legume of the Fabaceae family. It is a tolerant of drought perennial that is generally grown as a yearly tall shrub. India's second-most significant pulse crop after gram (channa) is redgram, also known as *Tur* or Arhar in local parlance. Redgram's propensity to generate high economic yields amid soil moisture deficits makes it an essential crop in both rainfed and dry land agriculture. India (42.80 lakh tonnes),

Malawi (4.24 lakh tonnes), Myanmar (3.39 lakh tonnes), Tanzania (1.36 lakh tonnes), and Haiti (1.23 lakh tonnes) are the world's top redgram producers. Pigeon peas are an excellent supplier of nutritional fibre, carbs, and proteins, all of which are required for development and growth. Incorporating *Tur dhal* in your daily meals serves to fulfill your calcium and iron needs, while providing an excellent supplier of folic acids stimulates foetal development and prevents congenital birth problems in the foetus. *Tur dhal* contains dietary fibre and protein, which help to reduce appetite, delay digestion, assist weight reduction, regulate diabetes, and lower cholesterol levels. Furthermore, abundant vitamin and mineral reserves such as magnesium, manganese, phosphorus, potassium, sodium, and zinc help to improve physical and mental health. In accordance to the USDA (United States Department of Agriculture), a serving or cup of *Tur dhal* has the following nutrients: Calories (343 kcal), Total Fat (1.5g), Total Carbohydrate (63g), Protein (22g), Sodium (17mg), Potassium (1392 mg), Calcium (0.13mg). In Ayurveda, it is utilized as a vulnerant to treat injuries and sores. It also can be utilised as an astringent to prevent bleeding. It also is additionally utilised to treat lung and chest problems and get rid of internal parasitic worms. It aids in the treatment of jaundice, cough, and pneumonia. Inflammation of the throat, diarrhea, and chlorosis is all treated with the roots. Pigeon pea flour may be used to make protein-rich breads and biscuits with higher levels of important amino acids. Pigeon pea flour can assist governments in meeting the second sustainability development objective of achieving zero hunger. Researchers are also investigating the feasibility of creating pasta with this flour.

ASSESS THE PROGRESS OF YOUR SESSIONS 4

- 1) Give an overview the nutritional benefits of Bengal gram.

- 2) Mention the health benefits of Red gram.

c) **Green gram:**



Fig 3.4 Green gram

Mungbean (*Vigna radiata* L. Wilczek), commonly called green gram, is a legume plant which is considered as a native food of India. It is a small green bean with a shape that is circular that is mostly cultivated in the southeast, east, and South Asian countries. It may be used as an ingredient in both savoury and dessert recipes. Mungbean is a superior protein (20-24%) supplier with greater digestibility that can be ingested as whole grains, dhal, or sprouted form, and serves as an excellent addition to rice as a source of adequate nutrition for humans. In addition to being a good supplier of dietary fibre, carbs, and calories, it is also a great source of flavonoids, phenolics, and other antioxidants. Other vitamins and minerals found in it include copper, magnesium, phosphorus, potassium, and vitamin B6. It also has a low cholesterol and saturated fat content, making it ideal for medicinal and new food compositions. It is primary source for both human food and animal feed.

Mungbean is a high fibre carbohydrate source that may aid in the reduction of blood glucose levels. The soluble fibre and resistant starch in mung beans promote healthy digestion. In comparison to other legume proteins, mung bean protein is also simpler to digest. Mung bean elements such as potassium, magnesium, and fibre have been related to a decreased risk of high blood pressure. In India, green gram is mostly consumed as dhal. Mung dal may be used in a variety of ways, including sprouts, processed grains, fried beans, bean paste, and incorporation into pasta, cakes, bread, cold jellies, and sweets.

MUNGBEAN IS A HIGH-PROTEIN, EASILY DIGESTIBLE FOOD THAT MAY BE GIVEN TO SICK NEWBORNS OR THOSE SUFFERING FROM MALNUTRITION.

PHYSICAL ACITIVITY 1

- 1) Make a list of the foods that can be cooked with green gram.

d) Lentil:



Fig 3.5 Lentil

Red lentils, often referred to as Masoor dal in India, are a highly demanded lentil. They are cultivated throughout the nation and eaten for their many health advantages. Red lentils are incredibly beneficial to your skin and can help you avoid problems like premature ageing and acne. They may also be utilised to brighten skin and remove tans. Red lentils, due to their high fibre content, aid in weight reduction and digestion. Red lentils (Masoor Dal) are beneficial to diabetics because they moderate the erratic spikes and decreases in blood glucose levels. It is high in proteins and mineral substances, which serve to support your body's numerous functions. Lentil is the most sought legume in many countries due to its high average protein content and quick cooking qualities. Lentil seeds provide 1-2% fat, 24-32% protein, and minerals (iron, cobalt, and iodine) as well as vitamins (lysine and arginine). Lentils can be cooked in a variety of ways, including soaking, boiling, sprouting/germination, fermentation, frying, and dry-

heating. Processed lentils are utilised in the preparation of the lentil snacks, and medical applications.

e) Blackgram:



Fig 3.6 Black gram

Black gram is most significant pulse crops farmed in India. It is consumed as 'dhal' (whole or split, husked and un-husked) or perched. It is utilised as a nutritious fooder, particularly for dairy cows. It's also a green manuring crop. In terms of balanced human nutrition, urdbean is a great complement to rice due to its high lysine content. Urad dal having a low glycemic index (it slowly raises blood glucose levels). It contains a high quantity of indigestible fibre and a low glycemic index, making it a great alternative for managing blood sugar levels in diabetics. Consuming urad dal on a regular basis in conjunction with a low-fat diet may aid in the maintenance of lipid homeostasis (balancing). As a result, it may aid in lowering the risk of heart disease. There are various methods to incorporate urad dal into your diet. Urad dry seeds may be boiled and used in a variety of dishes. Urad may also be processed into flour and used to add protein to bread. Urad dal may also be the major component in meals such as idli and dosa. These are fermented rice and dhal cakes.

ASSESS THE PROGRESS OF YOUR SESSIONS 5

1) In what ways is black gram utilised in Indian cuisine?

PHYSICAL ACTIVITY 2

- 1) Create a graph to show the nutritional profile of lentils.

3.4.1 TOXIC ELEMENTS IN PULSES

Several chemical components in pulses have hazardous qualities. Prolonged cooking time, a lack of sulphur, amino acids, and low protein digestibility are some of the variables that prevent the complete utilization of legumes.

Lathyrogens: A crippling nerve condition known as lathyrism affects men. It is well known that it is brought on by consuming too much kesari dhal (*Lathyrissativus*), a pulse. Muscular stiffness, weakness, and paralysis of the leg muscle are signs of lathyrism.

Trypsin inhibitors: These may be found in dried peas, red gram, Bengal gram, cowpea, *lathyrus sativus*, double beans, and soyabean. Trypsin inhibiting substances are proteins restrict the activity of trypsin in the stomach, obstruct protein digestion, and reduce protein absorption.

Haemagglutinins: In nature, they are proteins that are abundant in leguminous seeds. Haemagglutinins reduce nutrient absorption, impairing growth.

Goitrogens: These chemicals prevent the thyroid gland from absorbing iodine. They can be found in soyabeans and groundnuts. Excessive consumption of these foods may precipitate goitre.

Saponins: Saponins, which are found in soyabeans, produce nausea and vomiting. Toxins can be removed through soaking before cooking.

Tannins: The majority of legumes have a substantial quantity of seed coat. Tannins form irreversible bonds with iron, interfering with iron absorption. Furthermore, proteins are bound by tannins, which makes them less available.

ASSESS THE PROGRESS OF YOUR SESSIONS 6

- 1) What are the Toxic elements in pulses and how may they be removed?

3.4.2 PRODUCTS MADE FROM PULSES:

Bengal gram flour, often known as besan, is made from chickpea. The flour is commonly used in batters and doughs, which can be salted and spiced and utilized in extruded dishes such as crisp *sev*, *murakku* or *chakli*, *thengole*. It is also used to make *pakor*as, *bhajias*, and potato *vadas*. These snacks are made using Bengal gram and black gram, which have an unusual sticky quality that leads to great moulding, extruding, and binding capabilities.

- **Puffed Grains:**

Puffed peas and Bengal gram are popular. These are consumed as snack and also used as part of in the preparation of other foods. With jaggery syrup, Bengal gram rolled into *laddus*. Puffed Bengal gram and peas have a high nutritional content and can be easily digestible. Moist conditioning before roasting aids in most effective puffing. Continuous gram roasting facilities are used in the commercial puffing process. As the roasted grains are subjected to mild impact between a knurled roller and a hot plate, they are dehusked, puffed, and split. For homogeneous heat transmission and smooth discharging of sand and puffed grain, the manually driven puffing machine created by Suryanath and Srivastava (1982) was modified.

- **Ready to Use Mixes**

Dals are used to make rasam (a thin soup), dal dhansakh (a thicker dal), and sambhar (a thicker dal). Dals are commonly utilized in the production of commercial instant mixes. Dals are the core of Indian protein diet. They are less expensive than meat. Lysine is found in abundance in all dal products. Many pulses have anti-nutritional properties such as haemagglutinins, goitrogens, and trypsin inhibitors. They are also present in trace levels but are eliminated during the cooking process. The protein value of papad, which is the crisp, textural addition to an Indian

diet, is roughly 22% when roasted dals such as black gram dal (urad), green gram dal (mung), red gram dal (tur), and Bengal gram dal (chana) are used.

- *Papads*, the crisp, textural component of the Indian cuisine, can be deep-fried or roasted. The protein content of papad is about 22% because dals like black gram dal (urad), green gram dal (mung), red gram dal (tur), and Bengal gram dal (chana) are utilized. If deep-fried, the nutritional content of a single 10 g papad can be as high as 50 calories.
- In order to make fermented meals like idli, dosa, and dhokla, we can ground soaked dhals. The dhal is allowed to ferment all night. The dishes are light and simple to process.
- Cereals and pulses can be mixed to create a variety of delicious dishes. In order to produce khichri, dhal-stuffed *Paratha*, puris, etc., you may combine pulses with atta and rice. The combination of grains and pulses is more nutrient-dense, as you have already read.
- Puranpolis can be made with dhals that have been cooked to a soft consistency, well-mashed, or crushed and cooked with jaggery.
- Sprouted pulses are occasionally used in traditional legume dishes. Starch and proteins undergo a partial breakdown during sprouting, which improves digestibility. An extra benefit is the distinctive taste that sprouted legumes have. It is necessary to spread the sprouting method and use more sprouted legumes. It could also be offered as a commercial, ready-to-use product.

PRACTICAL ACTIVITY 3

- 1) Make dishes using whole grains, sprouting pulses, split dhals, parched pulses, and pulse flours.

PRACTICAL ACTIVITY 4

- 2) Make recipes with the combination of cereal and pulses.

PRACTICAL ACTIVITY 5

- 3) Prepare dishes utilizing items made from fermented pulses.

ASSESS THE PROGRESS OF YOUR SESSIONS 7

- 1) What are the different healthy foods items developed from pulses?

- 2) Plan and make two snacks acceptable for malnourished children using chickpea flour.

3.5 CHANGES DURING COOKING OF PULSES

Legume seeds that have not been roasted contain antinutritional elements that, if taken in sufficient quantities, can be harmful. Bean protein lost quality when it is overheated. As more lysine is present in roasted pulses than in boiled or pressure-cooked ones, roasting pulses brings about more improvements in the protein quality of pulses than dry heat treatment. Methionine loss occurs during heat treatment. On the contents of calcium, magnesium, and total iron, cooking has little impact. Heat application may cause thiamine loss. Sodium metabisulphate is

present to be effective in marinating colour of lentils, other seeds acquire a darker colour during processing.

**GREEN GRAM CAN BE EASILY COOKED AT MUCH FASTER RATE THAN
MANY OTHER LEGUMES**

ASSESS THE PROGRESS OF YOUR SESSIONS 8

1) What are the factors affecting cooking of pulses?

3.6 LET US SUMMERISE

The Indian meals are not complete without pulses. We all consume a variety of pulse in our diet. Pulses such as Urad, Masoor, rajmah, chana, besan, moong, and Arhar are widespread. They are abundant in minerals and vitamins, in addition to being high in protein. All pulses have enough lysine, which is lacking in cereals, and hence can augment cereal protein. A combination of grains and pulses outperforms each one. As a result, a cereal-and-pulse combination is suitable for human eating.

3.7 GLOSSARY

Sprouted: to begin growing or producing new growth

Redgram dhal: Pulse of 'Cajanus cajan,' commonly known as arhar dal, tur dal, tuver dal, or pigeon pea.

Rajma: Dry French bean; legume of the plant *Phaseolus vulgaris*.

Moth bean: *Phaseolus aconitifolus*, Jacq., legume and also called Dew Gramme and Aconite bean.

Khichri: A dish produced by cooking a combination of rice and pulse with seasoning, spices, and other ingredients.

Jaggery: A kind of non-centrifugal cane sugar popular in Asia. It is a concentrated product of date, cane juice, or palm sap that does not separate the molasses and crystals and ranges in colour from golden brown to dark brown.

Papad: *Papad*, the crunchy, textural element of Indian food, can be roasted or deep-fried.

Dosa: A snack made with a fermented batter of rice and urad dal.

Extrusion: In the food industry, extrusion involves pushing soft and combined materials by a hole in a perforated surface or die intended to create the desired form.

3.8 EXERCISES TO CHECK YOUR PROGRESS ANSWERS

Assess the progress of your sessions 1

- 1) When buying pulses, make sure the dhal is clean, free of pebbles and twigs, and insect-free. To prevent fungus from forming on the pulse, it must be dry.
- 2) Masoor dhal, black gram dhal, green gram dhal, Bengal gram dhal, and red gram dhal

Assess the progress of Your Sessions 2

1) 100g of pulses has 340 calories. Pulses are high in micronutrients including selenium, zinc, niacin, folate, and riboflavin. They have a high concentration of polyunsaturated fatty acids. They include calcium, magnesium, zinc, iron, potassium, and phosphorus; 80 per cent of the phosphorus is found as phytate phosphorus.

2) a) Vitamin A and E

b) Minerals like calcium, magnesium, zinc, iron, potassium, and phosphorus.

Assess the progress of Your Sessions 3

1) Pulses include a lot of micronutrients like selenium, zinc, niacin, folate, and riboflavin. Pulses are high in both vitamin A and vitamin E. Legumes are high in the B complex vitamins thiamin, folic acid, and pantothenic acid. Although they lack vitamin A and C, like cereals, germinating beans do contain small amounts of vitamin C content.

2) The nutritious value of sprouts is increased. Minerals like calcium, zinc, and iron are released from their bound condition during sprouting. Vitamin C is created during the germination process.

Assess the progress of Your Sessions 4

- 1) Chickpeas are high in fibre, protein, antioxidants, and beneficial fats, as well as having a low glycemic index (GI). As a result, chickpeas contribute in the control of triglycerides, cholesterol, blood sugar, and blood pressure levels; maintaining a healthy weight; and promoting gastrointestinal health. It may help strengthen your bones.
- 2) Red gram can also be used as an astringent to stop bleeding. It is also used to treat lung and chest issues and to get rid of internal parasitic worms. It is used to treat jaundice, cough, and pneumonia. The roots are used to treat throat inflammation, diarrhoea, and chlorosis.

Assess the progress of Your Sessions 5

- 1) There are several ways to include black gram (urad dal) to your diet. Boiling urad dry seeds allows for usage in a number of cuisines. In order to increase the protein content of bread, urad can also be made into flour. Urad dal could also be the main ingredient in dishes like idli and dosa. These are cakes made of fermented rice and dhal.

Assess the progress of Your Sessions 6

- 1) Protease inhibitors, haemagglutinins, phytates, flatus factors, tannins. Antinutritional elements can be considerably reduced or removed using processing processes such as heating, soaking, germination, and fermentation.

Assess the progress of Your Sessions 7

- 1) Fermented foods (Idli, Dhokla, Dosa), Sprouted dhal, chakli, murmura, puffed peas etc.
- 2) Besan *Cheela* ,*Laddus*, Chocolate Bar

Assess the progress of Your Sessions 8

- 1) Heat treatment causes methionine loss. Cooking has minimal effect on calcium, magnesium, and total iron levels. The application of heat may result in thiamine loss.

UNIT IV SELECTION, NUTRITIONAL CONTRIBUTION AND CHANGES DURING COOKING OF FRUITS AND VEGETABLES

You learned regarding pulses and their dietary significance in Unit 3. You will learn how to choose fruits and vegetables as well as their beneficial nutrients in this unit.

Structure

4.0 SCOPE

4.1 OVERVIEW

4.1.1 Health benefits of Fruits and vegetables

4.2 FRUITS

4.2.1 Selection of Fruits

4.2.2 Nutritional Contribution of Fruits

4.2.3 Changes during cooking of fruits

4.3 VEGETABLES

4.3.1 Some Vegetables

4.3.2 Selection of Vegetables

4.3.3 Nutritional Contribution of vegetables

4.3.4 Changes during cooking of vegetables

4.3.5 Significance and dietary applications of vegetables

4.3.6 Vegetable preparation

4.4 LET US SUMMERISE

4.5 GLOSSARY

4.6 EXERCISES TO CHECK YOUR PROGRESS ANSWERS

4.0 SCOPE

The information given in this lesson will help you understand the significance, dietary benefits, and nutritional value of fruits and vegetables. This section also goes into a lot of detail regarding the alterations that take place when vegetables and fruits are cooked. The major objectives of this unit are:

- describe the significance of fruits and vegetables in our diet;
- state the dietary beneficial of various fruits and vegetables ;
- choose excellent fruits and vegetables from the marketplace;
- clarify the numerous forms in which the fruits may be consumed other than uncooked

4.1 OVERVIEW

Consuming different types of vegetables and fruits is a key component of keeping up a nutritious diet. The World Health Organisation (WHO) suggests that we take 400 grammes of vegetables and fruit every day, or five meals. This suggested daily intake may help lower the chance of developing significant health disorders such as type 2 diabetes, obesity, heart disease, and stroke. Vegetables and fruits include phytochemicals. Vegetables and fruits that are yellow, orange, red, blue, purple, and green in colour comprise phytochemicals. The wide variety of plant-based substances that plants naturally produce is referred to as phytochemicals. Plant pigments and flavour agents are among them. Fruits and vegetables both have medical benefits.

4.1.1 HEALTH BENEFITS OF FRUITS AND VEGETABLES:

- Fruits and vegetables are abundant in fibre. Due to fibre makes you feel full, you eat less. Fibre is beneficial to the heart and the intestines. It lowers the probability of cancer of the colon, regulates bowel motions, and aids in maintaining an optimal digestive system. Fibre lowers the risk of stroke and lowers blood cholesterol levels, which together help avoid cardiovascular illnesses.
- Folate protects birth defects of the neural tube and is found in spinach, beans, melons, and oranges.
- White potatoes, and white beans, lima beans, cooked greens, carrot juice, and prune juice all lower blood pressure.
- Infections might be avoided with vitamin A, which also supports healthy skin and eyes. Excellent sources of vitamin A in fruits and vegetables include the following: Pumpkin, sweet potatoes, pumpkin, carrots, and green vegetables such as turnip greens, mustard leaves, kale, collard greens, seasonal squash, cantaloupe, and red peppers.
- Vitamin C supports gum and tooth health and aids in the healing of cuts and wounds. The following are excellent resources of vitamin C in vegetables and fruits: red and green peppers, kiwifruit berries, sweet potatoes, kale, cantaloupe, broccoli, pineapple, cabbage, Brussels sprouts, oranges, lemons, and mangoes.
- Olives, the flesh of avocados and coconut are the only naturally fat-free foods that are not found in vegetables and fruits.
- Every healthy diet and weight loss plan should include substituting fruits and vegetables for foods with a higher caloric content.

- Each fruit and vegetable delivers a unique combination of nutrients, flavours, and textures. We must select a range of fruits and vegetables for the best overall nourishment.

ASSESS THE PROGRESS OF YOUR SESSIONS 1

1) Mention any two health advantages of consuming folate and vitamin C rich fruits and vegetables.

2) What role does photochemical play in fruits and vegetables?

FRUITS AND VEGETABLES WITH A GREEN COLOUR CONTAIN ANTIOXIDANTS. YELLOW AND ORANGE VEGETABLES AND FRUITS ARE RICH IN VITAMIN A AND C, WHICH IMPROVES EYE HEALTH AND HELPS YOUR IMMUNE SYSTEM.

4.2FRUITS

Fruits play a significant role in a healthy diet and are a great source of several essential nutrients, such as potassium, folic acid, and antioxidants like polyphenols.



Fig 4.1Fruits

You will learn about their nutritional worth in this section along with how to buy them and how they change when cooked.

Table 4.1 Some Examples of different types of fruits

S.No.	Groups	Examples
1.	The delicate fruits and berries	grapes, strawberries, and all other berries
2.	segmented fruits or citrus fruits	Mandarins, grapefruits, oranges, pomelos, delicious limes, and tangerines
3.	Stone fruits or drupes	apricots, cherries, peaches, plums, and
4.	Melons	Muskmelon and Watermelon
5.	Pomes and hard fruits	pears and Apple
6.	Fruits from the tropics and subtropics	fruits include bananas, guavas, papayas, jackfruits, dragon fruits, custard apples, and kiwis

a) APPLE (*Malus domestica*): Apples are divided into four major groups based on their maturity time (summer, winter, or autumn), colour, size, and flavour, among other factors, such as cooking apples, eating apples, cider apples, and drying apples. It is a cold-weather crop. It requires a span of time with temperatures ranging from -2 to 6°C and an annual rainfall of 60 to 75 cm of two to three months. Apples flourish on rich, well-aerated, wet soil with very little of lime. Apples are grown in orchards by grafting or clonal propagation. It is mainly eaten fresh, however it is also utilized in processed foods such as apple butter, jam, canned apple sauce, and apple juice (sweet cider). Sweet cider can be fermented longer with controlled bacterial inoculation to produce alcohol (hard cider) or acetic acid (vinegar). Apple pomace, a byproduct of the cider press, is a source of pectin that is used in the manufacture of jellies, jams, and marmalades. Apple is also used to make murabba, an Indian preserved meal that is thought to be a cardiac stimulant. The apple is the only fruit with a well-known phrase “An apple a day keeps the doctor away”.

b) BANANA (*Musa paradisiacal*):

It is an herbaceous plant with a tree-like look. The wrapping spiral leaf bases form the stem. The leaves are around 4 feet long and 1 foot wide, with a pronounced midrib. The banana was first cultivated in South East Asia's humid tropical areas. Bananas were first mentioned in 500 BC

Hindu literature and epics. It can be cultivated in practically all warm climates across the world, although tropical lowlands provide the best growing conditions. It grows well in fertile alluvial soil with a pH of 4.5-7.5. For banana growth, 100-250 cm of rainfall and an average temperature of 27°C are ideal, and the plantation should be shielded from strong winds. The greatest and fastest way to get energy is from ripe bananas, which are rich in vitamins, minerals, and a high proportion of carbs along with some oil and protein. It is eaten raw, and it is used to make a variety of products such as banana purée, banana chips, and banana figs. Fermentation of banana produces alcohol and vinegar. Following the removal of the fibrous outer bracts, the male buds are sometimes consumed as a boiled vegetable in parts of Southeast Asia. In banana growing areas, even the inner core of the pseudostem is cooked like a curry. It has been observed that ingesting banana peel or smoking dried peel causes hallucinations. 5-hydroxytryptamine (5-HT) is known to induce these effects.

c) MANGO (*Mangifera indica*):

Evergreen mango trees may grow up to 90 feet tall. It features dense panicles of tiny pink blooms. The meaty drupe has a thick yellowish-red surface and a big seed. The fruit comes in a variety of sizes, shapes, and qualities. The fruit's pulp is orange or yellow in colour, and when fully matured, it has a rich, delectable, fragrant flavour with a great balance of sweetness and acidity. Fruits that are not ripe are fibrous and extremely acidic. It comes originally from South East Asia and has been grown in India for over 4,000 years. It is significant in Hindu mythology, religion, ritual, and traditions. In almost all Hindu festivals, garlands of mango leaves are tied on doors as decoration. The colder regions of India are the only ones where mangoes are not grown. It thrives on well-drained soils with a pH of 5.5 to 6.0. An annual rainfall of 75–190 cm and an average temperature of 24–27 °C are needed for mango growing. Ripe mangoes are eaten as a dessert fruit and used to create jams, jellies, and squash. Pickles, chutneys, aam panna, aampapad, and amchur are all made from mangoes. The kernel within the stone is also roasted, pulverised, and boiled into gruel.

d) CITRUS FRUITS:



Fig 4.2 Citrus Fruits

Citrus fruits are from the genus citrus, which has roughly evergreen 16 species fragrant trees and shrubs, typically through thorny branches, that are found across the world's tropical and subtropical climates. Orange, lemon, and lime are the three most common citrus fruits. They are a beloved fruit because of their vibrant shade, tempting flavour, and sweetness. They can be consumed raw and are served as juice. They are rich in vitamin C content.

e) DRUPES:



Fig 4.3 Drupes Fruit

Drupes are delicious fruits with a thin shell and luscious meat that contain a single seed (Stone). This category includes apricots, cherries, peaches, and plums.

f) MELONS: Cucumbers and melons are both members of the Cucurbitaceae family. Melons are typically consumed uncooked. Their flesh is composed of 94% water and only 5% sugars. The seeds may be eaten after being peeled of their hard coverings, and they also produce edible oil.

g) BERRIES:



Fig 4.4 Berries

Berries are fruits having layers of pericarp (fruit coat) that, except from the skin on the exterior, are frequently homogeneous. The pulpous and luscious pericarp layers contain seeds imbedded in the pulp mass. The fruits' cell structure is delicate and might be destroyed by hard handling or freezing.

YELLOW FRUITS: Yellow fruits include mangos, apricots, gooseberries, and papayas. These kinds of fruit are high in beta-carotene, which is a precursor of vitamin A. They guard the eyes from night blindness and other vitamin A deficiencies.

FOR VITAMIN A, EAT MANGOES, APRICOTS, AND PEACHES. THEY PROTECT YOU FROM NIGHT BLINDNESS.

ASSESS THE PROGRESS OF YOUR SESSIONS 2

1) List the top five fruits that are most popular in India.

a) _____

b) _____

c) _____

d) _____

e) _____

2) Mention any five vitamin C rich fruits.

a) _____

b) _____

c) _____

d) _____

e) _____

3) What kinds of foodstuffs are made from mangoes?

4.2.1 SELECTION OF FRUITS

Size, grade, and diversity are all important factors in the selection of fruits. Knowledge of the ripening process in fruits is essential in order to choose fruits suitable for preservation. Fruits that are just ripe, crisp, fine, and bruise-free are considered to be of good quality. They should not have any symptoms of deterioration, such as the presence of mould, shrinking and limpness, discoloration and mushy texture, the appearance of insects and worms, overripe vegetables, or bruised or damaged skin.

Bananas:When buying bananas, it should not have any black spots on the skin, be free of bruising, and be slightly hard. As completely ripe fruit is readily crushed even as you carry it home from the market, they should then be allowed to ripen at room temperature.

Apples:A good apple is firm, crisp, colourful, and weighty. Each kind has its own distinct hue and form. When apples are kept for an extended period of time, they get spongy texture and lose flavour and aroma. As a result, it is best to buy apples only when they are in season. Small, tart fruits can be used to make jelly, sauce, and other preserved foods.

Grapes: Grapes must be full, lustrous, color-coordinated, securely connected to stem, and devoid of bruising and discoloration. They should not leak since it indicates spoiling.

Citrus Fruits: Oranges, sweet limes (mausambi), grape fruits, lemons, and other citrus fruits are examples. These are organised by size, and the price decreases as the size increases. In some markets, lemons are sold by weight in addition to being sold by the dozen or basket. Citrus fruits with bright and thin skins, firmness, rich colour, and weight in relation to size are favoured since they are more likely to contain juice. A spongy texture and dull, dry skin are signs of ageing and poor eating habits. Additionally, keep an eye out for signs of decay, such as cuts or skin punctures, soft spots, surface mould, skin punctures, and discoloured, weakened areas of skin near the stem end or button.

Pears: Pears ought to be picked when they are firm and have already begun to soften to ensure that they will mature accurately. They should not be droopy or shrivelled, with dull-looking skin and little weakening of the flesh around the stem, since these pears will not ripen. Avoid stains on the pear's sides or blossom ends, which indicate corky tissue below.

Plums and prunes: Choose plums and prunes that are the right colour for the kind and at the right stage of ripeness—from moderately firm to slightly soft.

Pineapples: Choose pineapples with a firm, plump, and hefty for their size appearance, with a vibrant golden yellow, orange-yellow, or reddish brown colour that covers 15% to 20% of the fruit, a fragrant perfume, and a very tiny separation of the eyes or pips. These colours may be found on pineapples of different varieties. The proportion of edible flesh increases with fruit size. They are supposed to be lack of bruises, microbial growth, soft or discoloured patches, and bruising.

Peaches: These should be fairly firm, not too soft, with yellowish or at least creamy skin between the red areas.

ASSESS THE PROGRESS OF YOUR SESSIONS 3

- 1) When buying fruits, list any three selection criteria.

PRACTICAL ACTIVITY 1

1. Prepare the following recipes with fruits:

- a) Salads
- b) Desserts

4.2.2 NUTRITIONAL CONTRIBUTION OF FRUITS

Fruits are extremely low sources of both fat and protein. The exception is the avocado, which has 28% fat. Fruits are very perishable since they contain a significant amount of moisture. They are also an excellent source of fibre. Fruits are often a poor source of iron. Mangoes are a great source of carotene. Beta-carotene is found in abundance in Indian dates and papaya. Fruits high in vitamin C include guavas and citrus fruits. Large levels of vitamin C may be oxidized in fruits if they are damaged, peeled, cooked, or exposed to air, alkali, or copper. Flavonoids, which act as antioxidants, are present in a variety of fruits including apples, pears, cherries, grapes, and citrus. Vitamin C is abundant in fruits, particularly citrus and guava. Yellow fruits, such as mango and papaya, contain beta-carotene. Bananas are high in carbohydrate and hence high in energy. With the exception of avocado, protein and fat content of fruits is low.

Fruits also provide fibre as well as minerals including salt, potassium alongwith magnesium. Fruits do not provide a good amount of calcium. Iron is present in significant proportions in dry fruits, *seethaphal*, and watermelon.

Table 4.2 Nutritional composition of fruits

Species	Fiber (mg/g)	Vit. A (IU/g)	Vit. C (µg/g)	Vit. E (µg/g)	Vit. B ₁ (µg/g)	Vit. B ₂ (µg/g)	Ca (µg/g)	Fe (µg/g)	K (mg/g)
Apple	24–27	0.53	46–58	1.81	0.14	0.14	72	1.45	1.15
Apricot	20–23	26.11	100–114	8.90	0.29	0.29	143	5.71	2.97
Avocado	50–62	6.21	71–173	20–27	1.07	1.07	107	10.71	6.43
Banana	24–26	0.81	87–93	1.02	0.42	1.02	59	3.39	3.96
Blackberry	53	1.65	210	11.70	0.28	0.42	319	5.56	1.96
Blueberry	24–27	1.00	97–131	5.72	0.48	0.48	62	1.38	0.89
Cherry	21–23	2.15	71–73	0.73	0.44	0.59	147	4.41	2.24
Cucumber	7	0.74	25–32	0.29	0.17	0.08	143	1.68	1.48
Grapefruit	11–16	0.1–2.6	312–382	1.28	0.33	0.16	116	0.83	1.38
Kiwi	30–34	1.75	928–974	14.6	0.26	0.53	263	3.95	3.32
Lemon	28	0.29	529–534	1.55	0.34	0.17	259	5.17	1.38
Mango	18	38.94	278	11.21	0.61	0.55	103	1.21	1.56
Melon	8	32.24	367–425	–	0.38	0.19	112	1.88	3.09
Cantaloupe									
Nectarine	17	7.36	51–54	7.72	0.15	0.44	51	1.47	2.12
Orange	24	2.05	533	1.83	0.84	0.38	397	0.76	1.81
Papaya	18	2.84	620	7.30	0.29	0.29	243	0.71	2.57
Pear	24–36	0.20	38–42	1.21	0.18	0.42	108	2.41	1.25
Pineapple	13	0.23	155–362	0.19	0.90	0.39	71	3.87	1.13
Plum	15	3.23	91–95	2.57	0.45	0.91	45	1.52	1.73
Pumpkin	11	10.82	49	–	0.33	0.78	151	5.71	2.30
Squash	11–19	1.96	150–170	1.24	0.62	0.35	203	4.42	1.95
Strawberry	22	0.27	566–592	2.78	0.18	0.66	138	3.61	1.66
Sweet pepper	17–20	6.3–57	804–1900	5.92–15.8	0.67	0.27	87	4.70	1.77
Tomato	12	6.23	125–189	5.32	0.61	0.50	50	4.44	2.22
Watermelon	4–5	3.66	81–99	0.49	0.79	0.20	79	1.97	1.16

Adapted from Dorais and Ehret (2008); data are from the USDA database

ASSESS THE PROGRESS OF YOUR SESSIONS 4

- 1) Give a list of the main nutrients that can be found in fruits.

- 2) Bring attention to the value of fiber-rich fruits and vegetables in a healthy lifestyle.

4.2.3 CHANGES DURING COOKING OF FRUITS:

- During ripening and cooking, the fruits go through a number of changes. These consist of modifications to the product's appearance, flavour, juiciness, soluble solids, colour, texture, and flavour.
- The food becomes soft, tasty, and digestible after cooking. Cooked apple, guava, and mango chunks are examples of fruits that become soft because to softening cellulose found between the cell walls.
- High temperature causes gelatinization and thickening of starch.
- The fruit tissue's pectin is extracted during cooking, aiding in the synthesis of gel. This may be seen while jam or jelly is being made.
- Because vitamin C is lost during cooking, fruits should be eaten raw whenever possible.
- Because of the high temperature while cooking, colour pigments in fruits often oxidise, darken, and become bland. Anthocyanins leach in water, giving the preparation a bluish purple hue owing to oxidation, as in adding black grapes to apple jam, orange, marmalade, and other similar preparations.
- Cooking improves the flavour of fruits, but overcooking might result in flavour loss; consequently, optimal cooking should be done.

Scientists and producers all across the world are working hard to fulfill customer demand for high-quality products. Initial sales are influenced by appearance and freshness, but flavour satisfaction is critical for frequent purchases. Most researchers previously considered that physicochemical characteristics including TSS, TA, hardness, and volatile chemicals were good predictors of fruit ripeness and flavour. Scientists, on the other hand, are becoming increasingly conscious of the relevance of sensory analysis with skilled groups or consumers, particularly for measuring variables that are difficult to assess with normal scientific studies. The effect of thermal treatments on the sensory attributes of fruit has received little attention, but contemporary postharvest research is giving these investigations considerable attention.

ASSESS THE PROGRESS OF YOUR SESSIONS 5

- 1) What effect does cooking have on the nutritive value of fruits?

4.3 VEGETABLES

Plants or plant components that are consumed as vegetables. Vegetables provide various nutrients in addition to adding variety to the diet. They make the dish more appealing due to its colour, texture, and flavour. According to their nutritious content, vegetables may be divided into three types.



Fig 4.5 Vegetables

1. Green leafy vegetables

Green leafy veggies are high in fibre and low in calories, have high water content, and are crisp and fresh. Fenugreek, spinach, Colocasia, amaranth, radish, cabbage, celery, coriander, and dill (shepu) leaves are among examples.

2. Roots, tubers and bulbs:

These veggies are an excellent supplier of carbohydrate. The inclusion of carbohydrate (starch) makes them a good source of calories. They may be kept for a long time because of their less moisture value. Among them are beetroot, carrot, colocasia, turnip, potato, sweet potato, yam, tapioca, onion, and garlic.

3. OTHER VEGETABLES

They provide food diversity and are a great provider of dietary fibre. They provide a respectable amount of vitamins and minerals. Variations of (for instance) brinjal, ladies finger, cauliflower, cucumber, and gourd.

Table 4.3 Vegetable classification based on commonly eaten plant sections

Group	Examples
Roots	Carrot, beet root, radish, turnip, colocasia
Tubers	Potatoes, sweet potatoes, tapioca
Bulb	Onion, garlic, leeks
Leaves	Cabbage, lettuce, spinach, amaranth, fenugreek leaves, coriander leaves, mint leaves, greens
Flowers	Plantain flower, Cauliflower, broccoli
Fruits	Tomatoes, brinjal, lady's finger, pumpkin, cucumber, gourds (ash gourd, bottle gourd), capsicum, drumstick, plantain
Legumes (Pods and seed)	Peas, beans, chowli, broad beans, French beans, double beans, Bengal gram tender, red gram tender.
Stems	Plantain stem, ginger, amaranth stem, celery stem, lotus stem

ASSESS THE PROGRESS OF YOUR SESSIONS 6

- 1) Give some examples of roots and tubers.

4.3.1 SOME VEGETABLES

a) Spinach



FIG 4.6 Spinach

Spinach (*Spinacia oleracea*) is a green leafy vegetable that is high in iron. It contains more than 13 flavonoids, which fight cancer and function as antioxidants. Spinach contains vitamin K as well as carotenoids that are good for heart and bone health and for preventing age-related macular degeneration and cataracts in the eyes. Due to its low calorie content and high vitamin content, spinach constitutes a few of the numerous necessary nutritious vegetables. More than enough vitamin K and A, manganese, folic acid, and around 40% of the magnesium the body needs are present in a cup of spinach leaves. Nearly 20 elements, including dietary fibre, calcium, and protein, are present in it in excellent amounts. Even yet, a cup only has 40 calories.

b) Amaranth:



Fig 4.7 Amaranth leaves

Amaranthus (L.) is a genus with around 60 species that belongs to the *Amaranthaceae* family. The plants have a wide range of kinds and morphologies, and the green sections of certain species are eaten as vegetables. Due to its nutritional value, amaranth is still incorporated in the human diet today. Amaranth is regarded as a "superfood" due to its high nutraceutical value, which includes high-quality protein, unsaturated oils, dietary fibre, tocopherols, tocotrienols, phenolic compounds, flavonoids, vitamins, and minerals. Amaranth has a greater protein, dietary

fibre, calcium, iron, and magnesium content than other grains; hence, although being an old crop today, it is regarded a millennium crop or superfood with important nutraceutical qualities and agronomic adaptability. These are employed in human nutrition in the form of whole-meal amaranth flour, crackers, eggless pasta, gluten-free brown bread, biscuits, cookies, and so on.

c) Broccoli:



Fig 4.8 Broccoli

Brassica oleraceae var. *italica* is a variety of brassica that resembles cauliflower and comes in two varieties: the heading or calabrese variety and the sprouting variety. Among the veggies addressed are kale, cauliflower, Brussels sprouts, bokchoy, cabbage, collard greens, rutabaga and turnips. The sprouting type, collected in the spring following a dormant winter, is made up of small immature purple or green compact clusters of miniature blooms that branch from a thick 1 m tall main stem. They are regularly cut to be utilized as a vegetable or salad ingredient unless they have become hardly usable. It can be consumed fresh, cooked, steamed, cool, or heated. These nutrient-dense meals give plenty of nutrients for a low calorie count.

d) Potatoes:



Fig 4.9 Potatoes

The plant *Solanum tuberosum*, among the most frequently cultivated and productive crops, uses the swollen tip of a stem that grows underground as a starch store to encourage the formation of

new stems from the eyes. The two primary varieties are waxy and floury, characterized by the tissue integrity.

ASSESS THE PROGRESS OF YOUR SESSIONS 7

- 1) Enumerate the advantages of spinach and amaranth for health.

4.3.2 SELECTION OF VEGETABLES

When vegetables remain in the sun or for an extended period of time, they normally wither. Purchase vegetables that are fresh. When purchasing root and tuber crops make assured that they are of the exact same variety, well-shaped, smooth, and nearly the same in size. The following are the qualities of different vegetables that are desirable:

- **Beans** : Seeds should be less than half grown and should break readily with a sharp sound to be considered tender, fresh, crisp, clean, firm, and velvety to the touch.
- **Cabbage**: no yellow or withered leaves, should be compact, and be fresh.
- **Carrots**: There should be no wilted, soft, or flabby portions. They should be firm, fresh, smooth, and yellow orange in colour.
- **Cauliflower**: It should be compact with no insect, fine heads, soft leaves, should not be rough, and flowers should not be spread out. Yellow flowers should not be used. The colour yellow signifies over maturity.
- **Brinjal**: Firm, bright, uniform dark rich purple or green colour, free of marks or decay, should not be wilted, flabby or soft, no bug holes.
- **Greens**: tender, fresh dark bright green, no holes in the leaves, no wilted leaves, not with too much of water, no soft portion of leaves. The leaves should be crisp, and the stems should be slender.
- **Tomatoes**: bright red in colour, firm, should not be soft, plump body with uniform red colour, any holes, softness, black, overripe, or cracks.

BLANCH CAULIFLOWER IN SALT WATER TO REMOVE THE WORMS

ASSESS THE PROGRESS OF YOUR SESSIONS 8

- 1) Give any two selection standards you use while buying vegetables.

PRACTICAL ACTIVITY 2

- 1) Go to a local market and describe how you plan to buy any five veggies that are high in iron and vitamin C.

4.3.3 NUTRITIONAL CONTRIBUTION OF VEGETABLES

Due to their high mineral and vitamin content, vegetables are regarded as foods that provide protection. Green leafy vegetables, roots and tubers, and other vegetables are divided into three categories based on their nutritional value.

a)Green leafy vegetables

Green leafy vegetables are high in vitamins and minerals. They are composed of a high carotenoid content, which converts to vitamin A. They contains vitamin C. Drumstick leaves, and Spinach leaves are high in vitamin C and iron content. Fenugreek, drumstick leaves, and colocasia leaves all contribute calcium and fibre to our diet which help in preventing degenerative diseases.

Greens are high in B vitamins, including riboflavin and folic acid.B-Vitamin levels decline with drying and withering.

Iron is abundant in green leafy vegetables. Iron is abundant in leaves of plants that are generally discarded, such as the beetroot and cauliflower leaves. It is necessary to understand how to include such types of leaves into your normal diet. Mint and mayalu (red bacchali) are high in iron.

Calcium is provided by Agathi, Colocasia leaves, Drumstick leaves, and Fenugreek leaves in our diet. Oxalic acid, another component of greens, limits the body's ability to absorb calcium and iron. Greens are often rich in moisture therefore they must be well preserved.

The energy content of foods is not increased by greens since they are not a rich source of proteins, lipids, or carbohydrates.

b) Roots and Tubers

- Roots and tubers provide more calories than green-leafy vegetables because they contain more carbohydrates.
- Carrots contain a high percentage of carotene; however it is less than that found in green leafy vegetables.
- They contain fair amount of vitamin C content.
- Calcium, iron, protein, and B-vitamins are scarce in roots and tubers.
- They contain poor source of protein.

c) Other Vegetables

- Vitamin C is found in capsicum. Small bitter gourds are more nutrient-dense than regular ones.
- They are particularly perishable due to their high moisture content.
- They are frequently deficient in every nutrients.
- They are a good supply of vitamin C.
- They help to increase fibre intake of the diet. Iron is abundant in plantain green.

Table 4.4 Nutritive value of some common vegetables

Nutrients	Mint	Amaranth	Spinach	Coriander leaves	Gogu	Drumstick Leaves
Calories	4.8	45	26	44	56	92
Protein (g)	4.8	4	2	3.3	1.7	6.7

Calcium (mg)	200	397	73	184	172	440
Iron (mg)	5.6	3.49	1.14	1.12	2.28	0.85
Carotene (µg)	620	5520	5580	6918	2898	6780
Thiamine (mg)	0.05	0.03	0.03	0.05	0.07	0.06
Riboflavin (mg)	0.26	0.30	0.26	0.06	0.39	0.05
Vitamin C (mg)	27	99	28	135	20	220

Source:National institution of Nutrition, 2013

ASSESS THE PROGRESS OF YOUR SESSIONS 9

- 1) List some examples of vegetables that are an excellent source of vitamins A and C.

4.3.4 CHANGES DURING COOKING OF VEGETABLES

The colour, flavour, and texture of vegetables are increased with cooking, which also increases their overall palatability. Digestibility is also improved. A softening of the fibre occurs. Protein coagulates and gelatinizes starch. Cooking vegetables provides variety to your diet. Microorganisms are eliminated during cooking. If the vegetables are cooked submerged in water or steam, water may be absorbed. The cooking process softens cellulose and hemicelluloses. The pectic substances go through several chemical modifications. Cooked vegetable cutting and chewing are made simpler by pectic compounds. Boiling induces the gelatinization of starch, as is the case with boiled potatoes. When potatoes are fried, dextrinization of starch occurs. Caramelisation of sugar occurs when vegetables, such as onions, become scorched or burnt. During cooking, some nutrients are lost as the food is exposed to various variables. Vegetables lose nutrients beginning with their preparation and particularly when getting cooked.

- Ascorbic acid and carotene are lost during dehydration.
- The addition of soda causes a significant loss of B-vitamins during cooking. To maintain the natural colour of the veggies, keep them away from alkaline items like soda and acidic meals like tomatoes and lime juice for green leafy vegetables and green leafy vegetables respectively.

- To avoid overcooking, vegetables should only be cooked until tender-crisp. Raw veggies may be used in salads and *Raitas* to provide colour and texture to meals while also preventing nutritional loss while cooking.
- Since many vitamins, including thiamine and vitamin C, are heat-sensitive, cooking can partially destroy these nutrients. To reduce nutritional loss, cook all veggies except those with strong flavours in a closed pan.
- When using the moist heat method of cooking, the vegetables absorb water.
- Dryness is an adverse effect of dry heat techniques like baking because some water is lost.
- Water is released from the cells of high moisture plants like tomatoes and leafy greens as a result of cell breakdown. If sulphur-containing vegetables are kept uncovered for a few minutes after cooking, the development of a strong taste and discoloration of green leafy vegetables can be avoided.
- According to the variety of vegetables used, the flavour of the veggies may change throughout cooking.
- To preserve the colour, flavour, and nutrition, cook tubers and roots like potatoes, sweet potatoes, and beets with the skin on as well.
- Cook veggies as quickly as possible after they have been prepared. They should not be soaked. When cut areas are exposed, vitamin C is degraded. Water soluble vitamins B and C are lost during soaking.
- If the vegetables have been thoroughly washed, do not discard the cooking water; it can be used to make soups or gravies.

<p>MINIMIZE THE LOSS OF NUTRIENTS BY LEACHING AND OXIDATION</p>
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ASSESS THE PROGRESS OF YOUR SESSIONS 10

- 1) What is the best way to prepare greens so that their colour and nutrients are preserved?

4.3.5 SIGNIFICANCE AND DIETARY APPLICATIONS OF VEGETABLES

One of the most important reasons to include veggies in your meal is to offer a naturally rich in vitamins, fiber, and minerals. Vegetables are essential nutrients for preventing disease and are excellent for maintaining health. They contain vital nutrients that may be used for bodybuilding and repair. Their high fiber content adds diversity to the diet, increases palatability, and prevents constipation.

4.3.6 VEGETABLE PREPARATION

Vegetables can be utilized as garnishing agents in curry dishes, salads, and sambhar, as thickening substances in gravies and soups, in chutneys (onion) and pickles (tomato, onion), in the making of recipes such as *pulao*, Avial, and non-vegetarian meals, and as preserved foods.

Vegetable preparations include filled vegetables, dried vegetables, vegetable curries, and kofta curries, as well as vegetable salad and also stuffing in *paranthas*. Various food ingredients such as pulses and cereals can be used to prepare vegetables. For example, *Chana* dhal with gourd (ghia) and dhal puri will be healthier as well as taste better as a result of this. When making sambhar, vegetables such as brinjals, drumsticks, and potatoes are cooked with arhar dhal. In addition, you may prepare veggies in a few different manners.

a) Vegetables Soups and Vegetables Juices:

Vegetables add flavour and appeal to the dish. Vegetables such as drumstick, beetroot, Spinach, carrots, peas, beans, tomatoes and Cabbage can be used to produce a different variety of soups. Tomatoes, carrots, and other vegetables can be juiced. They enhance the flavour of the food. Vegetable based drinks and soups are particularly beneficial to newborns and the elderly.

b) Vegetable based snacks: Vegetables can be used to make snacks such as cheela, pakoras, cutlets, vegetable burger, and stuffed kachories.

c) Vegetables as Desserts: Vegetables can be used to make *Kheers*, *Halwas*, and desserts.

d) Vegetables as Pickles and Chutneys: You're probably aware that greens in season are inexpensive. You may preserve them by producing pickles, chutneys, murrabas, and other condiments.

e) Salads: Salads made of vegetables are a significant way to meet some of your needs for fibre

PRACTICAL ACTIVITY 3

1) Prepare a nutritious raw snack using vegetables.

BROWNING:Induced by the activity of enzymes, the surface of fruits and vegetables including apple, banana, potato, and brinjal develops a brown colour when they are chopped. Enzymatic browning is the name given to this process. When tissue is injured or cut and subjected to air, phenol oxidizing enzymes being generated. They interact with the polyphenols in the fruit to oxidize them into orthoquinones, which gives cut tissues their characteristic brown colour.Following techniques can be used to stop browning:

- By using heat, polyphenols become inactive by oxidation.
- Vacuum packing to remove oxygen.
- A pH change to inhibit enzyme activity.
- Submerging veggies in salt and sugar solutions.
- Antioxidants like ascorbic acid are used to delay oxidation.

Salads can be made with both fruits and vegetables.Dietary vitamins and minerals are added by the vegetables used to make salads..Fruit salad is a vibrant, energising, and healthy meal.Some of the fruits that may be used in a salad are pineapple, orange segments, apple and papaya cubes, grapes, bananas, sapotas, mangoes, and pomegranates.

4.4 LET US SUMMERISE

For a healthy diet and balanced diet, fruits and vegetables are necessary. In addition to giving the diet colour and diversity, they also contain significant quantities of vitamins, minerals, and carbs,

including roughage (fibre). Choose fresh produce that is firm, crisp, and brightly coloured, free of evident bruising or rotting and wilting indications, when you are making your purchase. Water-soluble nutrients like thiamine, riboflavin, pantothenic acid, nicotinic acid, pyridoxine, folic acid, and vitamin C can dissolve in the cooking water and be lost while boiling vegetables. In order to reduce nutritional loss, attention must be made to adopt suitable cooking practices. The sparkling and unique colours of fruits and vegetables, which are caused by pigments present in plant cell plastids, add to their attractiveness. Chlorophyll, anthocyanins, anthoxanthins, and carotenoids are the main pigments found in fruits and vegetables. Enzymatic browning causes particular veggies and fruits cutting edges to become brown or black, this may be avoided by blanching or adding lemon juice. Eating a wide range of vegetables and fruits is an important part of a balanced diet and reduces the risk of heart disease and type 2 diabetes.

4.5 GLOSSARY

Goose Berries:Rasbari

Dates: Khajur

Figs: Anjeer

Grape-fruit: Chakotra

Grapes:Angoor

Peaches:Aarhoo

Pear: Nashpati

Sweet lime:Mausambi

Dietary fiber: The elements of plant foods which the human body is unable to absorb or digest are referred to as roughage or bulk.

4.6 EXERCISES TO CHECK YOUR PROGRESS ANSWERS

Assess the progress of your sessions1

1) Folate protects birth defects of the neural tube and is found in spinach, beans, melons, and oranges. Vitamin C promotes gum and tooth health, as well as wound and cut healing. Vitamin C-rich vegetables and fruit including red and green peppers, kiwi, strawberries, sweet potatoes, kale, cantaloupe, broccoli, pineapple, sprouts from Brussels, oranges, and and mangoes.

2) Vegetables and fruit contain phytochemicals. Phytochemicals are found in yellow, orange, red, purple, blue, and green fruits and vegetables. The word phytochemicals refers to the large range of plant components that plants naturally create

Assess the progress of Your Sessions 2

1.a) citrus fruits b) berries c) yellow fruits d) banana e) mango

2.a)Grapes b) Guava c) orange d) pineapple e) Mango

3. Ripe mangoes are eaten as a dessert fruit and used to create jams, jellies, and squash. Pickles, chutneys, aam panna, aampapad, and amchur are all made from mangoes.

Assess the progress of Your Sessions 3

Fruits that are just ripe, crisp, fine, and bruise-free are considered to be of good quality. They should not have any symptoms of deterioration, such as the presence of mould, shrinking and limpness, discoloration and mushy texture, the appearance of insects and worms, overripe vegetables, or bruised or damaged skin.

Assess the progress of Your Sessions 4

1) Fiber, Beta-carotene, Vitamin C, Water, Carbohydrate etc.

2) Fruits and vegetables are abundant in fibre. Due to fibre makes you feel full, you eat less. Fibre is beneficial to the heart and the intestines. It lowers the probability of cancer of the colon, regulates bowel motions, and aids in maintaining an optimal digestive system. Fibre lowers the risk of stroke and lowers blood cholesterol levels, which together help avoid cardiovascular illnesses.

Assess the progress of Your Sessions 5

1) During ripening and cooking, the fruits go through a number of changes. The food becomes soft, tasty, and digestible after cooking. Cooked apple, guava, and mango chunks are examples of fruits that become soft because to softening cellulose found between the cell walls.

Assess the progress of Your Sessions 6

1)Beetroot, Carrot, Colocasia, Turnip, Potato, Sweet potato, Yam

Assess the progress of Your Sessions 7

- 1) Spinach contains vitamin K and carotenoids that are good for heart and bone health as well as preventing age-related macular degeneration and cataracts in the eyes. With little calories and a lot of vitamins, spinach is one of the many vital nutritious vegetables.

The human diet still includes amaranth nowadays because of its nutritional significance. Amaranth is a "superfood" because of its high nutraceutical value, which contains high-quality protein, unsaturated fats, dietary fibre, tocopherols, tocotrienols, phenolic compounds, flavonoids, vitamins, and minerals.

Assess the progress of Your Sessions 8

- 1) Purchase vegetables that are fresh. When purchasing root and tuber crops make assured that they are of the exact same variety, well-shaped, smooth, and nearly the same in size.

Assess the progress of Your Sessions 9

- 1) Carrot, Drumstick leaves, capsicum, Fenugreek leaves

Assess the progress of Your Sessions 10

- 1) To avoid overcooking, vegetables should only be cooked until tender-crisp. Raw veggies may be used in salads and *Raitas* to provide colour and texture to meals while also preventing nutritional loss while cooking.

UNIT V -MILK AND MILK PRODUCTS

Milk is an excellent source of minerals, vitamins, and proteins. Paneer, Khoya, cheese, curds, and other dairy products are not only simple to include in our diets but also contribute to the flavour of our food. In this section, you will learn about the nutritional makeup of milk and dairy

products, methods to select and utilize them, and the changes that occur during the cooking of milk as well as milk products.

Structure

5.0 Scope

5.1 Overview

5.2 Selection of Milk and Milk Products

5.2.1 Milk Products

5.3 Nutritional composition of Milk and Milk-Based Products

5.3.1 Types of Processed Milk

5.4 Changes during cooking of milk and milk products

5.4.1 Utilization of milk and milk products

5.5 LET US SUMMARISE

5.6 GLOSSARY

5.7 EXERCISES TO CHECK YOUR PROGRESS ANSWERS

5.0 SCOPE

You will be enabled to do the following after complete this chapter:

- To know about the selection criteria for milk and milk products.
- To learn nutritional contribution of milk and milk products;
- Changes that occur when milk and milk products are cooked

5.1 OVERVIEW

Milk has been consumed since the beginning of humanity. Even in the prehistoric period, cattle were domesticated, and milk was among the staple meals. Milk is among the most complete natural foods that are in nature for fostering development and health. You may have noticed that milk is the initial nourishment for the young of most animal species, including humans. You might be shocked to learn that a newborn can survive on only mother's milk for the first few months of its existence. No commercial milk product can ever fully replace mother's milk. All mammals produce milk after giving birth, and man consumes milk from many different species. The cow is the most prominent of these species as a food source. Additionally, milk from goats and buffalo is used.

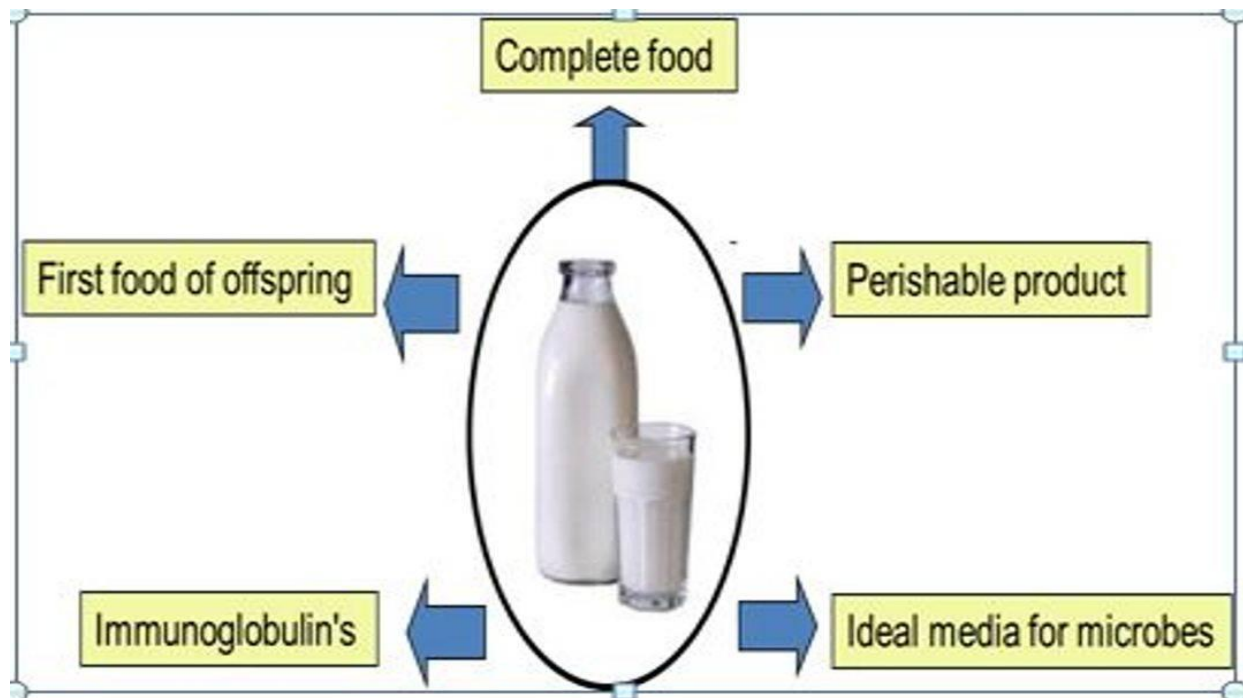


Fig 5.1 Benefits of milk

5.2 SELECTION OF MILK AND MILK PRODUCTS

Government Dairies as well as milk dealers provide milk that is available to us on the market. There are two ways to get government supplies: from the booth, which is homogenized milk, or in polypacks as full cream milk. A large amount of fat that separates as *Malai* on top makes polypack milk pricey. *Malai* can be used as is or turned into butter and ghee. The fat in milk that has been homogenized is reduced to very little particles so they don't float on top of the milk. This is why homogenized milk does not contain malai. Always get your milk from an authorized vendor. Keep the following in mind while purchasing milk:

- It is better to purchase milk from government organizations since it has been pasteurized. Pasteurized milk never spoils and is always safe for consumption.
- Do not buy milk from sellers since there is a possibility that it may be contaminated. For the purpose of increasing their profits, milk dealers may add any type of water to the milk. Drinking such milk is also not very hygienic and might result in issues with your health.

- Curds are best prepared at home as they are hygienic and far less expensive than curds purchased from the market.
- Always ensure that the paneer is free of fungus and offensive aroma before purchasing. If possible, buy paneer that has been wrapped in a hygienic packaging.
- The khoya must be firm and smell well. Fresh cream should not have a sour flavour or odour.

PRACTICAL ACTIVITY 1

- 1) Examine the various types of milk as well as milk products on the market and observe to the nutritional information given on the labels.

ASSESS THE PROGRESS OF YOUR SESSIONS 1

- 1) Make a list of the associated criteria you will consider before buying the following:
 - a) Paneer
 - b) Khoya

5.2.1 MILK PRODUCTS:

- i) **Cream:**



Fig 5.2 Cream

Cream, which comes from milk fat, is used to make desserts. A thick layer of fat from milk and a coagulated protein formed on top of large volumes of simmering milk. You may consume it whatever you choose, sugar-free or not.

ii) **Khoya:**



Fig 5.3 Khoya

Whole milk is used to make khoya by swirling it repeatedly in order to evaporate in an exposed cast iron skillet until it solidifies. This is frequently used to make Indian sweets.

iii) **Butter:**



Fig 5.4 Butter

Cream is converted into butter by churning. Butter and the milk's aqueous state separates from the cream when the fat globules in the cream are destabilized and agglomerate. The butter is taken out and cleaned. Numerous Indian recipes call for the use of butter as a cooking medium. It is a key component in bread, icing, cakes, and biscuits.

iv) **Ghee:** Butter oil is ghee. It is made by heating butter until the moisture is removed, then melting butter. It is used to make Indian sweets, savoury dishes, curries, and several kinds of rice, including pulav and biryani.

v) **Paneer and Cheese:**



Fig 5.5 Paneer and Cheese

You have definitely seen that when milk is heated with a little lemon juice or tartar added, the milk's particles separate into lumps and a thin liquid is left behind. Cottage cheese, or paneer, is this lumpy solid mass that contains all the proteins, fats, and vitamin A found in milk. Whey is the liquid that is left over after paneer has been separated. It includes beneficial vitamins and minerals including calcium, phosphorus, and B-complex vitamins. Therefore, it is not advisable to discard this priceless liquid. It is simple to include into breads, curries, beans, and other dishes. You can also provide this drink to a family member's child who may be experiencing diarrhoea. The produced paneer can be ripened further to produce several types of cheese. This is accomplished by introducing various microorganisms under various circumstances; the resulting cheese has a strong taste and is far more costly than paneer. Under several brand names, it is offered in tiny cubes and tins.

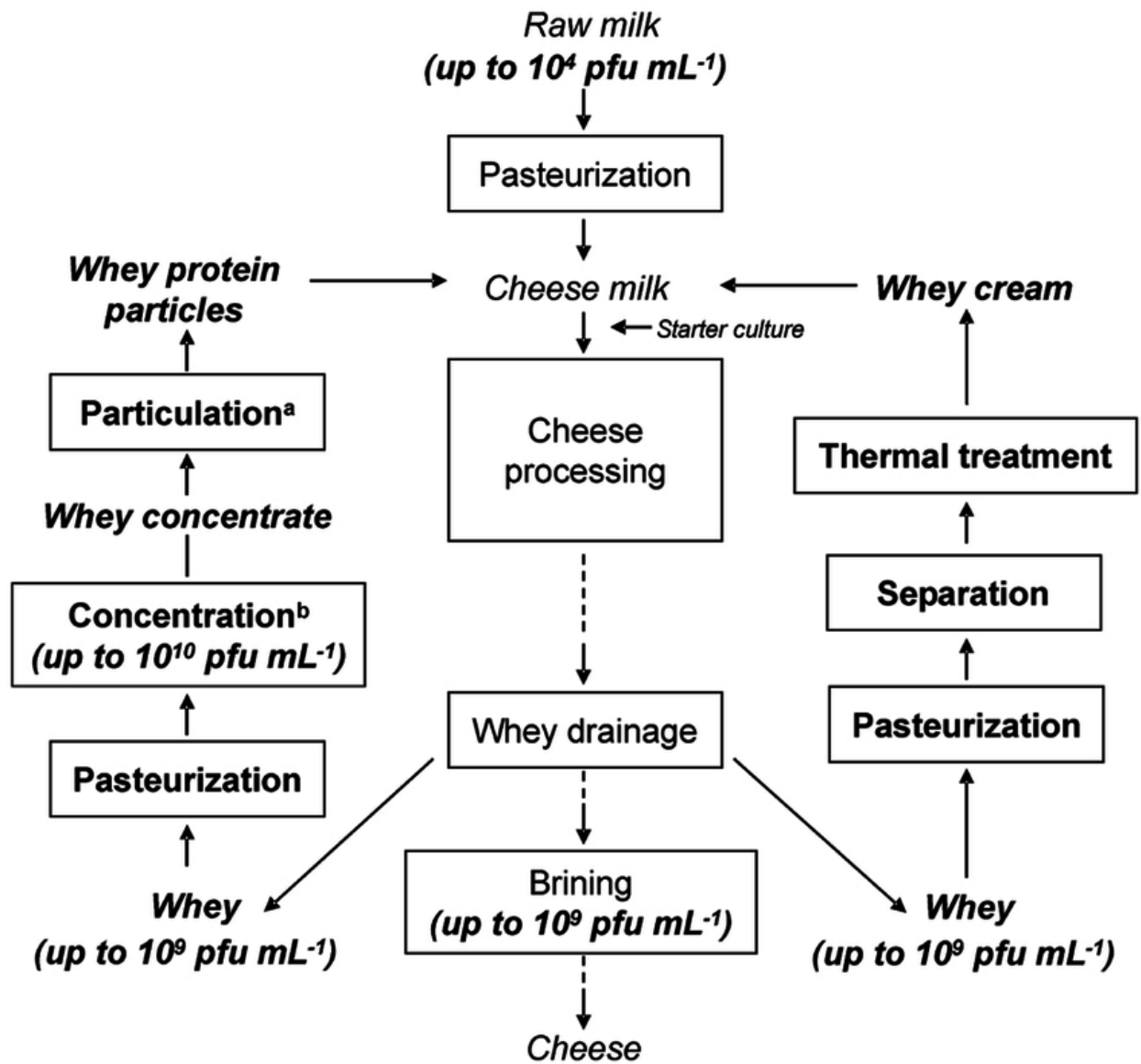


Fig 5.6 The production of Cheese

(Source: Atameret *et al.*, 2012)

- vi) **Curd:** It is a vital product made from milk. You must mix a small amount of curd with warm milk and let it rest for five to six hours in order to make curd. What happens when a little curd is added to milk? Certain bacteria in the curd convert lactose into lactic acid,

turning milk into curds as a result. The solid curd and sour flavour are a result of the lactic acid generated. We need milk that is just right for creating curds—not too hot or too cold. This explains why it's challenging for you to manufacture curds in the winter. To get around this, we need flip a big pan over it to keep it warm. The nutritional content of milk and curd is similar. As a result, some people who cannot drink milk can accept it when it is in the form of curds. Curd is preferable to milk because it is more readily digested, particularly in diseases like diarrhoea and dysentery.

vii) **Yoghurt:**



Fig 5.7 Yoghurt

This is a milk product that has been coagulated and has a curd-like texture. It has a little acidic flavour and is created with whole or partly skim milk. Pasteurized milk is combined with a mixture of *Streptococcus thermophilus*, *Lactobacillus bulgaricus*, and *Lactobacillus acidophilus* to make yoghurt, which is then incubated at 42°C to 46°C.



Fig 5.8 Milk based Products (source: <https://www.thecompletenatural.ie/real-talk/nutrients-in-milk-dairy-products>)

viii) **Ice Cream:**



Fig 5.9 Ice cream

Whole milk, skim milk, cream, butter, condensed milk products, or dry milk products are all included in this frozen dairy product. About 60% of the total solids in ice cream are made up of non-fat milk solids and milk fat. These ingredients increase the body, texture, and richness of ice

cream. Ice cream also includes dairy products, sugar, an emulsifier, a stabiliser, flavouring, water, and air.

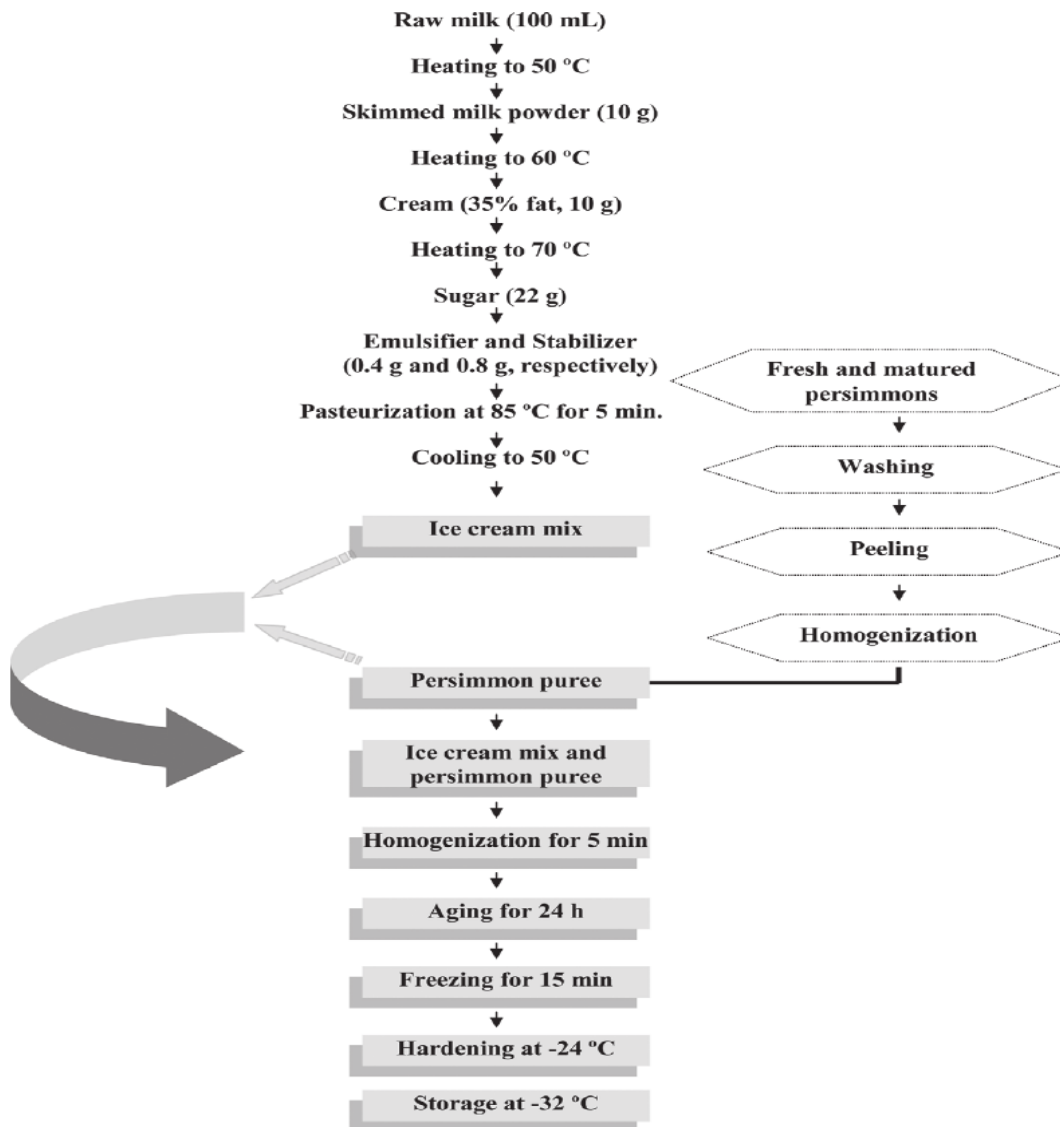


Fig 5.10 Manufacture of Ice cream

(Source: Karaman S., et al., 2013)

PHYSICAL ACTIVITY 2

- 1) Make a poster highlighting the value of milk consumption.

PHYSICAL ACTIVITY 3

- 1) Make a meal with cheese and khoya that you will eat.

PHYSICAL ACTIVITY 4

- 1) Make a flowchart showing how ice cream is made.

ASSESS THE PROGRESS OF YOUR SESSIONS 2

- 1) Name four examples of milk products that are popular in India.

2) How would you characterize Yoghurt?

5.3. NUTRITIONAL COMPOSITION OF MILK AND MILK-BASED PRODUCTS

A Complex combinations of lipids, carbohydrates, proteins and a number of other organic and inorganic substances that have been dissolved in milk. Fat, followed by protein, is the milk component that varies the most. Milk composition varies according to species, breed, food, lactation time, and milking interval. There is also individual variance.

- **Milk fat:**

The content of fat of buffalo milk contains 6.5 per cent. Cow's milk has 4.1 per cent fat. Milk fat or butter fat has a high nutritional and economic value. Milk fat is responsible for its taste. Milk is an oil-in-water emulsion. Milk fat is a complex combination of glycérides. Milk includes a high concentration of short chain fatty acids, which contribute to its distinct taste and off flavour. They provide butter with a soft, firm consistency because to their low melting point of -10 to 12oC. Phospholipids, sterols, free fatty acids, carotenoids, and vitamins that are fat-soluble are also present in milk. The colouring that gives milk fat its yellow hue is carotenes. Strong smells should never be present around milk, butter, or cream. Milk fat is easily digested. It has 2.1 per cent linoleic acid, 0.5 percent linolenic acid, and 0.14 per cent arachidonic acid. There is no fat in skimmed milk. Buffalo milk has a high fat content.

- **Milk proteins:**

Milk has a high biological value and high-quality protein. Lysine is an important amino acid found in high concentrations in milk proteins. Cheese, khyoa, and dried milk powders are concentrated forms with a high nutritional density per unit.

Casein accounts for 80% of the nitrogen in milk. It forms during the process of acidifying milk to pH 4.6 at 20°C. Lactoglobulin and lactalbumin make up the remaining whey protein. Proteoses, peptones, and milk enzymes are all found in milk protein. Casein is a phosphoprotein due to the

presence of phosphoric acid in its molecular structure. Casein contains a considerable amount of essential amino acids. Casein has a calcium content of 8.2 per cent and a carbohydrate content of 5.7 percent. Since it is a significant source of high-quality protein, it is a crucial food for young children and infants. It is the primary source of animal protein for vegetarians.

- **Minerals**

Calcium, phosphorus, salt, and potassium are key minerals found in milk. Calcium is required for the action of rennin to produce curd from milk. Because of the high mineral content, dairy products are a good amount of calcium. In the milk calcium-phosphorus ratio (1.2:1) in milk is thought to be optimal for bone growth. Additionally, dairy products contain nutrients as vitamin D as well as lactose that help the body absorb calcium. The calcium need cannot be readily reached without the consumption of milk. Milk is deficient in iron content. However, any iron that is present is used by the body. Khoya includes more iron since it is extracted from containers during the making process.

- **Enzymes**

Milk enzymes that are relevant to food scientists are alkaline phosphatase, lipase, and xanthine oxidase.

- **Vitamins**

Both fat-soluble and water-soluble vitamins are frequently found in milk. Milk has a relatively modest quantity of niacin and ascorbic acid. Milk contains just a good quantity of thiamine, which is present in generally stationary amounts. Milk is a reliable source of riboflavin since it contains higher levels of it compared the other B vitamins and is resistant to heat. Riboflavin is found in whey water during the cheese making process. Because it is light sensitive, milk loses 50 per cent of its riboflavin when exposed to sunlight.

- **Carbohydrate:**

Milk is the single food that includes lactose, which contains galactose, which is required for the production of the myelin sheath. Lactose, since it is not easily soluble, promotes the formation of lactic acid bacilli in the colon, lowering pH. This decrease in pH promotes calcium absorption.

Lactose also enhances calcium ion permeability in the small intestine. Milk sugar is recommended as a carbohydrate source due to its regulated glyceimic effect. The lactose sugar is the main carbohydrate found in milk. The infant can digest it without difficulty.

Milk has a lot of tryptophan but just a small amount of niacin. Milk has relatively little vitamin C. Vitamin A and D content are influenced by the animal's diet.

A DIET RICH IN DAIRY PRODUCTS IS AN EXTREMELY EFFECTIVE APPROACH FOR BOTH PREVENTING AND MANAGING HYPERTENSION, AS REPORTED BY RESEARCH.

Table 5.1 Nutritive value of milk

Constituents	Unit	Cow Milk	Buffalo Milk	Goat Milk	Sheep Milk
Water	g	87.8	81.1	88.9	83
Protein	g	3.2	4.5	3.1	5.4
Fat	g	3.9	8	3.5	6
Carbohydrate	g	4.8	4.9	4.4	5.1
Energy	kcal	66	110	60	95
	kJ	275	463	253	396
Sugars (Lactose)	g	4.8	4.9	4.4	5.1
Fatty Acids					
Saturated	g	2.4	4.2	2.3	3.8
Monounsaturated	g	1.1	1.7	0.8	1.5
Polyunsaturated	g	0.1	0.2	0.1	0.3
Cholesterol	mg	14	8	10	11
Calcium	IU	120	195	100	170

Source: International Laboratory Services.

Source: *Dai li and PenguZhou , 2016*

ASSESS THE PROGRESS OF YOUR SESSIONS 3

1) In terms of nutrition, what function do milk and milk products play in the diet?

2) List the five important nutrients found in milk.

a) _____

- b) _____
- c) _____
- d) _____
- e) _____

5.3.1 TYPES OF PROCESSED MILK

Skim milk: The Whole milk is converted to skim milk by having the cream separator remove the fat. The percentage of fat is typically between 0.05 and 0.2. Fat-soluble vitamins like Vitamin A and Vitamin D are also decreased when fat is removed from milk, in addition to taste and flavour. In order to make milk more nutrient-dense, these vitamins are added during fortification. Raw milk is used to make the following types of milk. A low-calorie diet and youngsters that require high protein levels utilise skim milk.

Dry milk: Dry milk can be made from whole or skim milk; milk powder can be dehydrated to about 97% by spray drying and vacuum drying; it can be reconstituted into fluid milk; and it has a good shelf life without refrigeration. Whole milk powder can only be stored for six months due to the tendency of the fat to oxidise.

Toned milk: In order to make toned milk, skim milk powder is reconstituted with milk. Skimmed milk is produced by removing milk fat in a cream separator. After mechanically drying, skim milk is produced as powder. It is combined with buffalo milk, which has 7% fat. Toned milk should have a 3 percent fat content.

Standardized Milk: Standardized milk contains fat 4.5 percent and solid non-fat 8.5 percent. It is made using a combination of skim milk and buffalo milk.

Homogenized Milk: The mechanical process of homogenization involves pushing milk through tiny openings at high pressure and speed to minimize fat globules size. Fat globules size after milk has been homogenized will typically be 2 micrometers. The quantity and fat globule surface area rise as their size decreases. The freshly generated fat droplets stabilize the milk emulsion and stop the cream from rising by stabilizing the milk emulsion. The texture, flavour, and colour of homogenized milk are all whiter and creamier.

Evaporated Milk: More over half of the water in milk is evaporated under vacuum, between 74 and 77 degrees Celsius, to create it. Following homogenization, it is fortified to vitamin D and packed into cans.

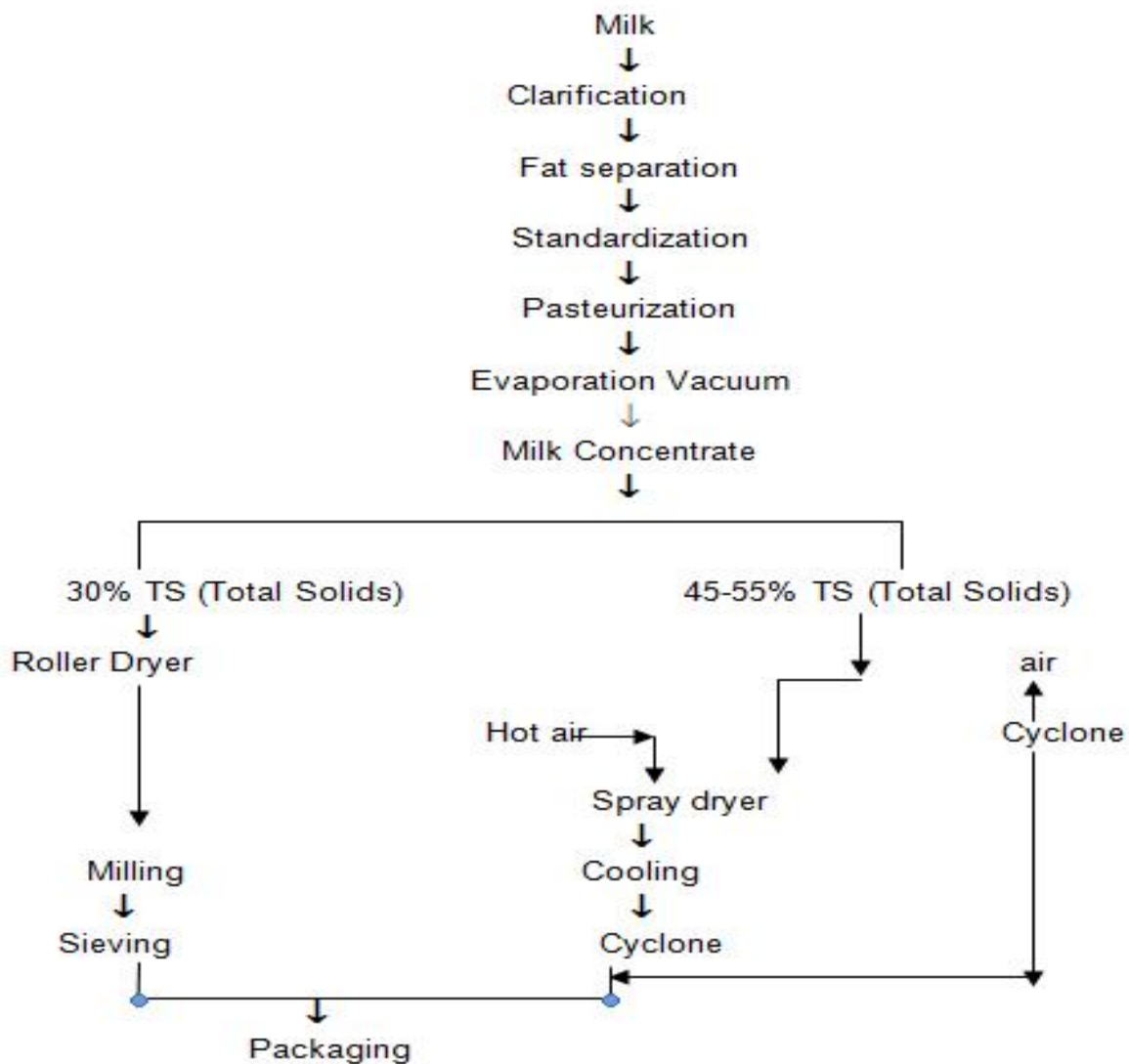


Fig 5.11 Manufacture of milk powder

(Source: B. Srilakshmi, 2010)

ASSESS THE PROGRESS OF YOUR SESSIONS4

1) What is the importance of skim milk?

2) Define Toned milk and Dry milk.

PASTEURISATION OF MILK:

Pasteurisation was named after the French scientist Louis Pasteur, who found that heating some liquids to a high level of temperature increased their storage quality. In general, it is the heating of milk to a temperature that eliminates the organisms responsible for TB and fever, as well as practically all of the other microbes found in that product, without significantly changing its composition or qualities. Following pasteurisation, the product should be immediately cooled to a temperature low enough to prevent the growth of microorganisms resistant to the temperature used. Pasteurisation is now regarded to be a crucial aspect in the production of butter, ice cream, and cheese. Pasteurisation also inactivates several natural enzymes, such as lipase.

Nowadays, three general approaches are in use.

- a) **Holding method or Batch process:**The holding procedure involves heating the milk or cream to a temperature of around 65°C and keeping it there for at least 30 minutes before rapidly cooling it. A greater temperature is occasionally employed, in which case the holding period is reduced. For instance, hold at 68.3°C for 20 minutes. Temperature and heating time must be carefully controlled.
- b) **High temperature short time method or continuous process (HTST):**The system is known as a "continuous flow or flash pasteuriser" because the machines are built in a way that allows for continuous operation. The technology requires that the milk be heated to at least 72°C for 15 seconds while it is being processed through the machine. Immediately after that, cooling occurs. The cream line is unaffected and no cooked flavour is imparted by this technique.
- c) **Ultra High temperature method:**The UHTS technology causes milk to be completely pasteurised. Milk is kept in this method for 3 seconds at 93.4°C or for 1 second at 149°C. In the dairy industry, this technique is also often used to process milk or cream. When compared to milk pasteurised using other methods, this product has a longer shelf life. Following pasteurisation, the milk is quickly cooled to 7°C or less.
After the heat treatment described above, milk should be quickly chilled to stop the growth of any remaining germs. The nutritious content of milk is not changed after pasteurisation. No undesirable cooked flavour results from it. Pathogens that are harmful, notably TB bacteria, are eliminated. The overall bacterial count has significantly decreased, lengthening the shelf life of milk.

ASSESS THE PROGRESS OF YOUR SESSIONS 5

1) Why is milk pasteurized?

5.4 CHANGES DURING COOKING OF MILK AND MILK PRODUCTS

- **Protein**

Lactalbumin and lactoglobulin become insoluble or precipitate when heated. At a temperature of 66°C, lactalbumin starts to coagulate. With higher heating temperatures and longer heating times, the amount of coagulum increases. The coagulum that develops gathers on the bottom of the pan in which the milk is heated and appears as little particles rather than a hard mass. Casein, the most abundant protein in milk, does not coagulate at the temperatures and times used for food preparation. Casein coagulates at 100°C for 12 hours, 135°C for one hour, or 155°C for three minutes. Casein is heat resistant because it is combined with certain quantities of calcium, magnesium, phosphorus, and citrate in milk. When the concentration of casein is raised above that of the normal fluid milk, the heating times that cause casein coagulation are reduced. For instance, it is required to take certain precautions to prevent casein coagulation while sterilizing canned evaporated milk. One such step is to pre-warm the milk before sterilizing it. When milk is heated, albumin congeals as a precipitate that drops on the container's sides. The coagulation of milk proteins by heat is enhanced by an increase in acidity. Additionally, the type and quantity of salts present have an impact. Heat accelerates the response of salts and tannins on casein coagulation.

- **Fat**

When milk is boiled, the proteins that cover the fat globules in the unheated milk are broken, which causes a coating of fat to occasionally develop on the surface. The coalescence of fat globules is made possible by the shattering of emulsifying agent film layers.

- **Sugar-protein mixtures**

Milk that has evaporated observes Maillard type nonenzymatic browning. Maillard (1912) was the first to explain how combinations with reducing sugars and amino acids developed a brown colour. Lysine has the greatest impact, followed by tryptophan and arginine. Lysine has a stronger reaction to glucose than fructose or lactose, while tryptophan and lactose interact most fast. The processes of the Millard reaction, which involves reducing carbohydrates and proteins or amino acids, are as follows:

- a) Condensation of an amino group with an aldehyde or ketone group
- b) Organising condensation by-products
- c) The rearranged products are dehydrated
- d) Additional degradation
- e) polymerization to create dark pigments

Because it lacks a reactive group, sucrose is inactive, but its hydrolytic byproducts, such as glucose and fructose, do interact with amino acids. Proline can cause a response that might have an unpleasant taste. The rate of browning accelerates with rising temperature. Products made from concentrated milk, such evaporated milk and sweetened condensed milk, have high quantities of lactose sugar and protein and become black when heated. Dried milk that has been stored for a long period may also experience this response.

- **Acid**

Whenever milk undergoes heating, the acidity drops first owing to the discharge of soluble carbon dioxide and then rises due to the precipitation of hydrogen ions as calcium and phosphate combine to create insoluble compounds. Significant pH changes while heating are avoided by balancing these conflicting factors.

- **Minerals**

Iodine is a volatile chemical that evaporates from milk when heated. Heating reduces the dispersion of calcium phosphate in milk, and some of it precipitates. Most of it forms albumin coagulum in the bottom of the pan, and some of it is probably entangled in the scum on the milk's surface.

- **Colour, flavour and digestibility:**

Milk is pasteurised, however this has no major impact on the taste or look of the milk. The cooked flavour of boiling milk is caused by the loss of dissolved gases such as carbon dioxide and oxygen, as well as changes in protein. Digestibility may be improved slightly. In comparison to raw milk, heated milk produces smaller and tenderer curds in the stomach.

5.4.1 UTILIZATION OF MILK AND MILK PRODUCTS:

- Curds can be consumed on their own or in combination with other dishes. Add greens like cucumber, carrot, mint, coriander etc. or pulses like *pakori* or *vadas* to turn it into *Raitas*. You may also enjoy sweet *Raitas* by combining curds with sugar and fruits like bananas, mangos, etc. Curds are also used to make Shrikand. Curds may be made into *lassi* by adding water, which is delicious in the heat.
- It adds to the nutritional content of the diet, for example, shakes, normal milk, flavoured milk, and cheese sandwiches.
- Milk enhances the flavour and taste of a food, such as payasam, coffee or tea.
- It functions as a thickening agent in conjunction via starch, as in white sauce or creamy soup.
- Desserts like fruit cream, custard and ice cream also include milk as an ingredient.
- *Khoya* acts as a binding agent in dishes such as carrot halwa.
- As a garnish, cheese is used.
- A popular beverage for quenching thirst is salted butter milk.

YOUR TEETH AND BONES ARE KEPT HEALTHY BY MILK

ASSESS THE PROGRESS OF YOUR SESSIONS 6

1) Identify two cooking techniques that involve milk or milk products.

PRACTICAL ACTIVITY 5

- 1) Students come up with a list of ten foods that contain milk.
-
-
-
-
-

5.5 LET US SUMMERISE

In addition to being excellent sources of animal proteins, milk and dairy products also give the body the essential amino acids it needs to support healthy body growth and maintenance. In addition to improving the capacity of the animals most suitable to serve as his milk sources to produce more milk, man has perfected the skill of using milk and milk products as nourishment for his well-being. The cow is the primary producer of milk for human consumption in many parts of the world; other animals that offer milk to humans include the buffalo, goat, sheep, camel, and mare. In India, the buffalo produces more milk than the cow. Goat milk is also utilised in modest amounts. Milk, a multi-nutrient beverage, contains protein, fat, carbohydrates, vitamins, and minerals. The main protein contained in milk is casein.

5.6 GLOSSARY

Homogenized: High pressure is applied to milk to break down the fat into extremely tiny particles.

Malai:The tiny size of the particles prevents them from rising to the top of the milk as *malai*.

Curd:The method of sequentially coagulating milk to produce curd is known as curdling.

Yoghurt:Yoghurt is a manufactured food that may have sweetened.

Paneer:A form of curdled milk cheese utilized in Afghan, Iranian, and Indian cuisine.

Khoya:A common dairy ingredient in many recipes

5.7 EXERCISES TO CHECK YOUR PROGRESS ANSWERS

1) Assess the progress of Your Sessions 1

- a) The khoa must be firm and smell well. Fresh cream should not have a sour flavour or odour
- b) Curds are best prepared at home as they are hygienic and far less expensive than curds purchased from the market.
- c) Always ensure that the paneer is free of fungus and offensive aroma before purchasing. If possible, buy paneer that has been wrapped in a hygienic packaging.

Assess the progress of Your Sessions 2

- 1) Ice-cream (ii) Chhaina (ii) Cheese (iii) Paneer
- 2) Yoghurt is a milk product that has been coagulated and has a curd-like texture. It has a little acidic flavour and is created with whole or partly skim milk.

Assess the progress of Your Sessions 3

1) Generally speaking, milk must be heated at a temperature that kills virtually all of the other bacteria present in the product while also eradicating the TB and fever-causing organisms, without significantly altering the milk's composition or properties.

Assess the progress of Your Sessions 4

1) Dry milk can be made from whole or skim milk; milk powder can be dehydrated to about 97% by spray drying and vacuum drying; it can be reconstituted into fluid milk; and it has a good shelf life without refrigeration

2) In order to make toned milk, skim milk powder is reconstituted with milk. Skimmed milk is produced by removing milk fat in a cream separator. After mechanically drying, skim milk is produced as powder. It is combined with buffalo milk, which has 7% fat. Toned milk should have a 3 percent fat content and S.N.F. 8.5 per cent.

Assess the progress of Your Sessions 5

- 1) Milk, an extensive liquid, contains protein, fat, carbohydrates, vitamins, and minerals. Casein is the primary protein in milk. Since it is a significant source of high-quality protein, it is a crucial food for young children and infants. It is the primary source of

animal protein for vegetarians. The lactose sugar is the main carbohydrate found in milk. The infant can digest it without difficulty.

2) a) Protein b) Fat c) Minerals d) carbohydrates e) Vitamin

Assess the progress of Your Sessions 6

1) It functions as a thickener in conjunction with starch, such as in white sauce or cream soups.

2) Desserts like ice cream, puddings, and fruit cream utilise milk as well.

3) It increases the nutrient content of the diet, for example, cheese toast, milkshakes, and plain or flavoured milk.

UNIT-VI- EGGS, MEAT, POULTRY AND FISH

Eggs, meat, poultry, and fish are not nutritional necessities, although they serve as an excellent supply of nutrition. In this unit, you will learn about their nutritional significance, the varieties that are accessible on the market, how to choose them, in addition to the various ways that they may be included into our regular meals.

Structure

6.0 SCOPE

6.1 OVERVIEW

6.2 EGGS

6.2.1 Eggs Selection

6.2.2 Nutritional Content of Eggs

6.2.3 Pigment

6.2.4 Health Benefits

6.2.5 Changes during cooking

6.2.6 Utilization of eggs in cooking:

6.3 MEAT

6.3.1 Selection of meat

6.3.2 Nutritional Composition of meat

6.3.3 Changes during cooking meat

6.3.4 Meat Preparation

6.4 POULTRY

5.4.1 Selection of poultry

5.4.2 Nutritional Composition of poultry

5.4.3 Changes during cooking

6.5 FISH

6.5.1 Classification of Fish

6.5.2 Selection of fish

6.5.3 Nutritional Composition of fish

6.5.4 Health benefits

6.5.5 Changes during cooking fish

6.6 Let us Summaries

6.7 Glossary

6.8 Exercises to Check Your Progress Answers

6.0 SCOPE

The aim of the course is to learn the following:

- Understand the Selection criteria of eggs, meat, poultry and fish
- Purchase excellent quality eggs and flesh foods from the market and list the many possible uses of eggs and flesh foods in the making of different dishes.
- To know about the role of eggs, meat, poultry and fish in our diet; and
- To understand about the changes that occur when eggs, meat, poultry, and fish are cooked

6.1 OVERVIEW

We will study the usage of eggs, which is comparable to that of milk, in this unit. To properly understand the significance of eggs in the diet, it is necessary to know their genuine nature. Although an egg are occasionally selected for use at home, hen eggs are the most commonly consumed, hence this section focuses on hen eggs. An egg of hen is similar to an undeveloped chicken since it has all of the necessary nutrients required to build the chick's body and give it with the energy it requires to traverse the outside world.

Following that, let's go deep into the poultry utilised in restaurants. The poultry refers to tamed birds which have been brought under man's control for two reasons: the eggs that they ought to develop and the flesh meal that they offer. Most popular domestic fowl species are considered poultry, including chickens, ducks, geese, turkeys, guinea fowls, and pigeons. But only if they are raised for at least one of the two aforementioned goals are any of these species considered to fall under this category. Poultry, as used in this the Section, refers to all kinds of native birds slain for their meat to be cooked and consumed by humans. Poultry is unlikely to be a need in the average diet, and when costs are high, it is clearly a luxury. But it makes a big difference in offering that "a thing different from the normal" for special occasions and breaking up the repetitive process of traditional animal protein dishes. This chapter will instruct students on how to use poultry and game birds in restaurant cuisine.

We will learn about meat in the final portion of the unit. Meat is composed of tissue from muscles. It is produced from the meat of both animals that are domesticated (like pigs, cattle, and sheep) and wild hunting animals (e.g. deer). As a culinary professional, the chef, or supervisor of

a catering business, meats will take up more of your time and money than another kind of dish. Therefore, if you want to cook meats properly and effectively, it is essential to have a thorough understanding of them.

PHYSICAL ACTIVITY 1

- 1) Design and prepare two snacks that are healthy for students by utilizing eggs.

6.2 EGG

As you learned in Unit 1, eggs and flesh items such as meat, fish, and so on are high in protein and belong to the fundamental food category. As a result, they are a vital element of the diet. Eggs are extremely healthy due to their high protein, mineral, and vitamin content. Eggs are a high-protein component in human beings meal. By itself, an egg is a great and complete food. All types of birds' eggs are edible, however in India, hen and duck eggs are mostly used for human consumption. Due to the presence of essential amino acids that are significant, it is the perfect preventive food. So, reference protein is known as egg protein. Lysine and methionine are mostly missing in our Indian diets. Egg is a dietary supplement since it is a rich source of these amino acids. An egg is made to provide food and shelter to a growing chick. Therefore, it is very nourishing meal. The shell, the white, and the egg yolk are its three essential components.

Table 6.1Distribution of egg components as a percentage (g)

Part	Weight
Shell	8-11
White	56-61
Yolk	27-32

Egg rewards are determined by size rather than flavour because all eggs have the same flavour. Winter-reared eggs are said to be superior to summer-reared eggs. An inner and outer membrane located inside the shell also serves to preserve the egg's quality. Both membranes are permeable and made up of fibres. The broader outer membrane (48µm) than the thinner inner membrane (22 µm) is securely linked to the shell. The outside membrane has six layers of fibres, whereas the inner membrane has three. The inner membrane is linked to the outer membrane, and the two membranes are loosely tethered to one another, generally towards the egg's wide end. Protein and carbohydrate make up the membranes.

The egg's white is made up of three layers, with two thin portions enclosing a thick area. Some chickens excrete more thick to thin white in comparison to other hens. The thickness of albumin and the ratio of thick to thin egg white are also affected by storage conditions.

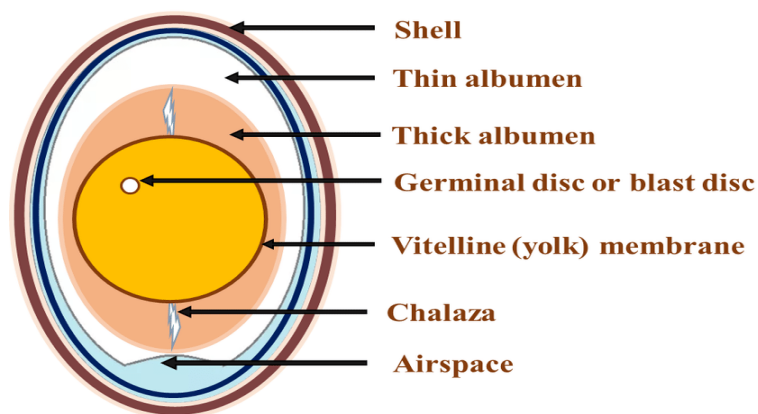


Fig 6.1 Structure of the Egg

The yolk of the egg is encased in a sac known as the vitelline membrane. Chalaziferous, or the inner layer of solid white, lies next to the vitelline membrane, the thin membrane that encloses the egg yolk. This chalaziferous layer, which penetrates the chalazae, strengthens the vitelline membrane. The chalazae are two tiny, twisted strands of thickened white that are attached to either end of the yolk and serve to secure the yolks in the egg's middle. Ovomucin and chalazae appear to have very identical molecular structures. The female reproductive nucleus in infertile eggs is not fertilized by association with cock sperm. Because they are incapable of generating

chicks, they are referred to as lifeless or vegetarian eggs. When a male bird is not maintained with the laying hens, infertile eggs are generated.

The market offers eggs in the following ways:

a) Brown eggs: A large number of consumers prefer to purchase eggs with a dark shell and will even spend more on products as their value is likely they are healthier, tastier, or most authentic. The egg's flavor, purity, or nutritional content are unrelated to the shell color, which is determined by the breed of hen.

b) Fresh eggs or shell eggs: These are the major topic of this section and are most frequently utilized in morning cooking.

c) Frozen eggs: The majorities of the time, frozen eggs is produced from premium fresh eggs and are fantastic in baked goods, omelets, French toast, and scrambled eggs. They are pasteurized. These defrost at refrigerator temperatures over the course of at least two days. The entire eggs, Whites, Yolks, and whole eggs along that contain extra yolks are types of frozen eggs.

d) Dried Eggs: Bake is the most common use for dried eggs. These shouldn't be suggested for utilize during the preparation of morning meal. Dried eggs must be kept chilled or frozen, properly wrapped, as opposed to the majority of dehydrated items, which are shelf-stable. It can be whole eggs, yolks, whites.

6.2.1 SELECTION OF EGGS

The selection of eggs can be based on the following parameters.

- Buy only what you need to last one or two weeks.
- Always buy eggs from a reputable store, *Grahak Sangh*, or government cooperative group.
- Purchase farm organic or refrigerated eggs.
- An egg typically weighs between 52 and 55 g. Every egg's thickness is inversely proportional with their dimensions.
- The shell should be clean and not cracked.
- There is a little air cell in fresh eggs. This may be assessed by holding the egg up to the light.
- When held up to the light, the yolk ought to appear in the middle with no dark spots.
- The quality of the eggs is not affected by colour, which might be either brown or white.

- When submerged in water, a high-quality egg will sink. Because of the expanded air cell and moisture loss, low-quality eggs will float.
- When an egg is broken in a dish, it will stand up in a spherical shape, similar to a hard round yolk. A stale egg has a propensity to spread across the plate, and it is often impossible to separate the egg white from the yolk (yellow component of the egg).

PRACTICAL ACTIVITY 2

1) Using a few quick tests you can perform at home, you can determine the grade of an egg.

ASSESS THE PROGRESS OF YOUR SESSIONS 1

1) Make an outline with the factors you'll take into account when buying eggs.

- **EGG QUALITIES INCLUDES:**

The proteins in eggs have three major characteristics that make them suitable for so many various cooking applications.

1. When heated, egg proteins coagulate.
2. When beaten, egg proteins expand and maintain air within the structure.
3. Proteins in egg yolks work well as emulsifiers.

Table 6.2 Characteristics of fresh and deteriorated eggs

Characteristics	Fresh egg	Deteriorated egg
------------------------	------------------	-------------------------

Consistency of egg white	Firm and viscous	Thin and runny
Position of the yolk	Center of the white	Yolk moves towards the shell
Air cell	small	Large
Chalazae	strong	Weakens
Vitelline membrane	Intact and strong	Weak, Ruptures-white mixes with the yolk

6.2.2 NUTRITIONAL COMPOSITION OF EGGS

Eggs are inexpensive and packed with many of the vital nutrients. Except for ascorbic acid, eggs are a good source of all nutrients. Table 6.3 shows the nutritional value of eggs.

Protein:

Eggs contain 12-14 per cent proteins that are well balanced in terms of all necessary amino acids. As a result, it serves as a standard for the chemical score of other proteins. Nearly 25% of an adult man's daily protein needs are covered by the contents of two eggs. Aside from egg proteins, all other plant protein diets provide a high supplemental value. Cereal proteins, for example, are low in the amino acid lysine. The sulphur-containing amino acid cysteine is deficient in pulses and oilseed proteins. As a result, combining an egg with any cereal or cereal pulse combination will improve the protein content of the dish. Among the proteins found in many foods, egg protein has the highest biological value i.e 96.

Fat:

Egg represents one of the most abundant supplies of lecithin, a phospholipid that is found in the construction of every cell wall in the body. Aside from providing energy, it also contains important fatty acids such as linoleic acid and arachidonic fatty acids. The yolk contains vitamins A, D, and E, and egg fat serves as a carrier for these fat-soluble vitamins. Because egg fat is highly emulsified, it is easily digested and absorbed.

Each egg contains around 250 mg of cholesterol, and the daily limit is 300 mg of cholesterol. Normal people can consume between three and four eggs each week without ill effect.

Minerals and Vitamins:

The percentage of minerals in an egg is strongly correlated with the mineral composition of the hen's diet. The egg's calcium content is highest in the shell, where it is also concentrated. The egg contains significant minerals including phosphorus, iron, zinc, and other trace components. Zinc that is physiologically accessible is abundant in eggs. Conalbumin-bound egg iron is ineffectively absorbed by men.

The egg contains significant levels of both water-soluble and fat-soluble vitamins, with the exception of vitamin C, which is completely lacking.

Vitamins A, riboflavin, folic acid, and B12 are especially abundant in eggs. The amount of each of these vitamins in an egg depends on the amount of these elements in the bird's nutrition.

The egg white's constitution is very different compared to the yolk's. Yolk which has a low percentage of fluid (49.5%) as well as a high percentage egg lipid (33.3%), the white has a large amount of water (87%) and zero fat.

The yolk contains fat, soluble in water, mineral compounds, and nutrients that are fat-soluble, while the white contains albumin proteins. With a 13.3% protein content and excellent quality that includes all of the key amino acids needed by humans, the eggs are particularly crucial during childhood, teenage years, gestation, and nursing.

By changing the hen's diet, one may alter the nutritional value of the egg. Although it is difficult to significantly alter the protein level, adding liquid oils to the hens' food can raise the egg's fat content. The vitamin D content of the egg is increased by either exposing the birds to sunlight or adding vitamin D to their meal. Egg production is reduced in hens who are vitamin D deficient. By adding fish oil to the food of the hens, even the cholesterol level of egg yolks may be decreased. Comparing infertile and fertilized eggs, there is no discernible difference in nutritional content.

EGG IS PARTICULARLY RICH IN VITAMIN A, RIBOFLAVIN, FOLIC ACID AND B₁₂

Table 6.3 Nutritive Value of Egg

Nutrients	Whole Egg	Egg white	Egg Yolk
Energy (Kcal)	149	50	358
Water (%)	75.33	87.81	48.81

Protein (g)	12.49	10.52	16.76
Fat (g)	10.02	0	30.87
Cholesterol (mg)	425	-	1.3
Carbohydrate (g)	1.22	1.03	1.78
Vitamin A, IU	635	-	1.95
Riboflavin (mg)	0.508	0.452	0.639
Calcium (mg)	49	6	137
Phosphorus (mg)	178	13	488

Source: Britannica 2000

6.2.3 PIGMENT

Shell: In almost all of breeds, the shell is white in hue. According on the breed, it can be in various colours of brown. The Quality or nutritional value is not determined by colour.

Egg white: Egg white includes trace levels of ovoflavin, which gives it a greenish tint. The more riboflavin there is in the egg white, the greener the colouring.

Egg Yolk: A number of factors, including the kind and quantity of pigment contained in the hen's diet, the colour of the egg yolk can range from a pale yellow to a vivid orange. Xanthophylls and carotenoids are what give the colour. The body may turn the carotenoids into vitamin A. The majority of yolks with a deep tint are high in vitamin A. The yellow coloration is caused by xanthophylls, which are not converted into vitamin A. The yolk may be rich in vitamin A but may not be coloured if the hen is fed only pure vitamin A.

6.2.4 HEALTH BENEFITS OF EGG

Eggs are a fantastic and fairly priced source of protein with excellent biological value. Several different kinds of plant protein diets benefit greatly from the inclusion of the proteins contained in eggs. Therefore, adding eggs to any grain or grain-pulse combo will raise the dish's protein level. Additionally, these substances are rich in riboflavin, the A, D, and E vitamins. The yolk of an egg is rich in iron and beta-carotene. Lecithin, a phospholipid present in all of the body's cell walls, may be found in eggs, one of the finest food resources for it. Important fatty acids like linoleic acid and arachidonic acid are also found in eggs.

ASSESS THE PROGRESS OF YOUR SESSIONS 2

1) Egg provides significant amounts of certain nutrients, as follows:

a) _____

b) _____

c) _____

d) _____

2) Write the nutritional importance of egg.

6.2.5 CHANGES DURING COOKING EGG

Egg boiling has little to no impact on the nutritional content of the protein, minerals, or fat-soluble vitamins, with the exception of a little reduction in thiamine and riboflavin. The retention of thiamine and riboflavin in hard-cooked, fried, poached, and scrambled eggs is more than 85 percent. As avidin is denatured by heating egg white, biotin availability is improved.

Temperature and Time Effects: When cooking eggs, it is necessary to maintain the ambient temperature down or the duration of cooking shorter. Heated eggs with excessive temperatures or over prolonged periods duration degrades their appearance, taste, even colour. Overheated proteins become hard and sticky, and reduce due to water loss, that's why overcooked egg scrambles seem curled and seem hard and stretchy.

Temperatures of Coagulation: Egg whites and yolks coagulates at various degrees. Around 60°C is when egg whites start to coagulates; they are completely coagulated between 165°C and 70°C. Temperatures ranging from 62°C to 70°C are necessary for the egg yolks to begin coagulating. Because of this contrast, eggs may be cooked so that the whites become firm while the yolks stay soft. An egg can be cooked for an hour at 142°F (61°C) and still have a soft yolk. Furthermore, eggs that have been beaten coagulate at a little more elevated temperature (about 69°C).

Colour Variations: Unwanted colour changes in eggs might occur during processing. The sulphur with the egg white may combine to iron from the yolk, boiling fluid, or different iron elements to create ferrous sulphide, an algae-like substance with a unique smell as well as

fragrance, when eggs are excessively cooked or subjected to heat to extreme temperatures. Utilise high-quality cooking utensils, cook meal at moderate temperatures to minimise excessive cooking, quickly cool hard-cooked eggs in chilled water, and serving food right away to prevent green yolk issues. The modest browning of cooked eggs brought on through the Maillard process, as the egg proteins interact with the quite a limited carbohydrates in the egg, is a different one more difficult to avoid, change.

6.2.6 UTILIZATION OF EGGS IN COOKING

In the kitchen, eggs may be utilized in a variety of ways. When eaten purely or in conjunction alongside other meals, eggs constitute the primary source of animal protein in a plate of food. Boiling, scrambling, frying (omelettes), or poaching eggs are all options. Eggs are frequently baked and fried using dry heat. Fried eggs are commonly served in the form of scrambled eggs and omelettes. Baked egg dishes include shirred eggs, the meringues (that is, spongy and hard), and soufflés. When cooking eggs, using a frying pan, a sauté pan (Omelets pan), or maybe a pancake. Eggs are best cooked in cast iron pans that have been primed or seasoned. Preparation is accomplished by scraping a tiny amount of vegetable oil into a clean frying pan and heating it on medium, then briefly raising to high. By cleaning the frying pan with detergent or cooking anything other than eggs in it, the coated top is eliminated. Nonstick pans require no seasoning or preparation. Frying is used in the preparation of fries and eggs that have been scrambled, as well as omeletes.

Eggs can be used for:

- Diced eggs that have been hard-boiled are used to decorate meals like as biryani.
- Eggs generate elastic sheets that may trap air when they are pounded. While baking, this air increases, resulting in an airy soft product. Cakes, foamy omelettes, soufflés, and meringue may all be made with them.
- In culinary combinations, eggs can be utilised to taste and colour foods like pastries and desserts such as pudding
- It's advantageous to add an egg to clear soups. The albumin coagulates and moves suspended particles when a minute bit of egg white is cooked and poured to the watery soup. It turns into a clear soup after given time to settle.

- Egg proteins aid to maintain the structure of the products that they are found in by coagulating between 65 and 70°C. You may use them to make samosa, toasted bread, and mango fritters.
- Because the proteins in eggs aggregate when cooked, they may be used to thicken stirred and bake desserts, beverages, and desserts such as pudding.
- Eggs or yolks from eggs, milk and/or cream mixtures, sugar substitutes (sugar, nectar), and flavours (vanilla, nuts, etc.) are the main ingredients in custards. Custards are thickened by the coagulation of protein from eggs after cooking. These egg proteins destroy during cooking and reassemble to form a network, which coagulates or sets at the correct temperature to create the firm custard gel. Custard dishes should be covered and chilled immediately as feasible after being made since they are extremely susceptible to microbial contamination.

THE NUTRITIONAL CONTENT OF MANY RECIPES IS INCREASED BY THE ADDITION OF EGGS.

PHYSICALACTIVITY 3

- 1) List five pulse-based dishes that you have consumed in the last two days.

ASSESS THE PROGRESS OF YOUR SESSIONS 3

- 1) Describe the role that eggs play in the typical diet.

- 2) List five egg-based dishes that are popular in your area.

6.3 MEAT



Fig 6.2 Meat

Meat is the term for the flesh of warm-blooded, four-legged animals, typically cattle, sheep, and swine. Lamb is the flesh of young sheep, usually under a year old. It can be referred as mutton after 12 months of age. Pork is the flesh of a pig that has been harvested between the ages of 5 and 12 months. Cattle slaughtered between three and fourteen weeks after birth are used to make meat from them. Calf meat is produced when a calf is slaughtered between the ages of 14 and 52 weeks. Beef is the name for meat taken from cattle that have been slaughtered a year after birth.

6.3.1 SELECTION OF MEAT

The freshness of the food you purchase is essential. Our bodies can be harmed by eating stale meat or the flesh of elderly animals. Our health is also harmed by the presence of disease-causing organisms in these diets. As a result, always buy such foods from clean, trustworthy stores. The quality of the meat may be determined by looking at how it appears.

Consider the following while purchasing meat foods:

- The flesh of a calf or veal is firm and light pink. The sliced surface is wet, and the flesh is mushy and flabby.
- The bone is pinkish white and has some blood in it. No indications of fat are seen. Young lambs younger than a year old have flesh that is tender, pink red, and smooth.

- The skeletons are spongy and brown in colour in appearance. A slick fat layer and a deep crimson hue characterise excellent-quality lamb. White and sturdy is the bone.
- Animal products of lower quality contain darker flesh and fibrous, coarse grain. The fat layers are delicious and thick.

ASSESS THE PROGRESS OF YOUR SESSIONS 4

- 1) Describe the factors to take into account while buying mutton.

6.3.2 NUTRITIONAL COMPOSITION OF MEAT

Meat is a very nourishing meal. It can be absorbed almost entirely. The quantity of high-quality proteins, essential fatty acids, numerous crucial minerals, and the B complex vitamin family (thiamine, niacin, riboflavin, pantothenic acid, B6, folic acids, biotin as well and B12) are all factors in the nutritional value of meat. The amount of fat in meat affects how many calories it contains. Various meats include organs including tongue, the brain, thymus (sweet breads), the liver, heart, and spleen. A great source of nutrients, they are also. A, B, C, D, E, and K vitamins are abundant in various meat (organ flesh), notably the kidneys and liver.

Table 6.4 Nutritional composition of meat

Food	Moisture (%)	Energy (Kcal)	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)	Phosphorus (mg)
Beef Muscle	74.3	114	22.6	2.6	10	0.8	190
Buffalo Meat	78.7	86	19.4	0.9	3		189
Fowl	72.2	109	25.9	0.6	25		245
Goat meat	74.2	118	21.4	3.6	12		193
Liver Goat	76.3	107	20.0	3.0	17		279
Liver Sheep	70.4	150	19.3	7.5	10	6.3	380
Mutton	71.5	194	18.5	13.3	150	2.5	150

Muscle							
Pork (muscle)	77.4	114	18.7	4.4	30	2.2	200

Source: Gopalan C., Rama Sastri, B.V. and Balasubramanian, S.C., 2004 (NIN,ICMR, Hyderabad)

ASSESS THE PROGRESS OF YOUR SESSIONS 5

1) Which nutrients are plentiful in meat?

6.3.3 CHANGES DURING COOKING MEAT

When meat is cooked, numerous alterations occur that make it appear appealing, smell good, and taste well. Meat is cooked to eliminate any potentially hazardous bacteria and enhance its flavour. In addition to changes in colour, weight, volume, flavour, and fatty tissue, meat experiences morphological alterations to the protein structure, tendons, ligaments, as well as muscle fibre.

a) Change in Colour: Myoglobin is transformed into brown or dull red globin hemochromogen during cooking, which causes a change in colour. Some myoglobin undergoes oxidation during a particular period to become brown metamyoglobin. Metmyoglobin contains ferric-state iron. Thus, the colour of cooked meat changes from a drab red to a brown colour.

b)Reduction in weight and volume: Cooking has an impact on the pace and volume of shrinkage that results from shrinkage. The meat's pH appears to be the key component in influencing the loss during cooking. The flesh will shrink the most if its pH is 5.8, which correlates to the isoelectric point of the major muscle protein. When pH is 4.0 or 7.0, there is less shrinking.

c) Changes in fatty tissue:Collegenous tissue destruction as well as the release of fat that has melted is responsible for changes in fatty tissue. The oxidation of fat may be the factor that causes the surface browning of fat. Depending on the quantity of fat is in the meat, different amounts of drip include fat.

d) Intracellular protein and fibres in muscles alterations: Muscle protoplasmic proteins have been modified and are no longer water soluble. Muscle fibres get shorter and thinner.

e) Flavour: Cooked meat has a different flavour and aroma than raw meat because of the release of volatile compounds created during cooking as well as the presence of water and fat-soluble components in raw meat. On heating, a meaty taste emerges from a raw beef water extract. However, it is less intense than the flavour of the water used to boil the meat.

f) Juiciness: Juiciness is determined by the capacity of meat proteins to retain cooked water.

ASSESS THE PROGRESS OF YOUR SESSIONS 6

1) What occurs following the meat's cooking?

6.3.4 MEAT PREPARATION

Flesh meals may be cooked in a variety of ways at home. It is relatively simple to incorporate some food from this category in one's daily diet because there are so many various kinds of meat meals accessible on the market. Cleaning and cutting the outside of the meat are prerequisites before cooking. Remove any internal organs that will not be consumed. There are several methods to prepare meat items, including:

- Our dinners would not be complete without curry. A variety of curries may be made using any meat food.
- Meat, chicken, and other ingredients can also be utilised as stuffing for a variety of snacks and cuisines, including pies, bread rolls, samosas, and sandwiches.
- You can make soups and broths with flesh-based ingredients. These are simple to digest and extremely helpful for growing kids and people getting well after a protracted illness.
- The 'tandoori' dish is highly popular in India. On an open tandoor, food such as mutton tikkas, seekh kababs, tandoori chicken, fish, etc. can be made.
- Cutlets and rolls can be made with fish, chicken, or mutton along with additional components like potatoes, etc.
- To create particularly delicious meals, meat products can be fried, roasted, or baked.
- Popular dishes include fried chicken and roasted mutton.

FLESH FOODS BASED SOUPS AND BROTHS ARE VERY ADVANTAGEOUS FOR GROWING CHILDREN AND PEOPLE RECOVERING FROM A PROTRACTED ILLNESS BECAUSE THEY ARE SIMPLE TO DIGEST.

PRACTICAL ACTIVITY 4

- 1) Specify the names of five dishes you've made using various types of rice.

6.4 POULTRY



Fig6.3Poultry farming

These birds come in a wide range of varieties, including chicken, turkey, goose, and duck. Our diet includes poultry as an option of animal protein. There are several chicken items available on the market, including whole live birds and prepared birds. A bird's tenderness increases with age. The juvenile bird's skin is easily removed from the flesh since it is delicate. Young birds' breast bones and other bones are delicate and easily removed.

Age-based classifications are used for poultry. The softness and fat content of the chicken are influenced by age. The categorization, as determined by Indian criteria, is as follows:

Broiler or fryer: All types of chicken between the ages of 8 and 10 weeks have flexible cartilage in the breastbone, soft flesh, and smooth, supple skin.

Roaster:An immature bird, usually between three and five months old, of any gender, with delicate flesh and skin that is so elastic and smooth-textured, however the cartilage of the breastbone may be slightly less elastic as a result of the grill or fryer.

Stag: An adult male chicken, usually under ten months old, with skin that is rough, relatively stiffened with darker flesh, a noticeable hardening of the bone in the breastbone.

Stewing chicken or fowl:A fully grown bird, frequently older than the age of ten, with less pliable meat than that of a roaster and breastbone points that are strangely fastened.

Cock: with hardened, darker, and coarser skin, and a mature male chicken, usually older than ten months, possesses all of these traits, including a hard breastbone tip.

6.4.1 SELECTION OF POULTRY

Young birds (under 9 months old) are better for cooking since their meat is more delicate.

Signs of a young bird:

- The feathers and particularly the quills attached to the wings, should be easy to lift.
- The body has no lengthy hair.
- Skin should be smooth and either white or clean.
- Scales on the feet should be level, smooth, and overlying.

The distinctive indications that a bird is fresh:

- Soft and fluffy feathers, clear and clean eyes, no unpleasant aroma, and soft, not stiff and dry feet.
- Skin that is clear and free of any dark or greenish tones.

6.4.2 NUTRITIONAL COMPOSITION OF POULTRY

Poultry has a comparable composition to meat (muscle tissue, connective tissue). With a high protein content of around 25%, fowl flesh resembles in quality and nutrient content to other types of meats. Water makes up over 75% of muscle tissue, followed by protein at 20% and fat at 5%. It contains each essential amino acid required to build biological tissues. Young birds' flesh has a little amount of fat, although the amount depends on the species and age of the bird. Compared to red meat, chicken fat is more unsaturated, which is good for your health. Poultry meat is beneficial to people who must limit their fat consumption as a result of a great protein to lipid proportion. Meat of the poultry, like other animal tissues, is high in B vitamins and

minerals. All four birds contain black flesh; however the connective tissue is different in duck, goose, and squab. Dark meat has a dark colour because of a protein called myoglobin. In order for muscles to function during moments of intense exercise, this protein stores oxygen.

ASSESS THE PROGRESS OF YOUR SESSIONS 7

- 1) Name the three nutrients that are found within poultry.

6.4.3 CHANGES DURING COOKING

Similar to other types of meat, changes occur during the cooking of chicken. Low to moderate heat should be used to cook poultry so that it is moist, tender, and cooked evenly. Proteins become tougher, shrink, and lose their juiciness with extreme heat. The chicken must be fully cooked before being dipped in flour, egg, and bread crumbs then slowly fried if deep-frying it. The time required for browning in deep fat is insufficient to allow for complete meat cooking. When roasting a whole chicken, delicate sections like the breast may overcook prior to the legs and thigh are done. Stuffed birds should be cooked until the filling achieves an internal temperature of 74°C. This eliminates the possibility of food poisoning caused by bacteria.

PRACTICAL ACTIVITY 5

- 1) Write down five different ways that meat food is prepared, and then examine the methods that are used.

6.5 FISH

India has a coastline of 5,100 km. More than 200 edible fish varieties are known, including sardines, mackerel, tuna, catfish, and scombroides.



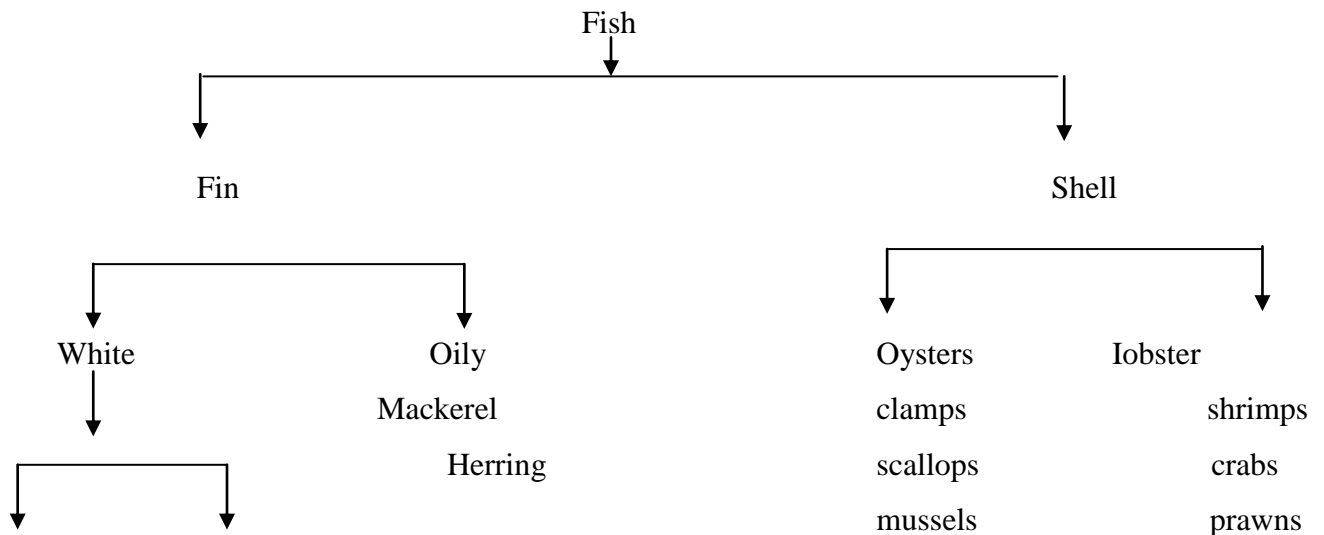
Fig 6.4 Fish

Fin fish as well as shell fish are two distinct types of fish. Shellfish are mollusks and crustaceans with shells, whereas fin fish are bony-skeleton fish. Animal proteins, minerals, and vitamins abound in these fish and shellfish.

Marine fish include sardines, mackerel, tuna, catfish, brown duck, ribbon fish, prawns, and cattle. Fresh water fish include carps, catla, rohu, murrels, and hilsa. Fish contains complete proteins and may be substituted for meat in the diet; nevertheless, overall fish consumption is much lower than meat consumption.

6.5.1 CLASSIFICATION OF FISH

The two varieties of edible fish are fin fish and shell fish. Fin fish are fish that have a bony skeleton. The name "shell fish" encompasses includes mollusks and crustaceans. Shellfish is highly perishable. Crustacea have legs that are partially linked to their outer shells. Among them are crabs, lobsters, prawns, and prawns. Mollusks have more durable outer shells but no legs. They have hinged shells as mussels, the oysters, and scallops.



Round	Flat
Cod	Plaice
Haddock	Sole
whiting	

Fig 6.5 Classification of fish

6.5.2 SELECTION OF FISH

When choosing fish, keep the following things in mind:

- Bright eyes that are not sunken are preferable.
- • The gills have to be red.
- The flesh of the animal has to be solid and not flabby, and the tail of the animal must be sturdy with the scales well fastened to the skin.
- No objectionable scents should be present.
- If an indentation is left after pressing a cut piece with a finger, the fish is stale.
- The mere fact that the uncooked flesh is beginning to peel clear of the bone is dangerous.

ASSESS THE PROGRESS OF YOUR SESSIONS 8

- 1) List the points have to keep in mind while buying fish.

6.5.3 NUTRITIONAL COMPOSITION OF FISH

High amount of protein Present in fish. According to species as well as period of the year, the fish fat percentage varies between 0.2 to 20 percent. The bulk of the fish have minimal amounts of fat. Herring may have a fat proportion of 8-20%, but sardines may have a fat percentage of 1.9-14.66%. The protein amount in fish varies from 9 to 20 per cent based on its fluid level. Bombay duck contains a protein amount of 9.1 percent, which is because of its high level of moisture.

Shellfish is lower in fat and higher in carbs than finfish. Glycogen is found in the muscle tissues of fish, just like it is in meat. In live fish, glycogen is a form of energy stored.

Fish, especially little fish with bones, is high in calcium. Iodine, selenium, and fluoride are abundant in marine fish. Selenium is an extremely potent antioxidant. Oysters are high in copper and iron. Fresh water fish has a lower sodium level than beef. The best supply of zinc in nature is oysters, for instance. Fish meals have a higher bioavailability of iron and zinc than plant meals. Foods from the sea, especially shellfish, are rich in vitamin B12. Vitamins that are fat-soluble are abundant in fish liver oils. Shark liver oil contains 10,000–24,000 IU of vitamin A per gramme of oil. Vitamin C is abundant in rohu. Fish is a great source of niacin and vitamin D. Seafood contains a sizable amount of vitamin B12.

6.5.4 HEALTH BENEFITS:

Both the Greenlandic Eskimos and the Japanese fishing population are completely free of cardiac diseases. The fatty acid makeup of fish is thought to be responsible for the positive effect of eating fish. The brain's growth and function, as well as arthritic pain and inflammation, are all prevented by omega-3 fatty acids, which also guard against cardiovascular disease.

PRACTICAL ACTIVITY 6

- 1) Make a list of the different menu items that fish may be utilized in.

6.5.5 CHANGES DURING COOKING FISH

Fish cooks considerably more rapidly than beef and poultry because it has less connective tissue and shorter muscle fibers. When checked with a fork, fish is considered properly cooked when the flesh readily falls into clumps of pure white flakes. While cooking fish for an extended amount of time or at an extreme heat, the muscle protein contracts that making the fish tough, dry and flavourless. Fish requires cautious handling when cooking and serving since, compared to meat and poultry, cooked fish tends to break apart readily.

ASSESS THE PROGRESS OF YOUR SESSIONS 9

- 1) What is happening with frying fish?

6.6 LET US SUMMERISE

Eggs are a crucial component of our diet since they are rich in protein, iron, vitamin A, and B-complex vitamins as discussed in this section. A few quick tests can help us identify how fresh eggs are before we buy them. Eggs are simple to incorporate into our regular meals, and many preparations, such as omeletes, custards, etc., may be done at home. Meat from various animals, birds, and fish are considered flesh meals. These are abundant in B-complex vitamins, iron, and protein. We can tell the quality of meat items by their texture and outward look. With these flesh foods, a variety of food preparations can be developed. Long before they domesticated animals or learned to grow plants, humans subsisted on fish, shellfish, alongside aquatic mammals. The top beaks of birds were used to make fishnets, spears, and fishing hooks that were discovered during the excavation of Stone Age sites. The only significant food source still sought nowadays is seafood. Compared to moderately fat beef, several fish are lower in cholesterol and fat. Regular consumption of fish has an extra nutritional benefit. Most fish fat is highly unsaturated.

6.7 GLOSSARY

Fin fish: It covers to sharks, certain rays, and bony fish.

Shell fish: refers to molluscs

Mutton: the flesh of an adult goat or sheep

Lamb: The meat from a young sheep is referred to as lamb

Meat: animal meat that is consumed as food

Omelet: a meal composed with fried eggs that have been rapidly combined together (beating)

Custard: a milk, egg, and sugar sauce that is sweet and yellow.

Young birds: Birds in their infancy

Thaw- brings anything from frozen state to room temperature.

Marine mammals: Porpoises, whales, seals, walruses, and polar bears are examples of ocean-dwelling or ocean-dependent animals.

6.8 EXERCISES TO CHECK YOUR PROGRESS ANSWERS

Assess the progress of Your Sessions 1

1) Selection criteria for purchasing eggs

- Buy only what you need to last one or two weeks.
- Always buy eggs from a reputable store,
- Purchase farm organic or refrigerated eggs.
- The shell should be clean and not cracked.
- There is a little air cell in fresh eggs. This may be assessed by holding the egg up to the light.
- The yolk should be central and free of any dark areas when seen under light..
- The quality of the eggs is not affected by colour.

Assess the progress of Your Sessions 2

1. a) Vitamins that are fat-soluble
b) Vitamins that are water soluble
c) Minerals
d) Protein

2) The fat-soluble vitamins A, D, and E are also present in the eggs. Vitamins that are water-soluble, such as niacin, thiamine, riboflavin pyrodoxine, pantothenic acid (antioxidant), and vitamin B can be found in eggs. Nutrients including phosphorus, calcium, iodine, salt, and iron are abundant in eggs. The yolk of eggs consumption is restricted in persons with liver and heart diseases due to its high cholesterol content.

Assess the progress of Your Sessions 3

- 1) The addition of an egg to clear soups is beneficial. Diced eggs that have been hard-boiled are used to decorate meals like as biryani. Because egg proteins coagulate when cooked, they may be used to thicken stirred and baked custards, soups, and puddings.
- 2) a) Custards b) soups c) puddings d) Omlete e) Briyani

Assess the progress of Your Sessions 4

- The flesh of a calf or veal is firm and light pink. The sliced surface is wet, and the flesh is mushy and flabby. The bone is pinkish white and has some blood in it. No signs of fat are present. Young lambs within the age of 12 months have flesh that is delicate, fine-grained and pinkish red in colour. The reddish-colored bones are brittle.

Assess the progress of Your Sessions 5

- 1) High quality proteins 2) vital fatty acids 3) minerals 4) B complex group of vitamins

Assess the progress of Your Sessions 6

Meat is cooked to eliminate any potentially hazardous bacteria and enhance its flavour. Meat undergoes physical changes to the structural proteins, connective tissue, and muscle fibre in addition to changes in colour, weight, volume, taste, and fatty tissue.

Assess the progress of Your Sessions 7

- 1) Protein
- 2) Fat
- 3) Minerals

Assess the progress of Your Sessions 8

- The following points has to keep in mind while buying fish:
- Bright eyes that are not sunken are preferable.
- Gills must be red.
- The flesh should be solid and not flabby;
- The tail of the animal should be sturdy, with the scales firmly attached to the skin.

Assess the progress of Your Sessions 9

- 1) Fish becomes rough, dry, and flavourless when grilled at an extreme heat or for prolonged length duration because the muscle protein compresses.

UNIT VII- FATS AND OILS

You will learn about the selection, nutritional composition and changes during cooking and significance of fats and oils in our diets in this unit. Additionally, Students discover the numerous kinds of often used fats and oils, as well as how they work to prepare our meals.

Structure

7.0 SCOPE

7.1 OVERVIEW

7.1.1 FAT CLASSIFICATION

7.2 FATS AND OILS SELECTION

7.2.1 Sources

7.3 Nutritional contribution of Fats and Oils

7.3.1 Essential Fatty Acids (EFAs)

7.3.2 Recommended Dietary Allowances

7.4 TYPES OF FATS AND OILS

7.4.1 Butter

7.4.2 Ghee

7.4.3 Margarine

7.4.4 Lard

7.4.5 Cotton seed oil

7.4.6 Rice bran oil

7.4.7 Ground nut oil

7.4.8 Soyabean oil

7.4.9 Mustard oil

7.4.10 Olive Oil

7.5 UTILIZATION OF FATS AND OILS IN FOOD PREPARATION

7.6 CHANGES IN FATS AND OILS DURING COOKING

7.7 OUR HEALTH AND FATS AND OILS:

7.7.1 IMPORTANCE OF FATS AND OILS

7.8 LET US SUMMERISE

7.9 GLOSSARY

7.10 EXERCISES TO CHECK YOUR PROGRESS ANSWERS

7.0 SCOPE

You will be able to learn the following after finishing this unit:

- To learn the standards for choosing oils and fats;
- Emphasize the importance of oils and fats as part of diets; and
- enumerate the uses of various kinds of oils and fats during preparation and the alterations that occur during frying.

7.1 OVERVIEW

Since many years ago, man has employed oils and fats in the production of food. In the past, butter or ghee was used to prepare food because it gave richness to the flavour and colour. In addition to butter, human now consumes a wide variety of oils, fats, and products made from both animal and plant sources. In previous units, you learned about various foods such as grains, pulses, vegetables, meat, eggs, and milk and milk products. We require fats and oils to produce a range of appetising and delicious dishes such as stuffed *paratha*, omelet, cutlets, *chakli*, mathri, cake, biscuits, *Dum Aloo*, *Sweet* and dhal. Oils and fats are used in cooking and frying, as well as to add richness and taste to meals. They are also a good source of concentrated energy and several key elements. Numerous foods contain significant levels of fat that are not readily visible, such as the 16 per cent fat found in avocados, 31 per cent fat in egg yolks, 35 per cent fat in chocolate, 41 per cent fat in specific cuts of beef, 58% fat in almonds, and 32 percent fat in cheese.



Fig 7.1 Fats and Oils

7.1.1 CLASSIFICATION OF FAT:

According to their chemical composition, lipids may be divided into three groups:

- i. Both oils and fats are examples of simple lipids.
- ii. Phospholipids and lipoproteins are components of complex lipids, in addition to
- iii. Derived lipids like fatty acids and sterols.

The biological tissues and meals include about twenty fatty acids. Chain length, saturation, and essential fatty acids are three significant properties of fatty acids. The length of a fatty acid chain is determined by the number of carbon atoms in the acid. Milk, lard, acetic acid, coconut products all contains short-chain fatty acids while the vast majority regarding vegetable oils and fats from animals consist of fatty acids with long chains. Extra-long chain fatty acids are found in fish oils.

Cholesterol is a vital sterol. It is a waxy material. It is the most well-known sterol and has gained popularity because to the link between high blood cholesterol levels and heart disease. It is a vitamin D, hormone, and bile acid precursor. Corticosteroids, oestrogens, testosterone, and calcitriol (the active vitamin D hormone) are all hormones derived from cholesterol. Bile acids, which are required for fat breakdown, are generated from cholesterol.

Table 7.1: Fats sources

Meal	g/100g	Calories/100g
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VisibleFats		
Vegetables and oil	100.0	900
Vanaspati	100.0	900
Ghee,cow's	99.5	895
Butter	81.0	729
InvisibleFats		
nut and seed oils	37.0–64.5	537–681
Lamb, muscles	13.3	194
hen, eggs	13.3	173
Lamb, liver	7.5	150
dairy, cow	4.1	67

Source: Madhbani S.R. and Rajagopal M.V.,2007 *Fundamentals of Foods and Nutrition* and added *Diet Therapy*

ASSESS THE PROGRESS OF YOUR SESSIONS 1

- 1) Give a list of the three types of fat.

- 2) What kind of substance is cholesterol?

7.2 CHOOSING THE RIGHT OILS AND FATS

Choose your oils and fats based on what you need and what you can afford. When choosing fats, keep the following in mind:

- Natural flavour and colour should be present in oils and fats.

- They should be spotless and devoid of any debris, filth, dust, or offensive odours.
- Purchase the oil or fat from a reputable supplier
- .Avoid buying oils and fats loose since they could be tampered with. Purchase in polyjars or sealed tins.
- Butter needs to be packaged in a sanitary manner. It need to be flavorful of freshness and firm.
- Ghee ought to retain its delicate, natural flavour.

ASSESS THE PROGRESS OF YOUR SESSIONS 2

1) Which parameters would you possibly use to select oils and fats?

7.2.1 SOURCES

- Oils from nuts and seeds are extracted to make vegetable oils, which are utilised in cooking. Animal fats made from milk include the butter and ghee.
- Oils from plants are processed in order to produce vanaspati, a nearly solid fat. Because vanaspati is used in place of ghee, it is usually fortified with vitamins A and D.
- The visible fats in the Indian diet are provided through oils, butter, ghee, and vanaspati. The proportion of oils and fats in the diet varies by geography. Because these are expensive foods, the amount and type used in the diet vary according to the family's socioeconomic status.
- Animal fat-containing foods such as milk, eggs, meat, and liver Several dietary sources of submerged lipids.
- In addition to providing fat, nuts, seeds for oil production, eggs, dairy products, and livestock also include protein, minerals, and B-complex vitamins. Vitamin A is found in ghee, butter, eggs, and liver. Vitamin A is added to some refined oils and vanaspati.
- The Vanaspati, enriched oil that is refined, ghee, and the butter can all be used to meet some of the daily vitamin A requirements.

- Controlling visible fats in the diet is easier than controlling hidden fats. One may keep an eye on how much butter, ghee, and other liquid oil is being utilized, for instance. The cream in dairy products and milk, nuts utilized in making food, the yolk of an egg, and grease employed to season veggies, lentils and lettuce are examples of invisible fats. Although dairy milk with no fat has 3 per cent fat in it. 10% or more of the total energy in the diet is made up of undetectable lipids.

Table 7.2. Some Common Fatty Acids' Names, Formulas, and Melting Points

Carbon Atom Count	Fatty Acids	Specifications	Melting Point (in degrees Celsius)
Saturated			
4	Butyric	C_3H_7COOH	-7.9
6	Caproic	$C_5H_{11}COOH$	-3.4
10	Capric	$C_9H_{19}COOH$	31.6
16	Palmitic	$C_{15}H_{31}COOH$	62.9
18	Stearic	$C_{17}H_{35}COOH$	69.6
Unsaturated			
18	Oleic	$CH_3(CH_2)_7CH=CH(CH_2)_7COOH$	16.3
18	Linoleic	$CH_3(CH_2)_4CH=CHCH_2CH=CH(CH_2)_7COOH$	-5.0
18	Linolenic	$CH_3CH_2CH=CHCH_2CH=CHCH_2CH=CH(CH_2)_7COOH$	-11.0
20	Arachidonic	$CH_3(CH_2)_4(CH=CHCH_2)_4(CH_2)_2COOH$	-49.5

Source: Madhbani S.R. and Rajagopal M.V., 2007 *Fundamentals of Foods and Nutrition and added Diet Therapy*

ASSESS THE PROGRESS OF YOUR SESSIONS 3

- 1) Where can you get fats and oils?

7.3 NUTRITIONAL CONTRIBUTION OF OILS AND FATS

Oils and fats are significant sources of energy for us. Compared to proteins and carbs, lipids offer 2.25 periods' higher levels of calories in terms of weight. They aid in reducing the quantity of food we consume. Oils and fats are crucial sources of energy, good sources of the A, D, E, and K, which are fat-soluble vitamins as well as they participate the synthesis of number of long-chain alcohols. Fats reduce the bulk of our diet since they are high in energy. However, you should avoid eating too much fat because it causes the body to store it as fat, which makes you gain weight. Ghee and butter, two animal-based fats, are particularly high in vitamin A. Both the A and D vitamins are added to vanaspati. Strong bones and teeth require sunshine while as you may have read in the first unit of Block 1, a form of vitamin A keeps our eyes healthy. Linoleic acid, an important fatty acid that is necessary for human health, is provided by oils. Over consumption of saturated fatty acids increases lipids in the blood levels as well as the danger of heart disease and arteriosclerosis. Thus, a large intake of unsaturated acids is required for normal health. They provide concentrated energy. Fat has nine calories per gram whereas protein and carbs only have four.

Ghee, a common cooking method generated by clarifying butter, is very useful when making desserts like *Mawa Laddu* and Mysore pak. It is consumed on a regular basis. Sesame oil is more widely utilized in the other southern states, whereas coconut oil is more popular in Kerala. In Bengal, Uttar Pradesh, Punjab, and Haryana, mustard oil is frequently utilized. Sesame oil and safflower oil, both of which are high in lenoleic acid, are present in vanaspati, or hydrogenated vegetable oil, to a minimum of 5% each. It takes the acid to stop atherosclerosis. Additionally, palm oil is now used in Indian cuisine. It has roughly 10% linoleic acid, while palmolein has about 12%. Essential fatty acids included in oils help to maintain the health of the surfaces of our bodies as well as heart healthy. They protect against dermatitis and reduce chance of cardiac arrest in older people.

Other fats like margarine or bakery fats get utilized occasionally in the everyday diet. Acts like leavening components in cakes, pastries and cookies; in cakes, incorporating oil into the flour forms walls around each little bubble. Because fat is insoluble in water in foods that are baked, it interferes with gluten hydration and the gluten strand cohesion during combining them and making the product tender. They are typically used to make biscuits, bread, and cakes. Although table butter has been replaced by margarine in other nations, margarine is still not a significant part of the diet in India.

Table 7.3 Percentage of fatty acids in specific oils and fats

Oils /Fats	Total Saturates	Total mono unsaturated	Linoleic n-6	Total Poly unsaturated
Coconut oil	89.5	7.8	2.0	2.0
Corn oil	12.7	29.6	57.4	57.4
Cotton-seed oil	25.9	22.9	50.9	50.9
Groundnut oil	20.9	49.3	29.9	29.9
Mustard or Rapeseed oil	10.7	56.0	18.1	32.6
Olive oil	14.8	74.5	10.0	10.0
Palm oil	46.3	43.7	10.0	10.6
Rice bran oil	22.1	41.0	34.3	35.7
Soyabean oil	13.1	28.9	50.7	57.2
Butter	69.4	28.0	2.5	2.5
Lard	46.2	45.2	11.0	11.0
Tallow	54.9	40.9	4.2	4.2

Source: Gopalan et al., 2004 (NIN, Hyderabad)

ASSESS THE PROGRESS OF YOUR SESSIONS 4

- 1) Fats have high levels of a few specific dietary components.

2) What is the function of fat in baked products?

7.3.1 EFAs (Essential fatty acids)

- Linoleic acid (omega-6 PUFA) and linolenic acid (omega-3 PUFA) are considered vital fatty acids as these substances are not made in the human body, are required for important physiological processes, and can only be received from diet.
- EFAs serve various key purposes. They are necessary for early growth and the preservation of typical healthy skin. DecosaHexenoic Acid and EicosaPentenoic Acid are omega-3 fatty acids that play a crucial being involved in development of the embryo's brain and eyes. Additionally, such acids help to prevent Rheumatoid Arthritis as well as heart problems.
- The finest sources of these fatty acids are certain types of seafood. Through certain places, containing modified eggs higher quantities containing omega-3 fatty acids have been generated through incorporating high in DHA algae into food for chickens.
- The majority of natural fats, including only the case of coconut, are rich in linoleic acid.
- Omega-3 fatty acids may be present in greens, cabbage, as well as lettuce. Soybeans are also high in omega-3 fatty acids. A weekly serving of any fatty fish, including tuna, sardines, and salmon, can assist you satisfy the requirement. Fatty fish are rich providers of omega-3 fatty acids.
- Certain prostaglandins are synthesized using EFAs. Prostaglandins slow bleeding, reduce platelet thickness and stickiness, and lower triglyceride and very low density

lipoprotein (VLDL) levels in the blood. As a result, arterial obstruction is minimised. Prostaglandins also lower inflammation and consequently discomfort in certain conditions.

- Lack of EFAs causes growth retardation, dry skin, and itchy head patches.
- Diarrhoea and other symptoms may appear. These deficiency symptoms arise in low-birth-weight newborns fed fat-free formulas and in people nourished for lengthy periods of time on intravenous solutions containing no lipid.(like rheumatoid arthritis)

ASSESS THE PROGRESS OF YOUR SESSIONS 5

- 1) Write about foods that contain Omega-3 fatty acids.

7.3.2 RECOMMENDED DIETARY ALLOWANCES

The demand for fat is dependent on two things: the need for energy and the need for necessary fatty acids. Invisible fat in the diet provides around 10% of overall energy requirements. A minimum of 5% of total energy must be delivered in the diet as visible fat. This equates to around 12 g of fat each day. For healthy people, a greater amount of consumption of 20 g/day is preferred to give energy density and palatability.

Given the potential difficulties associated with high fat consumption, a maximum limit of 20 g/day for adults and 25 g/day for young children is recommended. To meet the essential fatty acid requirements, the diet should include at least 10 g of vegetable oil, which is a good source of linoleic acid.

7.4 TYPES OF FATS AND OILS

7.4.1 BUTTER: This is manufactured from separated cream through milk. The milk product may become vinegary on its own as well as after adding curds. The butter separates when it is churned. Butter prepared curd is now incorporated into cream, that provides better flavour and lasts longer. You may manufacture at your place and consume it plain, alternatively you may make ghee out of it. It may be an excellent resource of vitamin A and more costly than other fats since it is derived from milk. You can create sandwiches, cakes, cookies, and pastries using butter and chapatis and parantha. It is smooth and easy to digest. As a result, it is more suited to small kids, the elderly, and the sick.

7.4.2 GHEE: This originates from butter that has been heated until all of the fluid has been removed. It may be produced at home using homemade butter. Heat the butter until a light brown colour develops on the residual butter particles. Avoid overheating since this would cause the ghee heat and essential nutrients to be demolished. A component for frying and cooking is ghee that is also used to produce desserts. However, given that it is made of butter, it is expensive to buy.

7.4.3 MARGARINE: Margarine is a butter replacement manufactured from vegetable oils such as soya bean, cotton seed, and others, as well as a hydrogenated blend of vegetable and animal fat. Developed with whey or cultured pasteurised skim milk (SM) and one or more optional fat components. Vitamins A and D can also be added to boost nutritional value. Other ingredients that can be used as emulsifiers include lecithin, monoglycerides, and/or fat producing fatty acids, artificial colours, salt, citric acid or specific citrates, and sodium benzoate as a preservative to the level of 0.1 per cent.

7.4.4 LARD:



Fig 7.2 Lard

Lard is a kind of pig fat. Lard is made by rendering fatty tissues with heat. The amount of lard used is determined by the location of the fatty tissues in the animal and the technique of cooking. To avoid the beginning of rancidity, an antioxidant is added. Lard is sometimes changed to increase its baking performance.

7.4.5 COTTON SEED OIL:



Fig 7.4 Cotton seed oil

It is eaten as a salad dressing or as a cooking oil. It has a neutral flavour that does not overwhelm other foodstuffs.

7.4.6 RICE BRAN OIL:



Fig 7.5 Rice bran oil

It is strong in unsaponifiable components such as tocotrienols and oryzanol. These have antioxidant properties. This oil is high in vitamin E, which provides it oxidative stability. Furthermore, it has a greater cholesterol-lowering effect than other oils. When compared to other oils, it has a high keeping quality. Foods deep fried in rice bran oil were less absorbed or eaten in fried foods than meals fried in groundnut oil.

7.4.7 REFINED OIL

Vegetable oils are made from oil-containing seeds, fruits, or nuts by using different pressing techniques, solvent-based extraction, or a combination of these. A seed cake with a fair amount of protein is still present, and the fat is also utilized to make animal feed.

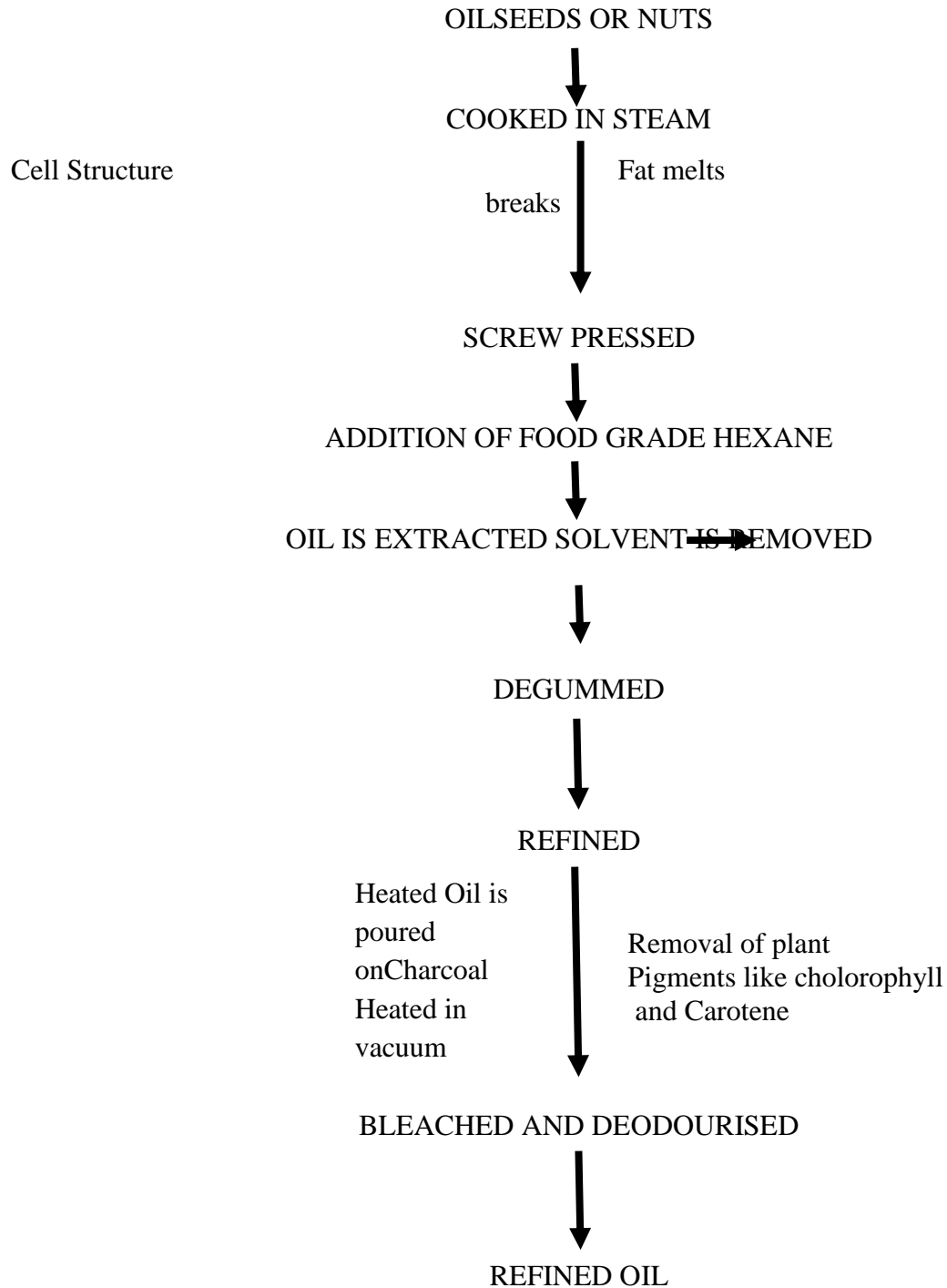


Fig 7.6 Flowchart of the production of refined oil

(Source: B. Srilakshmi,2011)

7.4.8Vanaspathi

In India, hydrogenated oil is referred to as "Vanaspathi." It is produced by hydrogenating groundnut oil that has been refined or a combination of groundnut oil and other edible vegetable oils. In Vanaspathi, both beneficial and harmful fatty acids may be detected.Vanaspathi must have a melting point between 31°C and 37°C, contain 5% sesame oil, and be fortified with vitamin A in accordance with the Vanaspathi Control Order.

PHYSICALACTIVITY1

- 1) Mention the foods that you usually prepare using rice bran oil.

ASSESS THE PROGRESS OF YOUR SESSIONS 6

- 1) State the preparations for which you utilize cotton seed oil in the food you prepare.

7.4.9 GROUND NUT OIL:



Fig 7.7 Groundnut

Groundnut oil accounts for over half of all oils produced in India. The protein and fat content of groundnuts is fairly high. The B-complex vitamin niacin is particularly abundant in them. The 'king' of oilseeds is groundnut. It is a crucial component of our nation's food supply and a major source of income. Aside from being a valuable source of all nutrients, it is also a low-cost product. The term "wonder nut" and "poor man's cashew nut" are also used for the groundnut. Compared to eggs and meat; groundnuts provide two times the amount of protein. Groundnuts are high in calcium, phosphorus, iron, and zinc, in addition to protein. It is clear amber liquid that is widely used in cooking and as a salad dressing. It is one of the most essential fats used in the production of margarine. It has high oxidative stability. It is also employed in the preservation of fish.

7.4.10 SOYABEAN OIL: In terms of both production and use, soybean oil is the world's top vegetable oil. It is extracted from raw beans using a solvent. It is a component in cake mixes, non-dairy creamers, cooking oil, Mayonnaise, sandwich spreads, and vanaspathi.

7.4.11 MUSTARD OIL:



Fig 7.8 Mustard oil

It is a member of the *Brassica campestris* family. Mustard is a member of the same family. It is also known as *Sarson*. Mustard oil has a strong flavour and aroma and is somewhat more viscous than other common vegetable oils. Mustard oil has antibacterial properties and can help to protect the skin. It can also prevent cold, cough and skin problems. Mustard oil contains strong antioxidant activity.

MUSTARD OIL IS A WONDERFUL OIL OPTION FOR COMMON COOKING OIL SINCE IT IS ALSO USED AS A STIMULANT TO AID DIGESTION AND CIRCULATION.

PHYSICAL ACTIVITY 2

- 1) Name five dishes that you develop with mustard oil along with their names.

7.4.12 OLIVE OIL:



Fig 7.9 Olive Oil

The conventional plant fruit known as the olive is used to make olive oil, which is fruit oil. The wild olive tree, which has its roots in southern Asia, has been extensively grown in the Mediterranean area. The substance that is extracted from the olive fruits can be divided through

different categories for commercial usage, including virgin, extra virgin, pure, and processed oils. Olive oil is extensively used in food preparation in the modern world. Pure and refined olive oils are both used for deep frying. For daily cooking, virgin olive oil is preferred, while extra virgin olive oil is used in dressings for salads. The risk of heart disease is significantly decreased by the monounsaturated fats found in olive oil. Additionally, it contains plenty of polyunsaturated fats, which help to lower cholesterol.

7.4.12 PALM OIL:

Elaeis guineensis palm fruit is used to make palm oil. It is used all over the world as a cooking oil, a component in margarines and shortening, as well as in a broad range of culinary products and fat blends. Both saturated and unsaturated fatty acids are present in equal amounts. It contains 5 per cent stearic acid and 44 percent palmitic acid. The liver contains 10% linoleic and terol and 39% oleic acid (MUF). Due to its high content of carotenoids (500–700 ppm), crude palm oil is one of the most abundant natural plant sources of carotenoids.

Palm oil is a good source of antioxidants, Carotenes and Vitamin E.

7.5 UTILIZATION OF FATS AND OILS IN FOOD PREPARATION

Cooking is carried out with fats and oils. You can do this by deep-frying, pan-frying, or doing shallow frying. Pan-frying is the process of cooking food in a skillet that has been lightly greased. Examples include frying *Puri*, *Pakora*, *Dhokla*, *Dosa*, omelets, fried eggs, pancakes, and *papad*. In this way, food is cooked in minute pieces or a thin layer. To finish cooking, the meal must be rotated from one side to the other.

To cook the meal when deep frying, it is submerged in fat. The ingredient is used to prepare a variety of foods. The technique used seems similar to the boiling process. The food cooks very rapidly because lipids can be heated to temperatures that are far higher than boiling water. In order to prevent food from burning, it requires regular care and attention.

Fats are employed as a shortening agent. It gives baked and fried goods a crisp texture thanks to the shortening action. This occurs in wheat goods because the gluten strands are cut shorter, which prevents the product from becoming tough.

BUTTER AND GHEE, TWO READILY SOFTENED FATS, ARE FREQUENTLY USED AS SPREADS, SANDWICHES OR AS BREAD PIECES.

ASSESS THE PROGRESS OF YOUR SESSIONS 7

1) How do we use fats and oils in our daily diet?

7.6 CHANGES IN FATS AND OILS DURING COOKING

Since they don't have a distinct melting point, fats gradually get softer when heated.

Smoke point, Flash point, and fire point: When fats and oils are burned to high temperatures, fat breakdown takes place and finally a point is reached when visible vapours are released. This is known as the smoking point, and the temperature is known as smoking temperatures of fat. When heated above the smoke point, they flash and burn. The terms "flash point" and "fire point" refer to the temperatures at which these take place.

Pyrolysis (Thermal breakdown): Whether or not the oil comes into contact with food, heating results in a breakdown in its molecular structure. When fat starts to smoke, its chemical breakdown begins, and glycerol is converted to free fatty acids and acrolein. The acrolein in the fat could cause irritation to the eyes and nose if it is allowed to smoke for any duration of time.

Oxidation: The development of rancidity is the result of molecular breakdown carried on by the oil surface's reaction with airborne oxygen. Every time the oil is heated, this change will take place.

Reaction with food residues: In particular, if the oil is heated again without the residues being removed, any food pieces left in it after frying will undergo chemical reaction. After usage, straining the oil can aid in preventing this kind of degradation.

They provide essential fatty acids, which are parts of the membranes of living cells, are a good source of A, D, E, and K vitamins, and add a distinctive flavour and texture to our food, making

it more palatable. They are also used by the body to produce prostaglandins and have a role in many important physiological functions.

7.7 OUR HEALTH AND FATS AND OILS:

Saturated fat and unsaturated oil are common terms used to describe the fats and oils derived from meals. Saturated fats have a high percentage of saturated fatty acids, whereas unsaturated oils have a high percentage of unsaturated fatty acids. Excessive saturated fat consumption, together with excessive cholesterol consumption, contributes to an increased risk of heart disease. Increases in unsaturated lipids (either mono- or polyunsaturated) on the other hand, have been associated to a decreased prevalence of certain disorders.

Cholesterol levels are relatively high in the heart, liver, kidney, and egg (embryonic stage of life). New tissues are created throughout infancy and toddlerhood, particularly the brain, which requires cholesterol. As a result, fat should not be reduced in the diet of children under the age of five. Physical exercise, in addition to food, is a key component in the regulation of obesity, plasma cholesterol levels, and the prevention of CHD. Even during periods of increasing caloric intake, exercise reduces fasting plasma TRG levels. It is also known to raise HDL levels, which safeguard the health of blood arteries. As a result, we can avoid crippling heart disease and maintain our heart's health.

As a result, there have been an increasing number of recommendations from government authorities and health groups to reduce the quantity of saturated fat in the diet and raise the proportion of unsaturated fat. The majority of these organisations also advise reducing the total quantity of fat in the diet.

Since 1992, the US Department of Agriculture has promoted a food pyramid that provides a clear, visual representation of how much of what types of foods comprises a healthy, balanced diet. It advises consuming as little fat as possible. Although nutritionists acknowledge that some fat is necessary (and, in most cases, unavoidable, even for rigid vegetarians), they highlight that a large proportion of any fat, saturated or unsaturated, in the diet is not healthy. Despite at this point a small distinction between a single and double carbon-carbon bond can have a major influence on health.

- Consume foods high in healthy fats, such as nuts (such as walnuts and almonds), seeds (such as sunflower and pumpkin), olives, and so on.
- Instead of frying, try baking, steaming, grilling, or broiling.
- Pick lean meat and poultry cuts, low-fat or fat-free dairy products.
- Consume a lot of naturally low-fat foods like whole grains, fruits, and vegetables.
- Remember to inquire about the types of fats used in the production of the meals you are ordering while dining out. In many fast food or chain restaurants, you may also request to examine the nutrition information, and then select a lower-fat dish.

PHYSICAL ACTIVITY 3

- 1) Write an article about how fat affects people.

7.7.1 IMPORTANCE OF FATS AND OILS

Fat improves texture: Acts as a leavening agent in cakes, biscuits, and cookies; in cakes, integrating oil into the flour produces walls surrounding each small bubble.

Fat act as a shortening agent: Because fat is insoluble in water in baked goods, it interferes with the hydration of gluten and the cohesion of gluten strands during mixing, shortening them and making the product tender.

Fats for smoothness: In ice cream and frozen desserts, it reduces crystal size and provides a smooth texture. Fats obstruct sugar crystallization like halwa, candies. Upma Forms emulsion in mayonnaise providing smooth texture and prevents lump formation.

Fats enhances flavor: Aromatic aroma compounds dissolve in fat and enhance flavour, such as onion, ginger, garlic, pepper, and so on. Fats, such as Ghee, increase taste, flavour, and palatability. Fats are colouring agents. Turmeric added to oil, for example, is dispersed equally in meals.

Synergists: Compounds that delays auto-oxidation by reinforcing the action of antioxidants. Citric acid, phosphoric acid, ascorbic acid, lecithin, EDA – They combine with the pro oxidant metals like copper and iron and make them ineffective.

ASSESS THE PROGRESS OF YOUR SESSIONS 8

- 1) What are the importance of fats and oils

7.7 LET US SUMMERISE

People eat fat in both visible and invisible forms. Fats shorten the strands of gluten, making the items delicate.4.Fats transport fat-soluble vitamins A,D,E, and K. Fats are an essential component of all salad dressings. Some types of foods cannot be cooked without fat.The food we eat is rich in flavour and texture as a result of fats and oils. Additionally, they enhance the flavour of meals and are a fantastic source of vitamins and energy. For frying and preparing meals, various fats and oils including ghee, butter, vanaspati, and vegetable oils are frequently used. In order to prevent heart disease and maintain our health, it is preferable to utilize more oils than fats. To avoid unfavourable changes, we should choose wisely, refrain from overusing them, and treat fats and oils with care while frying and storing them.

7.8 GLOSSARY

Fats and oil: Fats and oils are conventional names for fatty acid esters with glycerol.

Smoke point: The point of smoke indicates the level of heat that causes fats and oils begin to release visible fumes when heated.

Emulsion:A dispersion of colloidal particles consisting of two incompatible liquids is an emulsion..

7.9 EXERCISES TO CHECK YOUR PROGRESS ANSWERS

Assess the progress of Your Sessions 1

According to their chemical composition, lipids may be divided into three groups:

- i. Both oils and fats are examples of simple lipids.
 - ii. Phospholipids and lipoproteins are components of complex lipids, in addition to
 - iii. Derived lipids like fatty acids and sterols.
- 1) Cholesterol is a vital sterol. It is a waxy material. It is the most well-known sterol and has gained popularity because to the link between high blood cholesterol levels and heart disease. It is a vitamin D, hormone, and bile acid precursor. Corticosteroids, oestrogens, testosterone, and calcitriol (the active vitamin D hormone) are all hormones derived from cholesterol. Bile acids, which are required for fat breakdown, are generated from cholesterol.

Assess the progress of Your Sessions 2

When choosing fats, keep the following in mind:

- 1) Natural flavour and colour should be present in oils and fats.
- 2) They should be spotless and devoid of any debris, filth, dust, or offensive odours.
- 3) Purchase the oil or fat from a reputable supplier
- 4) .Avoid buying oils and fats loose.
- 5) Butter needs to be packaged in a sanitary manner. It need to be flavorful of freshness and firm.
- 6) Ghee ought to retain its delicate, natural flavor.

Assess the progress of Your Sessions 3

- a) Vegetable oils b) Plant oils c) Nuts and oilseed d) milk e)eggs f) meat

Assess the progress of Your Sessions 4

- 1) i) A, D, E, and K fat soluble vitamins ii)) high energy
- 2) Acts as a leavening agent in cakes, biscuits, and cookies; in cakes, incorporating oil into the flour forms walls around each little bubble. Because fat is insoluble in water in foods that are baked, it interferes with gluten hydration and the gluten strand cohesion during combining

them and making the product tender. They are typically used to make biscuits, bread, and cakes

Assess the progress of Your Sessions 5

- 1) It is present in soyabean, green leafy vegetables, cabbage, and lettuce.

Assess the progress of Your Sessions 6

- 1) Cotton seed oil is eaten as a salad dressing or as cooking oil. It has a neutral flavour that does not overwhelm other foodstuffs.

Assess the progress of Your Sessions 7

- a) It is employed in the making of dishes including puris, samosas, chips, cutlets, and pakoras.
- b) Butter and ghee, two readily softened fats, are frequently used as spreads. Sandwiches or as bread pieces.

Assess the progress of Your Sessions 8

The following represent a few of the advantages of fats and oils:

- 1) Improves texture
- 1) Act as a shortening agent
- 2) Smoothness
- 3) Enhances flavor

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UNIT VIII: NUTRIENT FUNCTIONS

Nutrition is the one of the streams of science which deals with foods, the nutrients and other components they contain, their action, metabolism, absorption and interrelation with health and disease. It is the collaboration of science and art wherein, we study the different processes by which all organism ingests, digests, absorbs, transports & utilizes nutrients & disposes of their end products.

In addition, nutrition can be influenced by different aspects of food and eating behaviors like for eg. Social, Economic, Cultural and Psychological. In short, nutrition science is the area of knowledge regarding the role of food in the maintenance of health.

FOOD: Any eatable substance that we can consume or drink is called Food. Food provides us nourishment, take care of wear and tear, heals our body and protects us from infections and diseases. Thus, food helps us to maintain good health. The major function of foods is the life support function. In addition to that foods satisfy hunger & create pleasure & happiness, when we consume foods of our choice.

The primary functions of food are to take care of physiological function & maintain health by providing body building & regulatory functions. It also provides psychological satisfaction by relieving hunger when we relish food made by our loved ones.

With these aspects we shall study nutrients & their functions under the following subtopics •

NUTRIENT: Nutrients are the chemical substances which are obtained from the food we eat and they are used in our body to provide energy, to support our growth & development, maintenance & repair of the body's tissues. Some of these nutrients are meant for reducing the risks of degenerative diseases and deficiency disorders.

ESSENTIAL NUTRIENT: An essential nutrient is a nutrient that our body cannot synthesize on its own or also not to an adequate amount & must be provided by the dietary sources. These nutrients are necessary for the body to function properly. The six essential nutrients include carbohydrates, protein, fat, vitamins, minerals and water.

CLASSIFICATION: The nutrients are classified on the specific basis, based on which they have been grouped under different terminologies.

1. Classification based on the need and requirements in our body:
 - a) Macronutrients
 - b) Micronutrients
2. Classification based on the function they perform in our body:
 - a) Energy giving nutrients (GO Nutrients)
 - b) Body building nutrients (GROW Nutrients)
 - c) Protective nutrients (GLOW Nutrients)

Let us know more about them.

1. **MACRONUTRIENTS:**Macronutrients provides the bulk to the diet and they are needed in large quantities by our body. They supply energy as well as the essential nutrients needed for growth, maintenance, & activity. They include carbohydrates, proteins and fats. Water is also included in macronutrient.
2. **MICRONUTRIENTS:** Nutrients which are just essential in small quantities for the proper functioning of our body are referred as micronutrients. Minerals and vitamins are grouped under micronutrient category.
3. **ENERGY GIVING NUTRIENTS:** Those nutrients which provide energy to the body are called Energy giving nutrients. For Eg., Carbohydrate, Fats
4. **BODY BUILDING NUTRIENTS:** Those nutrients which help to build up muscle and tissues, help in growth and development of the body and maintain repair are called Body building nutrients. For Eg., Protein.
5. **PROTECTIVE NUTRIENTS:** Those nutrients which are effective in providing protection to the body from various infections are called Protective nutrients. For Eg., Vitamins and Minerals.

Water is considered as a regulatory nutrient which does not provide above mentioned functions, still is very vital for life. One cannot survive without water for more than few days.

BASAL METABOLIC RATE (BMR)

The amount of energy required to carry on the involuntary work of the body is known as basal metabolic rate. It includes the functional activities of the various vital organs such as brain, heart, liver, kidney & lungs & also the secretory activities of glands, peristaltic movements of gastro intestinal tract, oxidation occurring in resting tissue, maintenance of muscle tone & body temperature. In general terms, it is amount of the energy expenditure required when the body is at rest and no physical movements are taking place. For Eg., When we are lying on bed or at sleep.

Determinants of BMR

Many factors affect the BMR of an individual, they are as follows;

1) Body composition

- 2) **Gender:** males have higher muscle mass & lower body weight therefore they have high BMR. Females have higher fat mass & thus have lower BMR.
- 3) **Age:** BMR decreases with advancing age.
- 4) **Hereditary factors:** some people are born with faster metabolism & some with slower metabolism.
- 5) **Body surface area:** surface area depends on height & weight. Greater the surface area higher the BMR & vice versa.
- 6) **Hormones:** some of the endocrine hormones like thyroid, catecholamine, adrenaline, growth hormone all of them increases.
- 7) **Pregnancy:** BMR increases by 5% during the first & second trimesters. During the last trimester it increases by 12%.
- 8) **State of nutrition:** BMR is lowered during starvation, malnutrition & wasting diseases.

BODY MASS INDEX (BMI)

Body mass index (BMI) is a measure of relative size based on the mass and height of an individual. BMI is defined as the ratio of weight (kgs) to height² (meter) of an individual (Fig:1)

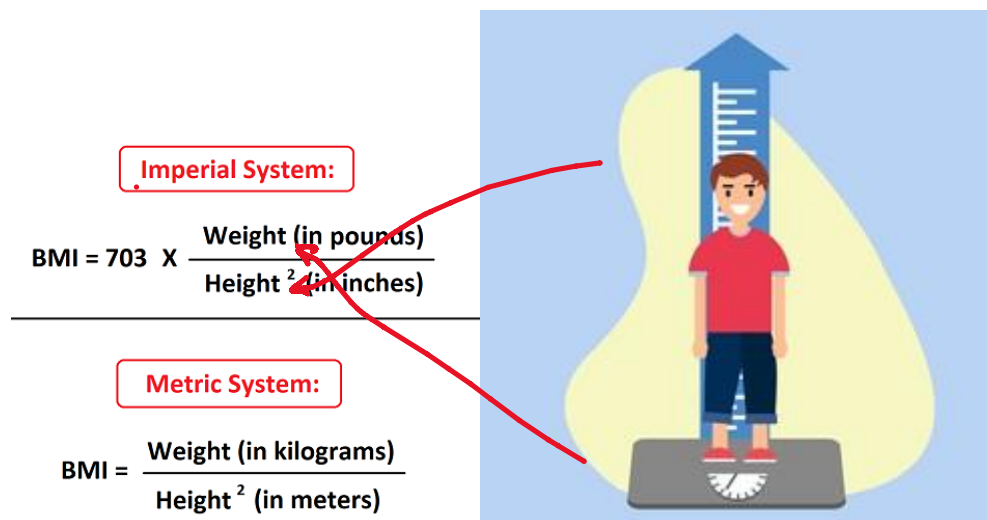


Fig.1: Formula for calculation of Body Mass Index (BMI)

BMI is used as a screening tool to indicate whether a person is underweight, overweight, and obese or a healthy weight for their height. It is a simple, inexpensive and noninvasive measure of

body fat. BMI values are age-independent and the same for both genders. However, BMI may not correspond to the same degree of fatness in different populations due to different body proportions. BMI Range :(Table 1) gives the range of BMI. Fig.2 (BMI ranges for men & women)

Table 1: BMI standard ranges, their relationship to the nutritional status & obesity.

BMI (kg/m²)	Nutritional status
Below 18.5	Underweight
18.5–24.9	Normal weight
25.0–29.9	Pre-obesity
30.0–34.9	Obesity class I
35.0–39.9	Obesity class II
Above 40	Obesity class III

Raised BMI is a major risk factor for non-communicable diseases such as- Cardiovascular diseases (mainly heart disease and stroke), which were the leading cause of death all round the world; Type II Diabetes Mellitus; Musculoskeletal disorders (especially osteoarthritis – a highly disabling degenerative disease of the joints); Some cancers (including endometrial, breast, ovarian, prostate, liver, gallbladder, kidney, and colon). The risk for these non-communicable diseases increases, with increases in BMI. As the high BMI is the sign of higher level of adiposity and obesity which the root cause of various deadly lifestyle disorders.



Fig.2: BMI ranges for the men and women.

DIETARY REFERENCE INTAKES

The results of research studies in the field of nutrition are used by Scientists/Researchers to derive standards. These standards explain the amounts of individual nutrients required by healthy individuals of all age groups for supporting health. Such standards are collectively called as '*Dietary Reference Intakes*' which is an umbrella term for the following individual values:

1. Estimated average requirements(EAR)

The estimated nutrient requirement that is adequate in 50% of the population studied and is used to develop the recommended dietary allowances.

2. Recommended dietary allowances (RDA)

RDAs are estimates of nutrients to be consumed daily to ensure the requirements of all individuals in a given population. RDA is adequate for 97-98% of the healthy population and is separate for physiological groups such as infants, preschoolers, children, adolescents, pregnant women, lactating mothers, and adult men and women, taking into account their physical activity. RDA also includes a margin of safety to cover variation between individuals, dietary traditions and practices.

3. Adequate intakes (AI)

For some nutrients, there is insufficient knowledge to determine an Estimated Average Requirement (which is needed to set an RDA). In these cases, an AI is used which reflects the

average amount of a nutrient that a group of healthy people consume.

4. Tolerable upper intake levels (UL)

It is the maximum intake of a nutrient that is not associated with adverse side effects in most individuals of the healthy population. Overall, these recommendations apply to healthy people and may not be appropriate for people with diseases who have altered nutrient needs. Care should be taken to consider country specific recommendations while deciding the nutrient requirements

Let us study RDA in details.

RECOMMENDED DIETARY ALLOWANCES (RDA)

RDA is defined as “the average daily dietary intake level that is sufficient to meet the nutrient requirement of nearly all healthy individuals (97-98%) in a particular life stage & gender group”. RDA is revised periodically by Expert Group of Indian Council of Medical Research (ICMR)& updated with newer concepts & emerging knowledge concerning human nutrient requirements. RDA is based on Indian reference man & reference woman.

Reference Man and Reference Woman

For the purpose of computing the total nutrient needs of population at the national level, the concept of reference man and woman is used.

- ❖ Reference man and woman are defined on the basis of body weight of well-nourished healthy adults in each country, who have satisfactory growth during their childhood and are currently leading a healthy and active life.
- ❖ **Reference man** is between 18-29 years of age, and weight 60 kg with a height of 1.73m with a BMI of 20.3. He is free from disease and physically fit for active work. On each working day, he is employed for 8 hours in occupation that usually involves moderate activity. While not a work, he spend 8 hours in bed, 4-6 hours in sitting and moving about and 2-4 hours in walking and in active recreation or household duties.
- ❖ **Reference woman** is between 18-29 years of age, non- pregnant, non-lactating and weighs 55 kg with a height of 1.61 m and a BMI of 21.1 is free from disease and physically fit for active work; on each working day, she is engaged in 8 hours of occupation which usually involves moderate activity, while when not at work she spends 8 hours in walking or active recreation or household chores.

RDA can also be defined as follows:

Recommended Dietary Allowances-The Recommended Dietary Allowances (RDA) are the levels of intake of the essential nutrients that are judged to be adequate or sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group.

A safety factor is considered while deciding the RDA for all nutrients except for energy. Thus, RDAs provide safe and adequate levels of nutrients needed by different age groups. A diet composed of a variety of foods from diverse food groups will be adequate in meeting the RDA for all nutrients.

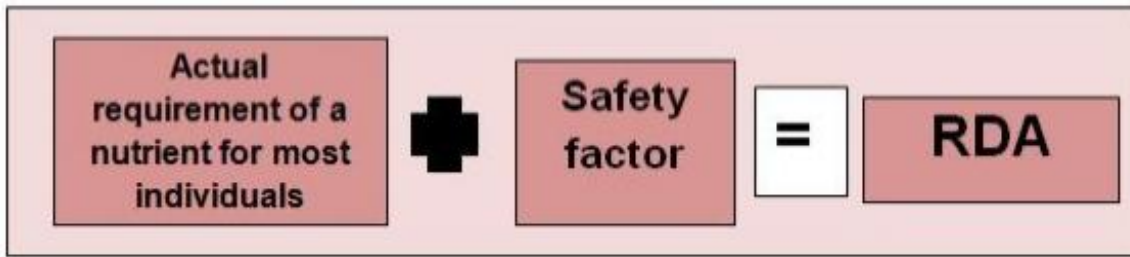


Fig.3: Simplification of RDA definition.

The latest RDA was revised in 2020 & recommendations for different age groups with nutrient requirement are shown below:

Age Group	Category of work	Body Wt	Protein	CHO	Cal cium	Magne sium	Iron	Zinc	Iodine	Thiamine	Ribo flavin	Niacin	Vit B6	Folate	Vit B12	Vit C	Vit A	Vit D
		(kg)	(g/d)	(g/d)	(mg/ d)	(mg /d)	(mg/ d)	(mg /d)	(µg/ day)	(mg /d)	(mg /d)	(mg /d)	(mg/ d)	(µg /d)	(µg/ d)	(mg/ d)	(µg/ d)	(IU/ d)
Men	Sedentary	65	54.0	130	1000	385	19	17	150	1.4	2.0	14	1.9	300	2.5	80	1000	600
	Moderate									1.8	2.5	18	2.4					
	Heavy									2.3	3.2	23	3.1					
Women	Sedentary	55	45.7	130	1000	325	29	13.2	150	1.4	1.9	11	1.9	220	2.5	65	840	600
	Moderate									1.7	2.4	14	1.9					
	Heavy									2.2	3.1	18	2.4					
	Pregnant woman	55 + 10	+9.5 (2 nd trimester) +22.0 (3 rd trimester)	175	1000	385	40	14.5	250	2.0	2.7	+2.5	2.3	570	+0.25	+15	900	600
	Lactation 0-6m		+16.9	200	1200	325	23	14	280	2.1	3.0	+5	+0.26	330	+1.0	+50	950	600
7-12m		+13.2	200						2.1	2.9	+5	+0.17	330					
Infants	0-6 m*	5.8	8.1	55	300	30	-	-	100	0.2	0.4	2	0.1	25	1.2	20	350	400
	6-12m	8.5	10.5	95	300	75	3	2.5	130	0.4	0.6	5	0.6	85	1.2	27	350	400
Children	1-3y	11.7	11.3	130	500	135	8	3.0	90	0.7	0.9	7	0.9	110	1.2	27	390	600
	4-6y	18.3	15.9	130	550	155	11	4.5	120	0.9	1.3	9	1.2	135	1.2	32	510	
	7-9 y	25.3	23.3	130	650	215	15	5.9	120	1.1	1.6	11	1.5	170	2.5	43	630	
Boys	10-12y	34.9	31.8	130	850	270	16	8.5	150	1.5	2.1	15	2.0	220	2.5	54	770	600
	Girls	10-12y	36.4	32.8	130	850	255	28	8.5	150	1.4	1.9	14	1.9	225	2.5	52	790
Boys	13-15y	50.5	44.9	130	1000	355	22	14.3	150	1.9	2.7	19	2.6	285	2.5	72	930	600
	Girls	13-15y	49.6	43.2	130	1000	325	30	12.8	150	1.6	2.2	16	2.2	245	2.5	66	890
Boys	16-18y	64.4	55.4	130	1050	405	26	17.6	150	2.2	3.1	22	3.0	340	2.5	82	1000	600
	Girls	16-18y	55.7	46.2	130	1050	335	32	14.2	150	1.7	2.3	17	2.3	270	2.5	68	860

* AI

Fig.4: SUMMARY OF R.D.A. FOR INDIANS-2020.

The various applications of RDA include:

- Comparison of individual intakes to the RDA allows an estimate to be made about the probable risk of deficiency among individuals.
- Modifying nutrient requirements in clinical management of diseases,
- To help public health nutritionists to compose diets for schools, hospitals, prisons etc.
- For health care policy makers and public health nutritionists to design, develop nutrition intervention programmes and policies,
- For planning and procuring food supplies for population groups,
- For evaluating the adequacy of food supplies in meeting national nutritional needs.
- For interpreting food consumption records of individuals and populations,
- For establishing Standards for the national feeding programmes implemented by the Governments for its vulnerable population,
- For designing nutrition education programmes for the masses,
- For developing new food products and dietary supplements by the industry,
- Establishing guidelines for the national labelling of packaged foods (by Food Standards Safety Authority of India (FSSAI).

Factors on which RDA depends:

- I. Age of the individual:** RDAs increases with age in young children and after adulthood during old age they gradually decreases.
- II. Physical activity:**On the basis of physical activity, individuals have been classified as follows:
 - Sedentary worker – with least physical activity like lawyer, teacher, doctor
 - Moderate worker – with moderate physical activity like carpenter, tailor, plumber
 - Heavy worker- with vigorous physical activity like coal miner, steel worker, army man.
- III. Sex:** Male has higher values than females

IV. **Body Composition**

- V. **Vulnerable:** pregnant and lactating mothers, infants and elderly people.

Why Is RDA Important?

- Maintenance of a state of positive health and optimal performance in populations at large by maintaining ideal body weight.
- Ensuring adequate nutritional status for pregnant women and lactating mothers.
- Improvement of birth weights and promotion of growth of infants, children and adolescents to achieve their full genetic potential.
- Achievement of adequacy in all nutrients and prevention of deficiency diseases.
- Prevention of chronic diet-related disorders.
- Maintenance of the health of the elderly and increasing the life expectancy.

General Principles of Deriving RDA

Number of methods have been employed for determining the human nutrient requirements.

- I. **Dietary intake:** This approach has been used in arriving at the energy requirements of children. Energy intakes of normally growing healthy children are utilized for this purpose.
- II. **Growth:** The requirements of any particular nutrient or the breast milk intake, for satisfactory growth has been utilized for defining requirements in early infancy.
- III. **Nutrient balance:** The minimum intake of nutrient for equilibrium (intake=output) in adults and nutrient retention consistent with satisfactory growth in children have been used widely for arriving at the protein requirement.
- IV. **Obligatory loss of nutrients:** The minimal loss of any nutrient or of its metabolic products (namely nitrogenous end products in the case of proteins) through normal routes of elimination- urine, faeces and sweat- is determined on a diet devoid of or very low in the nutrient. This information is used to determine the amount of nutrient to be consumed daily through the diet to replace the obligatory loss.
- V. **Factorial approach:** In this approach, the requirements for different functions are assessed separately and added to arrive at the total daily requirements.

- VI. **Nutrient turnover:** Data from turnover of nutrients in healthy persons, using isotopically labelled nutrients have been employed in arriving at requirements of certain nutrients. Requirements of Vitamin A and Vitamin C, iron and Vitamin B₁₂ have been determined on this basis.

Practical Application of RDA

- To assess the adequacy of national food supplies and to plan for food production both in terms of quantity and quality e.g., agriculture planning
- To provide dietary guidelines for healthy living individual and groups and to formulate balanced diets.
- RDA can also be used for judging the adequacy of intake of individuals or groups in a preliminary way. In the case of adult individuals, RDA has to be adjusted for the actual body weight while assessing the adequacy of intake.
- RDA are used for formulating diet plan for patient in various illnesses and nutrient deficiency diseases after specific modifications related to the subject.

ENERGY METABOLISM

Energy is the ability to do work. The energy contained within the chemical constituents of food can be either trapped within the chemical constituents of the body or used to produce heat. Energy is defined property of chemical compounds & other physical systems. Carbohydrates, fats, proteins in the diet are responsible for its energy content & are made available to the body when these compounds are oxidized in the energy releasing reaction of respiration.

Units of energy

All forms of energy are interconvertible. The energy value of food is expressed in “**kilocalories**” which have been used in nutrition for a long time. One kilocalorie is defined as “*the amount of heat energy required to raise the temperature of 1 kg of water by 1°C at normal atmospheric pressure*”.

However, recently the International Union of Science & the International Union of Nutritional Science (IUNS) has adopted ‘Joule’ as the unit of energy instead of kcal.

A joule is defined as “*the energy required to move 1 kg mass by 1 meter by force of 1 Newton acting on it*”.

$$1 \text{ kcal} = 4.184 \text{ kJ}$$

$$1 \text{ kJ} = 0.239 \text{ kcal}$$

$$1000 \text{ kcal} = 4184 \text{ kJ}$$

$$1 \text{ mJ} = 239 \text{ kcal}$$

Energy value of food

The energy value of a food indicates its value to the body as a fuel. After a food is ingested, some of its energy may be 'lost' during digestion and metabolism. Only three food classes release energy & they are carbohydrates, proteins & lipids. Carbohydrates gives 4calories/g, proteins 4calories/g & fat 9calories/g calories (Fig:5) the energy released from food is measured in calories.

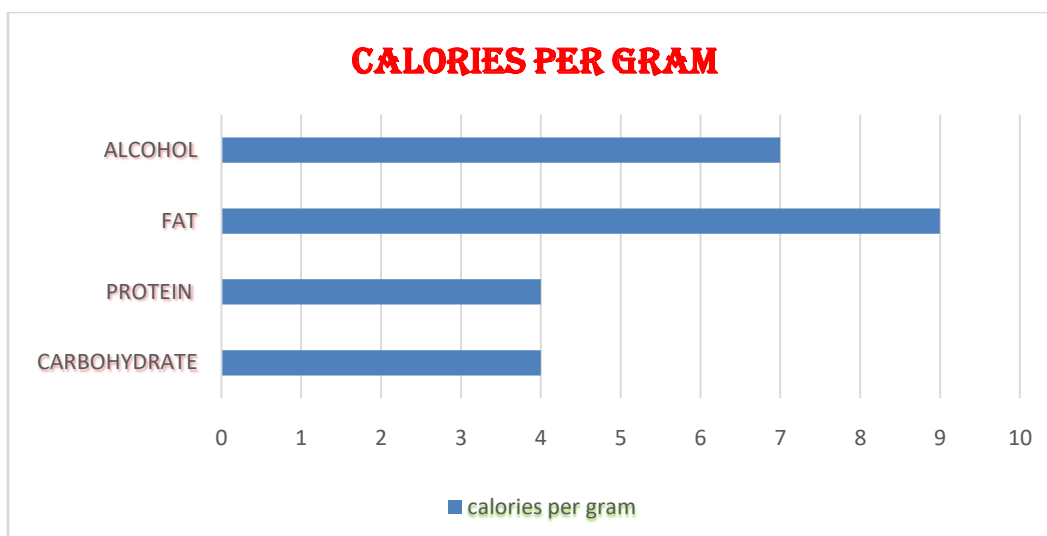


Fig. 5: Calorie content of molecules

Determination of energy value of foods

The first system for giving energy values to the macronutrients was described by Dr. W. O. Atwater in 1899. The amount of energy released from foods & the amount of energy expended by an individual can be obtained by direct & indirect calorimetry.

The principle of direct calorimetry includes the chemical changes that occur when carbohydrates or fat are oxidized during respiration in the body & the chemicals are burnt in the air. The amount of energy released or expended is measured by the heat produced.

Indirect calorimetry is based on the principle that when an organic substance is completely combusted either in calorimetry or in the human body. Oxygen consumed in amounts is directly related to the energy liberated as heat.

Although the energy value of some foods has been found by combustion in a bomb calorimeter, the amounts of the macronutrients - fat, protein, carbohydrate - in a food are taken into account when assessing the total energy value of the food.

Table 2: Equipment used & purpose in direct & indirect calorimetry

Principle	Equipment	Purpose
Direct calorimetry	Bomb calorimeter	Energy value of food
	At water Rose respiration calorimeter	Energy expenditure during BMR/RMR
Indirect calorimetry	Benedicts oxy calorimeter	Energy value of food
	Eenedict-Roth respiration	Determination of BMR
	Douglas bag	Energy expenditure respirometer during work
	Max Plank	

Physiological fuel value

The amount of energy actually available to the body from a given amount of nutrient is called physiological fuel value. In the human body the process of digestion does not proceed with 100% efficiency as carbohydrates, fats & proteins are not completely oxidized.

Therefore, the entire amount of any ingested nutrient does not eventually become available to the body. The efficiency with which nutrient is digested must be taken into account. The coefficient of digestibility is used to express the proportion of an ingested nutrient that ultimately becomes available to the body's cells.

The coefficient of digestibility for carbohydrate, fat & protein are 0.98, 0.95 & 0.92 respectively. There is no loss in metabolism of carbohydrate & fat. But in case of protein, a part of energy is lost as urea due to incomplete oxidation. The loss has been estimated to be 1.3 kcal/g of protein oxidized. The physiological energy values of carbohydrates, fats & proteins are 4, 9 & 4 respectively after making changes for losses of food energy in digestion & metabolism. These values are called Atwater Bryant factors or physiological fuel values.

Energy requirement

The energy requirement of an individual is based on the level of energy intake from food that will balance energy expenditure. The human body's total energy needs can be divided into three important components as follows- (Fig. 6)

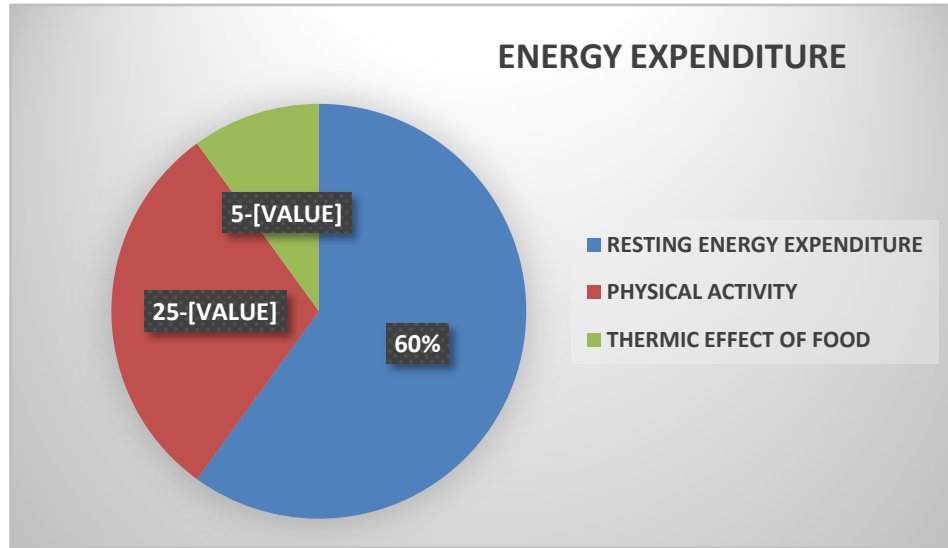


Fig. 6: Components of energy expenditure

- 1) Energy required to maintain basal metabolism (60%)
- 2) Energy required for the muscle movements or physical activity (25-30%)
- 3) The energy that is released as a result of the thermic effect of food (5-10%).

RDAs for Energy: The total energy requirement or the total energy expenditure (TEE) is calculated based on a multiplication of basal metabolic rate (BMR) to physical activity level(PAL): $TEE = BMR \times PAL$.

Table 3a. Summary of recommended energy requirement for Indians

Age group	Category	ICMR 2020	ICMR 2010	Difference
		Kcal/d		
Adult Men	Sedentary work	2110	2320	-210
	Moderate work	2710	2730	-20
	Heavy work	3470	3490	-20
Adult Women	Sedentary work	1660	1900	-240
	Moderate work	2130	2230	-100
	Heavy work	2720	2850	-130
	Pregnant	+ 350	+ 350	--
	Lactating (0-6m)	+600	+600	--
	Lactating (7-12m)	+520	+520	--
Infants	0-6 months	530	520	+10
	6-12 months	660	670	-10
Children*	1-3 y	1070	1060	+10
	4-6 y	1360	1350	+10
	7-9 y	1700	1690	+10
Boys	10-12 y	2220	2190	+30
Girls	10-12 y	2060	2010	+50
Boys	13-15 y	2860	2750	+110
Girls	13-15 y	2400	2330	+70
Boys	16-18 y	3320	3020	+300
Girls	16-18 y	2500	2440	+60

*For children 1% increase over the previous recommendations.

Table 3b. Energy Requirement*

Age Group	Category	Body weights	(kcal/d) ^a	(kcal/kg/day)
Men	Sedentary work	65.0	2110	32
	Moderate work	65.0	2710	42
	Heavy work	65.0	3470	53
Women	Sedentary work	55.0	1660	30
	Moderate work	55.0	2130	39
	Heavy work	55.0	2720	49
	Pregnant	55.0 + GWG ^b	+ 350	
	Lactating	55.0+	+600 +520	
Infants	0-6 m	5.8	530	90
	6-12m	8.5	660	80
Children^c	1-3y	12.9	1110	83
	4-6y	18.3	1360	74
	7-9 y	25.3	1700	67
Boys	10-12y	34.9	2220	64
Girls	10-12y	36.4	2060	57
Boys	13-15y	50.5	2860	57
Girls	13-15y	49.6	2400	49
Boys	16-18y	64.4	3320	52
Girls	16-18y	55.7	2500	45

^a Rounded off to the nearest 10 kcal/d

^b GWG: Energy need in pregnancy should be adjusted for actual bodyweight, observed weight gain and activity pattern for the population

^c Energy needs of children and adolescents have been computed for reference children and adolescents; with a moderate daily physical activity level.

*The actual requirement in specific population groups should be adjusted for the actual weight and physical activity of that population

(Source: A Brief Note on Nutrient Requirements for Indians, the Recommended Dietary Allowances (RDA) and the Estimated Average Requirements (EAR), ICMR - NIN, 2020)

Now, in this unit we will study our macronutrients (Carbohydrates, Lipids and Proteins) in details under the sub-heading of Definition, Classification, Dietary Sources, Functions, Recommended Dietary Allowances, Clinical signs and symptoms of Deficiency diseases and Excess.

[I] CARBOHYDRATES:

Carbohydrates are a major source of energy for humans, providing approximately 45 percent to 80 percent of the total caloric intake in different income groups. They are mainly present in food in the form of sugars, starches, and fibres.

Definition: Carbohydrates may be defined as polyhydroxy aldehydes or ketones or compound which produce them on hydrolysis. Carbohydrates are primarily composed of carbon, hydrogen and oxygen. They have general an empirical formula- $C_nH_{2n}O_n$

Classification:

Carbohydrates which are of immense importance in the diet, are classified on the basis of sugar units present in them, as **simple carbohydrate** and **complex carbohydrates**.

Monosaccharides and **disaccharides** make up simple carbohydrates, called simple sugars containing one and two sugar units respectively. **Polysaccharides** called complex carbohydrates are structurally larger and more complex than simple sugars. They include starch, dietary fibre and glycogen.

There are two main classes of monosaccharides based on the carbonyl group present in them. They are **aldoses** and **ketoses**, aldoses (eg; glucose) containing the aldehyde group (CHO) and ketoses, (eg;- fructose) containing the ketone group (C=O).

Aldoses are further divided into trioses, tetroses, pentoses and hexoses based on the number of carbon atoms.

The common disaccharides are Maltose, Lactose and Sucrose which on hydrolysis yield two monosaccharide units.

Polysaccharides have high molecular weight and are insoluble in water. They are in the form of long chains either branched or unbranched. The polysaccharides are further classified into groups depending upon the products they yield on hydrolysis. Homopolysaccharides yield only one type of monosaccharide units on hydrolysis eg:- starch, dextrin, cellulose, glycogen.

Heteropolysaccharides yield more than one type of monosaccharide units on hydrolysis eg:- Heparin, Hyaluronic acid. Heparin is an anticoagulant found in the liver, spleen, lungs and blood. Hyaluronic acid is found in the umbilical cord, synovial fluid and vitreous humour. It has a lubricating action. In tissues it forms an important part of the cementing ground substance.

The sugars are also classified as reducing and non-reducing sugar. The reducing property is attributed to the free aldehyde or keto group.

They may also be classified as available and unavailable carbohydrates.

Available carbohydrates: carbohydrates which can be digested in the human body and yield energy when they are oxidized in the body.

Unavailable carbohydrates: carbohydrates which cannot be digested because the human body does not contain the enzymes necessary for their breakdown. Unavailable carbohydrates do not provide any energy to the body but are necessary as they perform some important functions in the body such as elimination of faecal waste

Dietary Sources:

Daily diet should provide up to 50–70 percent kcal of energy from carbohydrate. Carbohydrates are not only an economical source of energy but are also readily available and easy to store as

they have a long shelf life. The important sources of carbohydrates in the diets of Indians are cereals and millets, roots, tubers, pulses, sugar and jaggery. All sugars provide 4 kcal/g of energy. The carbohydrate and calorie content of a food can be reduced by using sugars which are sweeter than sucrose so that the quantity of sugar required will be less.

Functions:

- The chief function of carbohydrate is to provide energy to the body so that it can carry out day to day work to maintain body temperature. All carbohydrates except fibre provide 4 kcal/g of energy. It is the cheapest source of energy available.
- Glucose is the only form of energy used by the central nervous system. When blood glucose levels fall, the brain does not receive energy and convulsions may occur.
- Carbohydrates spare proteins from being broken down for energy and are used for body building and repair. In carbohydrate deficient diets, proteins meant for body building and repair are oxidised to meet the most important and primary need of the body, i.e., energy.
- They are required for complete oxidation of fat. In the deficiency, fats are broken down rapidly for energy and intermediate product such as ketones are formed in large amounts resulting in a condition called ketosis.
- Carbohydrates can be converted into non essential amino acids, provided a source of nitrogen is available.
- The sugar lactose helps in the absorption of minerals calcium and phosphorus.
- Lactose helps certain bacteria to grow in the intestine. This bacterial flora is capable of synthesizing B complex vitamins in the gut
- Dietary fibre plays an important role of increasing faecal mass by absorbing and holding water, stimulating peristalsis, and eliminating faecal waste.
- Fibre also helps in lowering blood cholesterol levels by binding bile acids and cholesterol.

RDAs:

Table 4: RDA (2020) for Carbohydrate

Age Group	Category Of Work	Body Weight (kg)	Carbohydrate (g/d)
Men	Sedentary	65	130
	Moderate		

	Heavy		
Women	Sedentary	55	130
	Moderate		
	Heavy		
	Pregnant	55+10	175
	Lactation (0-6m)		200
	Lactation (7-12m)		200
Infant	0-6m	5.8	55
	6-12m	8.5	95
Children	1-3y	11.7	130
	4-6y	18.3	130
	7-9y	25.3	130
Boys	10-12y	34.9	130
Girls	10-12y	36.4	130
Boys	13-15y	50.5	130
Girls	13-15y	49.6	130
Boys	16-18y	64.4	130
Girls	16-18y	55.7	130

*AI

Deficiency:

The daily diet should not contain less than 100gram of carbohydrate. A deficiency of carbohydrate in the diet results in utilization of fat for energy. In severe deficiency, incomplete oxidation of fats causes ketone bodies to accumulate in the blood.

Excess:

- Excessive consumption of refined sugars could be one of the causes of dental caries or tooth decay.
- Excessive sugar depresses the appetite, provides hollow calories, and could result in malnutrition.
- High intake of sugar and refined carbohydrates increase the blood triglyceride levels leading to heart diseases.

- When excessive carbohydrates are consumed, they are converted into fat and deposited in the adipose tissue, which could lead to obesity, i.e., body weight of 20 per cent or more than the desirable weight.
- Excessive fibre could irritate the intestinal lining, causing cramps or bloating due to gas formation.
- Excessive fibre interferes with the absorption and availability of minerals elements such as iron and calcium

[II] LIPIDS:

Definition: Lipids consists of group of compounds containing fats and oils, which are insoluble in water but soluble in fat solvents. Similar to carbohydrates, they are mainly made up of carbon, hydrogen and oxygen. They contain much smaller proportions of oxygen than carbohydrates and larger proportions of carbon and hydrogen. They are more concentrated source of energy, providing two and a quarter times more energy than carbohydrates and proteins. The lipids of importance to our health are fatty acid, fats, oil, phospholipids, lipoproteins, and sterols.

Classification:

- A. **Classification Based On Structure:** Based on their structure lipids are classified into simple lipids, compound lipids, derived lipids, sterols
 - i. **Simple lipids:** They constitute more than 98 per cent of food and body fats. Simple lipids are made up of three fatty acids attached to glycerol. They are mixed triglycerides which means that more than one type of fatty acid is present in the fat, e.g., cooking oils and butter.
 - ii. **Compound lipids:** They are fats in which at least one fatty acids is replaced by carbohydrates, protein, or phosphorous, i.e., they are fats + non fat molecules, e.g., phospholipids, glycolipids, and lipoprotein.
 - iv. **Derived lipids:** They are the breakdown products of fats and include diglycerides, monoglycerides, glycerol and fatty acids.
 - v. **Sterols:** They are not made up of fatty acids and glycerol but have a benzene ring structure. These fat like substances include cholesterol and fat soluble vitamin A, D, E, K.

Fatty Acids: Fatty acids consist of chain of carbon atoms with a methyl (CH₃) group at one end and a carboxyl (COOH) group at the other end. Fatty acids may have short chains or they may have long chains (12-22 carbon chains). They may be saturated or unsaturated. Saturated fats have single bonds between carbon atoms, while unsaturated fats have one or more double bonds between the carbon atoms. Fatty acids with two or more double bonds are called polyunsaturated.

Fatty acids are classified as saturated fatty acids and unsaturated fatty acids. Unsaturated fatty acids are further classified as monounsaturated fatty acids and polyunsaturated fatty acids.

Monounsaturated Fatty Acid: Oleic acid is a monounsaturated fatty acid and has one double bond. It is found in groundnut, olive oil, corn oil, etc. It may help lower blood cholesterol levels. It is an omega-9 fatty acid.

Polyunsaturated Fatty Acid: The polyunsaturated fatty acids are those with two or more double bonds. They include linoleic acid (two double bonds) linolenic acid (three double bonds), and arachidonic acid (four double bonds). They help in lowering blood cholesterol levels and prevent atherosclerosis and coronary heart disease.

Essential Fatty Acids: Two of the PUFA cannot be synthesized by the body. They have to be provided in the required amount by our diet and are called essential fatty acids. They are linoleic acid (an omega-6 fatty acid), and linolenic acid (an omega-3 fatty acid). Omega is the last letter of the Greek alphabet used by scientist for naming fatty acids.

Omega-6 Fatty Acids: Omega-6 fatty acids have the last double bond located on the sixth carbon from the methyl or omega end. Essential fatty acid linoleic acid (18:2 omega 6) and arachidonic acid (20:4 omega 6) are omega-6 fatty acids. And are present in number of foods. Omega-6 rich oils include safflower, sunflower, cottonseed, corn, sesame, and groundnut. When consumption of omega-6 goes up, need for omega-3 increases. Omega-3 and omega-6 in the correct ratio helps in reducing blood cholesterol levels.

Saturated Fatty Acids: These are found in animal food such as meat, butter, cheese, and egg yolk and in plant food such as coconut oil, palm oil, and cocoa butter. Hydrogenated fats used in bakery products and confectionaries have high percentage of saturated fatty acids. Stearic acid, palmitic acid, myristic acid and butyric acid are some of the saturated fatty acids. A maximum 10 percent of our total calories should come from saturated fats

Phospholipids:They are composed of fats, phosphoric acid, and a nitrogenous base, e.g., lecithin and cephalins.They are required for cell permeability and for the formation of brain and nervous tissue.They help in transporting fats throughout the body as they form a part of the lipoproteins.

Glycolipids:They contain glucose or galactose in place of one of the fatty acids in the triglyceride.

Lipoproteins:They include chylomicrons, very low-density lipoproteins (VLDL), low density lipoproteins (LDL), and high-density lipoprotein (HDL).They are composed of lipids (triglycerides, cholesterol, and phospholipids) and proteins in varying proportions with percentage of proteins being least in chylomicrons and most in HDL.Lipoproteins are required for transporting triglycerides to various tissues in the body via blood circulation.Triglycerides are encased by a covering of water-soluble proteins which help them to circulate in water-based blood. These lipid protein complexes are called lipoproteins.Since LDL are the main carriers of cholesterol, and increase in LDL increases the risk of heart disease. High density lipoproteins help in lowering cholesterol levels. An LDL/HDL ratio of less than 3 is desirable.

Cholesterol:It is a fat like substance present in food. It is different in structure from triglycerides, as it has a ring structure. It is present in all cells of the body and in large amounts in brain and nerve tissue.Cholesterol if consumed in excess is responsible for disease of the cardiovascular system.The normal blood cholesterol level for adults should be below 200mg/100ml blood.If the diet is deficient in cholesterol, the body can synthesize the required cholesterol.The human gets cholesterol from two sources:

1. Synthesis in the liver
2. Food rich in cholesterol

Dietary Sources:

- A. **Plant Sources:**All oils and oilseeds, such as groundnut, sesame, soya bean, rice bran, coconut, almond, cashew nut, corn, safflower, sunflower, and all hydrogenated fats and margarine are sources of lipids.
- B. **Animal Sources:**Mutton, pork, fish, poultry, milk and milk products (butter, cream, yoghurt, cheese), eggs. And organ meat are rich sources of lipids.

C. **Invisible Sources:** Invisible sources of fats are nuts, salad dressings, flesh food, desserts, cookies, cakes, milk, eggs, milk based sweets etc., which are rich in fat, but fat is not visible.

Table 5a- Fatty acid and their food sources.

Fatty Acid	Number Of Carbon Atoms	Number Of Double Bonds	Food Sources
Oleic Acid	18	1	Groundnuts, Sesame, Olives, Butter, Cocoa Butter, Cashew Nuts, Avocado.
Linoleic Acid	18	2	Safflower, Sunflower, Cottonseed, Corn, Soyabean, Groundnut, Salmon, Tuna.
Linolenic Acid	18	3	Soya Bean, Rapeseed, Sesame, Butter.
Arachidonic Acid	20	4	Animal Fats, Groundnut.
Eicosapentaenoic Acid	20	5	Fish Oils.
Erucic Acid	22	1	Rapeseed Oil/ Mustard Oil.

Table 5b- Fatty acid and their food sources.

Fatty Acid	Number Of Carbon Atoms	Food Source
Acetic Acid	2	Vinegar
Butyric Acid	4	Butter
Caproic Acid	6	Butter
Caprylic Acid	8	Coconut, Palm Kernel
Lauric Acid	12	Palm Kernel, Coconut
Myristic Acid	14	Coconut, Butter
Palmitic Acid	16	Palm, Soya, Sesame, Butter, Lard, Cotton Seed
Stearic Acid	18	Beef Tallow. Cocoa Butter, Lard

Table 5c- Cholesterol content in different food sources.

Food	Cholesterol (Mg)	Food	Cholesterol (Mg)
Beef	109	Mutton	70
Lard	95	Beef	70
Butter	250	Pork	70
Processed Cheese	150	Chicken With Skin	80
Paneer	19	Liver	300
Ice Cream	40	Brain	2000

Whole Milk	14	Fish	60
Skimmed Milk	2	Shellfish	150
Mawa Based Sweets	65	Vanaspati	0
Egg White (1 Egg)	0	Margarine (Veg Fat)	0
Egg Yolk (1 Egg)	252	All Plant Foods	0

Cholesterol is present in animal body only. Whole milk, butter, ghee, cream, egg yolk, organ meat, and shellfish are rich sources. Cholesterol is also synthesized by the body independent of the dietary intake. It is a precursor of all steroid hormones, e.g., sex hormones. A precursor of vitamin D, 7-dehydrocholesterol is present in the skin which is irradiated by ultraviolet (UV) rays of sunlight to form vitamin D. It is required for formation of bile and is an essential constituent of cell membrane.

Functions:

1. **Energy:** Fats are concentrated source of energy in our diet. One gram of fat/oil gives 9kcal when it is oxidized in the body. All tissues, except those of the central nervous system and brain, can utilize fat as a source of energy.
2. **Protein Sparing Action:** The kilocalories from fat spare dietary proteins from being oxidized for energy. An adequate intake of fat in the diet allows protein to perform their main function of growth and maintenance.
3. **Thermal Insulation:** Subcutaneous fats acts as an insulation and helps in retaining body heat.
4. **Absorption of Fat-Soluble Vitamins:** Fat is necessary for the absorption of fat-soluble vitamins A, D, E, and K.
5. **Protection of Vital Organs:** Fat provides a protective padding to vital organs from mechanical shock and keeps them in place.
6. **Essential Fatty Acids:** An adequate intake of fats /oils is necessary to meet the body's requirement for linoleic and linolenic acids.
7. **Satiety Value:** Fats slow down the secretion of gastric juice and speed of digestion. Food is more flavoursome because of volatile essential oils naturally present in fats used for cooking. A well-cooked meal containing fats is more satisfying than a meal devoid of fats.
8. **Synthesis of Cell Membrane:** Fats are an important constituent of all cell membranes.

9. **Synthesis of Hormones:**The lipid cholesterol is necessary for the synthesis of some hormones, e.g., sex hormones.

RDAs:

Table 6: EAR values for Indians of Fats-(2020)

Age Group	Category Of Work	Body Weight (kg)	Fats/Oils (visible)(g/d) (#)
Men	Sedentary	65	25
	Moderate		30
	Heavy		40
Women	Sedentary	55	20
	Moderate		25
	Heavy		30
	Pregnant	55+10	30
	Lactation (0-6m)		30
	Lactation (7-12m)		30
Infant	0-6m	5.8	-
	6-12m	8.5	25
Children	1-3y	11.7	25
	4-6y	18.3	25
	7-9y	25.3	30
Boys	10-12y	34.9	35
Girls	10-12y	36.4	45
Boys	13-15y	50.5	50
Girls	13-15y	49.6	35
Boys	16-18y	64.4	40
Girls	16-18y	55.7	35

#: Visible fat requirement is in proportion to EER

Fat should contribute not more than 30 per cent of the total kilocalories. Kilocalories from the saturated fat should not exceed 10 percent of the total calories and at least 10 percent calories should be provided by PUFA to ensure an adequate intake of essential fatty acid. The correct ratio of omega-3 to omega-6 fatty acids should be maintained.

The cholesterol intake should not exceed 200 mg/day. A variety of cooking oils should be used everyday to ensure consumption of all essential fatty acids. Non vegetarians should eat groundnut, corn, soya, and olive oil throughout the year, while for fish eaters a mixture of safflower and sunflower oil is adequate. Rice bran oil and corn oil is recommended for vegetarians.

Deficiency:

- ❖ A deficiency of fat causes a deficiency of essential fatty acids, linoleic and linolenic acids and subsequently a deficiency of arachidonic acid.
- ❖ These (PUFA) are required for healthy cell membranes and their permeability. A deficiency results in characteristic eczema and skin lesions. It is seen in infants as dry scaly lesions on the skin. Toad skin or dry papules are seen on upper limbs.
- ❖ A deficiency of fat may result in a deficiency of fat-soluble vitamins, and growth and weight may be affected in children.
- ❖ Fat is present in minute quantities in almost all foods including cereals and pulses, a deficiency in adults is unlikely because these foods are consumed in large quantities.

Excess:

- ❖ The percentage consumption of fat varies widely in different regions and in different income groups. The percentage consumption increases directly with incomes, and today it is a major problem faced in urban areas and changing lifestyles.
- ❖ Excess intake of fat causes obesity because more kilocalories are consumed than required by the body. Excess fat is stored in the adipose tissue.
- ❖ Excessive consumption of saturated fats can elevate blood cholesterol levels. A high intake of saturated fats and cholesterol are predisposing factors for cardiovascular diseases, while foods rich in omega-3 fatty acids have a protective effect.

[III] PROTEINS:

Definition: Proteins are large, complex, organic compounds made up of carbon hydrogen, oxygen and nitrogen. Apart from nitrogen, elements such as sulphur, phosphorus, copper, and iron are also found in some proteins.

The basic units from which proteins are built are the amino acids. Each amino acid contains a carboxyl group (COOH) or acid group and an amino group (NH₂) or basic group. Proteins consist of chain of amino acids that are linked to each other by a peptide linkage (-CO-NH-)

Amino Acids: Twenty two different amino acids are widely distributed in nature.

Essential Amino Acids: Those amino acids which cannot be synthesized in sufficient amounts by the body and must be provided by the diet are called essential amino acids. The human adult requires eight essential amino acids, while growing children require ten essential amino acids. Essential amino acids are indispensable to life.

Non-Essential Amino Acids: All amino acids are required by the body for tissue synthesis and repair. Non-essential amino acids do not mean that these amino acids are not required by the body. They are termed non-essential because they are not dietary essentials. If they are lacking in the diet, they can be synthesized by the body from other amino acids. Innumerable proteins can be formed by using the 22 amino acids in varying sequences and quantities.

Classification:

Proteins may be classified on the basis of their structure or on the basis of their quality, i.e., the amino acids present in them.

1. Classification By Structure

- ❖ **Simple Proteins:** These proteins are made up of amino acids only, e.g., zein in corn, albumin in egg white, and gliadin in wheat consist of amino acids only
- ❖ **Conjugated Proteins:** These proteins have a non protein molecule attached to the protein, e.g., blood protein haemoglobin, which contains a haeme (iron) group attached to protein and milk protein casein, which has a phosphate group attached.
- ❖ **Derived Protein:** These result from a partial breakdown of a native protein. Proteoses, peptones, and polypeptides are formed when digestive enzymes bring their action on proteins.

2. Classification By Quality: Proteins are classified into three groups on the basis of their quality.

- ❖ **Complete Proteins:** These proteins contain all essential amino acids in sufficient proportions and amounts to meet the body's need for growth and repair of tissue cells.

A complete protein food has a high biological value. Eggs, Milk, Meat, fish, and poultry are complete protein foods. They are found in animal foods

- ❖ **Partially Complete Proteins:** These are proteins in which one or more essential amino acids are present in inadequate amounts. They cannot synthesize tissues without the help of other proteins. The value of each is increased when it is consumed in combination with another complete protein at the same meal. Cereals, pulses, nut, and oilseeds are partially complete protein foods. Cereals contain inadequate amounts of essential amino acid lysine, and pulses are deficient in essential amino acid methionine.
- ❖ **Incomplete Proteins:** These proteins are incapable of growth and repair of body cells. One or more essential amino acids may be completely lacking in these proteins, e.g., gelatin and zein in corn. Gelatin lacks three essential amino acids and is the only animal protein which is incomplete.

Dietary Sources: Proteins are present in both plant and animal foods

Animal Food Sources: Animal food sources provide the highest quality or complete proteins such as eggs, milk and milk products (cheese, paneer, mawa, milk powder, curds, condensed milk), meat, fish, shellfish, poultry, and organ meat.

Plant Food Sources: Pulses especially, soya bean (43% protein) and its products such as soya milk, tofu, textured vegetable proteins; nuts, and oilseeds- groundnut and gingelly seeds are important sources of protein in the Indian diet.

Cereals contain 6-12 % partially complete proteins and as they form the bulk of the diet, they contribute significantly to the protein content. Vegetables, with the exception of peas and beans, are poor sources of proteins. Green leafy vegetables contain a small percentage of good quality protein (1-3%). Fruits do not contribute towards the protein content of the diet

Special Protein Supplements:

1. Special protein supplements in the form of premix powders or ready to consume health drinks are available in a variety of popular flavours and different nutrient composition.
2. They are used by sportspersons for minimizing muscle catabolism, boosting energy and muscle growth and stimulating greater fat loss.
3. Protein supplements are available in the form of pure protein isolates, weight gainers or as meal replacements.

4. The protein, carbohydrate and fat content varies in these supplements depending on what they are being recommended for.
5. The following proteins are used:
 - Whey protein concentrate
 - Complete milk protein
 - Micellar casein
 - Soya protein isolate

Functions: Proteins perform three main functions: structural function, regulatory function, and energy.

1. Structural Functions:

A. **Growth:** The primary function of food protein is the synthesis of body cells. All body tissue and fluids, except urine and bile, are made up of protein. Protein are the major constituent of muscles, organs, endocrine glands, and collagen. Collagen is the main structural protein of bones, tendons, ligaments, skin, blood vessels, and connective tissue. All enzymes and some hormones, e.g., insulin are made up of proteins. Proteins are required for the formation and growth of all these substances. During periods of rapid growth, additional proteins are needed for synthesis of body components.

B. **Maintenance Or Wear and Tear:** Protein is required by all age groups for continuous maintenance of all the cells in the body. Cells have a varying lifespan and proteins are needed to replace the old or worn out cell.

2. Regulatory Functions:

- ❖ All amino acids from food protein are used for growth and maintenance. Certain amino acids and protein have highly specialized functions in the regulation of body processes and protection against disease. Some of the regulatory functions are as follows:
- ❖ Haemoglobin, an iron containing protein in the red blood cells, perform an important role by transporting oxygen to the tissue cells.
- ❖ Plasma proteins maintain water balance and regulate the osmotic pressure in the body.
- ❖ Antibiotics that are protein in nature perform a protective function by increasing the body's resistance to disease.

- ❖ The hormone insulin regulates blood sugar levels. Enzymes act as specific catalyst to metabolic processes in the body.
- ❖ Some amino acids have specific functions, e.g., tryptophan serves as a precursor for niacin, a B complex vitamin. The amino acid tyrosine in combination with iodine forms the hormone thyroxine.

3. Providing Energy:

- ❖ Like carbohydrates, proteins too provide 4 kcal/g when broken down in the body. The basic need of the body is energy and takes priority over protein synthesis.
- ❖ If the diet does not supply adequate calories from carbohydrates and fats, the proteins from the diet will be oxidized to meet the energy needs of the body.
- ❖ If the diet is deficient in calories, the body uses up its protein and fat stores. Using protein as a source of energy is not advisable as it puts an extra burden on the body and the pocket.
- ❖ Protein is used by the body as a source of energy only when no other source of energy is available.

RDAs:

Table 7: Summary of recommended protein requirements for Indians 2020.

		Body weight (kg)	EAR (g/kg/d)	RDA (g/kg/d)	EAR (g/d)	RDA (g/d)
Adult Men	Sedentary	65	0.66	0.83	42.9	54.0
	Moderate					
	Heavy Work					
Adult Women	Sedentary	55	0.66	0.83	36.3	45.7
	Moderate					
	Heavy Work					
Pregnant Women	2nd Trimester				+7.6	+9.5
	3rd Trimester				+17.6	+22.0
Lactating Women	0-6 months				+13.6	+16.9
	6-12 months				+10.6	+13.2
Infants	0-6 months	5.8	1.16	1.40	6.7	8.1
	6-12 months	8.5	1.04	1.23	8.8	10.5
Children	1-3y	12.9	0.79	0.97	10.2	12.5
	4-6y	18.3	0.70	0.87	12.8	15.9
	7-9y	25.3	0.75	0.92	19.0	23.3
Boys	10-12y	34.9	0.75	0.91	26.2	31.8
Girls	10-12y	36.4	0.73	0.90	26.6	32.8
Boys	13-15y	50.5	0.72	0.89	36.4	44.9
Girls	13-15y	49.6	0.70	0.87	34.7	43.2
Boys	16-18y	64.4	0.70	0.86	45.1	55.4
Girls	16-18y	55.7	0.67	0.83	37.3	46.2

For people consuming cereal-based diet with low quality protein, the protein requirements are 1 g/kg per day
Note: The cereal-legume-milk composition of the diet should be 3:1:2.5 for good protein quality.

Deficiency:

- ❖ A reduced intake of protein over a prolonged period of time leads to loss of weight, fatigue, anaemia, nutritional oedema, lowered resistance to infection, and poor healing of wounds.
- ❖ Protein deficiency is more marked during periods when protein needs are more, e.g., during infancy, childhood, pregnancy and lactation.
- ❖ The deficiency occurs when an individual does not eat enough proteins or obtains insufficient calories.
- ❖ Protein calorie malnutrition (PCM) is common in pre school children in developing countries and manifest itself in the form of kwashiorkor, a deficiency of protein or marasmus, a deficiency of calories as well as protein, which is equal to starvation in adults.
- ❖ Protein deficiency is also seen in people who follow a crash diet for weight loss. It can be prevented by including correct mixture of inexpensive protein rich foods in the diet.

Excess:

- ❖ An excessive intake of protein is not beneficial for health. When the diet provides more protein than what is necessary for body building, repair, and regulatory functions, the excess protein is used as energy or converted to fat and stored in the adipose tissue in the body.
- ❖ A high protein intake has many disadvantages:
 1. Once the body needs have been taken care of, the excess protein is determined by the liver and urea is synthesized. The kidneys have to work more to excrete the additional amount of urea. A high protein intake is an unnecessary burden on two vital organs, i.e. the liver and the kidneys. If these organs are diseased, toxic waste tend to accumulate in the body.
 2. When animal proteins, such as meat, poultry, and whole milk products, forma substantial part of the high protein diet, there is risk of high blood levels of cholesterol.
 3. A high intake of protein increases the loss of calcium through the urine.
 4. Protein rich foods are much costlier, are in short supply and are not an economical source.

UNIT: IX VITAMINS

INTRODUCTION: Students you all must be well aware with the fact that our body requires various kinds of macro as well as micro nutrients for sustaining our life. Vitamins are one such nutrient that is needed in minute quantities by our body.

VITAMINS: Vitamins are complex organic compounds, and are present in minute amounts in natural food stuffs. The term vitamin was coined from the words “VITAL AMINE”, as early scientist felt these chemicals, which are vital for life, were amines.

Vitamins were discovered one at a time from 1900 to 1950, some as a cure for classic disease such as **beriberi, pellagra, and scurvy**, while others were discovered after research on various body functions.

DEFINITION: Vitamins is the term used for a group of potent organic compounds other than proteins, carbohydrates and fats which occur in minute quantities in food and which are essential for some specific body functions such as regulation, maintenance, growth, and protection. Many of them cannot be synthesized, at least in adequate amounts, by the body and must be obtained from the diet.

‘An organic substance that occurs in foods in small amounts and is necessary for normal metabolic functioning of the body’. “VITAMIN” means “vital for life”.

Vitamins are organic substances present in small amounts in food. They do not contribute directly to the structure of the body, nor do they supply energy. They regulate metabolism by releasing energy from fats and carbohydrates. They are required for carrying out vital functions of the body. They are involved in amino acid metabolism and also assist in forming blood, bones and tissues. Though needed in small amounts, they are essential for health and well-being of the body. Vitamins were discovered based on their function and chemical nature and were designated as A, B, C, D.

They are generally susceptible to change in structure and stability when the environmental conditions are not favorable. Losses of vitamins may take place during processing, handling, packaging, exposure to heat, pH, presence or absence of oxygen and cooking. In our body

system, they act as co-enzymes and pre-cursors of many vital reactions, antioxidants against free-radicals and are very essential for overall health. When the body is deficient in one or more vitamins they lead to diseases.

Thirteen vitamins are recognized in human nutrition and these may be conveniently classified into two major categories on the basis of criteria of solubility, i.e.:

- a) Fat Soluble Vitamins- A, D, E & K.
- b) Water Soluble Vitamins- B-Complex & C (Fig.1)

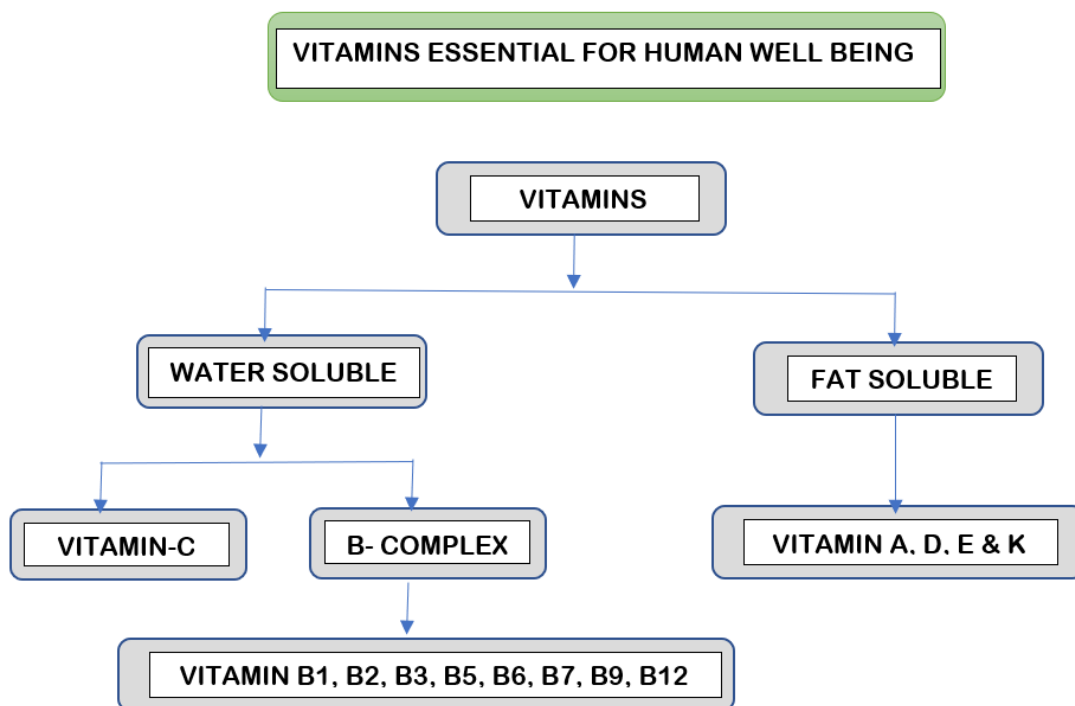


Fig. 1: Classification of Vitamins.

A. FAT SOLUBLE VITAMINS: They occur in nature in association with lipids and their absorption is known to take place in the presence of dietary fats. The conditions which are observed favorable to fat absorption are considered to be favorable for the absorption of fat soluble vitamins also. Fat-soluble vitamins can be stored in appreciable amounts in the body due to their lipid nature and are excreted in the feces via the bile.

(1) VITAMIN A- Vitamin A is a generic term used for a large number of related compounds such as **retinol** and **retinal** which are often referred to as preformed vitamin A. It was discovered in 1909 by McCullum and Davis. Vitamin A is required for the maintenance of normal vision.

Retinol as well as retinal can be inter-converted. Other most important compounds of vitamin A family are retinyl esters and β - carotene. Carotenoids are the major precursors of vitamin A and are structurally associated with β -carotene.

1.1 Functions of Vitamin A:

1. Vision – it facilitates vision in dim light. Adequate amount of retinol is essential otherwise it results in impaired dark adaptation, normally known as night blindness.

2. Immunity- it is also known as anti-infective vitamin. The skin and mucosal cells which line the digestive and urinary tract functions as a barrier to form body's first line of defense against infection. Retinol and its metabolites are much needed for maintaining the integrity and function of those cell lines.

3. Growth and development- both retinol and retinoic acid are very essential for embryonic development.

4. Cell differentiation & gene expression– the differentiation of immature bone cells into several types of mature cells is a very important process, highly dependent on vitamin A.

5. Reproduction– vitamin A is considered to be very essential during pregnancy as evidenced in recent years. Serum retinol concentration, 20 μ g/dl was found to be associated with preterm delivery.

1.2 Sources of Vitamin A

Vitamin A has been estimated to possess different potencies which vary with dietary sources. For instance-carotene is less easily absorbed than retinol and needs to be converted to retinal. Free retinol is not generally found in food. Retinyl palmitate is a precursor and is the major storage form of retinol which is exclusively found in foods of animal origin. Yellow orange and green coloured vegetables and fruits contains significant quantities of Vitamin A. Cod liver oil, eggs, butter, milk, sweet potato, carrot, papaya, mango, spinach and broccoli are considered as the good sources.

1.3 Deficiency of Vitamin A

Maintenance of normal vision is the unique function of vitamin A. Night blindness is one of the specific manifestations of this deficiency. Untreated cases would progress towards the development of bitot's spots, corneal ulceration, keratomalacia and development of corneal scar and it is non-reversible. Deficiency of vitamin A affects growth and development as it impairs skeletal growth. Severe deficiency could have adverse effect on fetal growth and development.

Sterility in males is a common problem seen as a consequence of degeneration of germinal epithelium. Both specific and non specific protective mechanisms are known to be adversely affected which tends to increase the individuals susceptibility to develop infections.

1.4 Toxicity of Vitamin A

The major symptoms include head ache, drowsiness, nausea, loss of hair, dry skin, reabsorption of bone are the major problems encountered among adults. Among infants it results in scaly dermatitis, loss of weight, anorexia, hyper irritability and skeletal pain. These symptoms are observed when the dose exceeds more than 8000 RE/day which when taken for more than 30 days.

1.5 RDA of Vitamin A

ICMR has recommended an intake of 4800 μg β -carotene for both adult man and woman. During pregnancy extra allowances are needed to support fetal growth and is estimated to be about 6400 μg . During lactation it is 7600 μg . For children between the age group of 1-6 years and 7-9 years it is suggested to consume about 3200 μg and 4800 μg /day of β -carotene.

(2) VITAMIN D: Vitamin D is commonly known as a sunshine vitamin since it is synthesized in the skin when exposed to sun light. It was discovered by Sir Edward Mellanby in 1918 who identified the antirachitic properties of vitamin D. This vitamin exists in two forms; vitamin D₃ also known as cholecalciferol which is found in foods of animal origin. The other form is vitamin D₂ referred to as ergocalciferol and is widely distributed among plant substances. Available scientific evidences have suggested that exposing hand and face for about 15 minutes a day for at least three times a week is considered to be sufficient to synthesize vitamin D in the body.

2.1 Functions of Vitamin D

The most important metabolite of vitamin D which has physiological significance is 1, 25-dihydroxy vitamin D. It has the ability to enhance the level of calcium binding protein in the small intestine thus helps in the absorption of dietary calcium and phosphorus. Mobilization of

calcium and phosphorus in association with parathyroid hormone occurs in the bone due to vitamin D. In the kidney vitamin D promotes reabsorption of calcium. 1, 25-dihydroxy is not directly involved in bone mineralization process, but it exerts significant amount on osteoblasts and these in turn would help for proper mineralization. Vitamin D is also involved in the regulation of specific gene activity. This mainly occurs through the binding at specific regions in the DNA.

2.2 Sources of Vitamin D

Vitamin D is naturally synthesized by exposing the skin to sun light. Most foods have negligible amounts of vitamin D. marine fishes are the good source. Egg yolk and butter milk are the poor sources. Cod liver oil is one of the richest sources having the highest concentration of 100000 IU/100g.

2.3 Deficiency of Vitamin D

The common manifestations include rickets and osteomalacia. Rickets is usually seen among children between the ages of 1 and 3 years. The pronounced effect is seen during pubertal stage. Occurrence of osteomalacia is associated with multiple parity. Osteoporosis is an age-related problem and is often accompanied by osteomalacia. Deficiency is very common in Indian subcontinent. Practice of purdah, living in improperly ventilated crowded houses.

2.4 Toxicity of Vitamin D

An intake of 100µg of vitamin D causes hypercalcemia in children. Among adults, consistently higher amounts of intake in the range of 25,000 – 60000 IU/day for 1-4 months would cause hypercalcemia. Common symptoms observed are loss of appetite, nausea, weight loss and failure to thrive. Hyper vitaminosis occurs when the serum concentration of 25 (OH) D (25, hydroxyl vitamin D) exceeds 700-1600nmol/l. Over exposure to sunlight does not cause toxicity.

(3) VITAMIN E: Vitamin E was basically discovered and characterized as a fat-soluble nutritional factor essential for normal reproductive processes. This specific role of vitamin E was found out in the course of carrying out reproductive studies with rats. In the year 1922 it was demonstrated that to prevent fetal death and sterility in rats an important fat-soluble dietary constituent was identified to play a vital role in this regard. Initially this was termed as “factor X’ and was also been referred to as “antisterility factor”. Later the name vitamin E was assigned. During the year 1936 it was isolated from wheat germ oil which was termed as tocopherol which is derived from the Greek word tokos and pherein. The term vitamin E is often used to denote a

mixture of biologically active tocopherols. There are totally 4 tocopherol compounds namely α , β , γ and δ tocopherol. About 4 types of tocotrienols have also been discovered. α - tocopherol is most abundantly available in nature and has been shown to possess highest biological activity and also has a vital role in reversing vitamin E deficiency symptoms among humans. In the year 1950s it was rediscovered that, vitamin E has specific role in cellular antioxidant system along with sulphur amino acid and selenium. Subsequently it was also proven that it is very effective in preventing lipid peroxidation and various other events associated with radical driven oxidative stress.

3.1 Sources of Vitamin E

Vitamin E is synthesized only by plants and hence is primarily found only in plant based foods. Thus, fats and oils of vegetable origin are known to be the richest sources of vitamin E. vegetable oils and oils derived from food grains have been estimated to contain about 50-100mg per 100g of the product. Only 8mg is present in coconut oil. Wheat germ oil is exclusively the rich source of vitamin E containing about 260mg/100g. The chief sources in Indian diets are the vegetable oils, nuts, oil seeds and whole grains. Significant amount of tocotrienols are found in palm oil, rice bran oil and the bran and germ portions of certain cereals like oats, barley and rice. On an average, consuming 20g oil would contribute 10mg of vitamin E. hence; consuming 400g of food grains would have been found to contain 6-8g of fat, out of which 3-4g of vitamin E might be obtained.

Table 1: Total tocopherol content of various vegetable oils.

Type of Vegetable oil	Total tocopherol (mg/100g)
Sunflower	75.82
Corn	48.54
Sesame	29.84
Peanut	29.45
Walnut	23.83
Olive	20.44
Grape Seed	15.3
Rice	7.49

3.2 Functions Vitamin E

1. Antioxidant activity: Due to its antioxidant property vitamin E protects key cell components by neutralizing free radicals before they can cause lipid oxidation or DNA damage. By reducing free radical attack, antioxidants help to break the chain reaction of lipid peroxidation (chain-breaking antioxidant) and they protect the cell membranes by facilitating the processes of lipid repair and lipid replacement. Through this mechanism they may prevent cancer or heart disease or any other form of degenerative disorders. A high plasma concentration of vitamin E is associated with lower risk of cardiovascular disease.

2. Role in cardiovascular disease: Supplementary vitamin E was reported to be effective in reducing atherosclerosis progression in subjects with previous coronary artery bypass graft surgery who have not been treated with lipid-lowering drugs

3. Role in cancer Vitamin E is known to induce apoptotic phase mainly via a process mediated through mitochondrial pathway and cell cycle arrest which happens due to the suppression of cyclin D by tocotrienols. Other functions Apart from its antioxidative role, vitamin E takes part in other biological processes also which are as follows;

- Facilitates the maintenance of cell membrane integrity.
- Exerts anti-inflammatory effect mainly by direct and regulatory interaction with the prostaglandin synthetase and complex of enzymes which are mainly involved in the metabolism of arachidonic acid.
- Plays a major role in DNA synthesis.
- Stimulates immune response.
- Regulates intercellular signaling and cell proliferation mainly by modulating protein kinase C activity.

3.3 Deficiency of Vitamin E

Vitamin E deficiency is rarely encountered in humans. Overt deficiency symptoms in normal healthy individuals consuming diets low in vitamin E have never been described. Vitamin E deficiency may occur only as a result of certain genetic conditions such as abnormalities occurring in α -tocopherol transfer protein, fat malabsorption syndromes or in severe protein energy malnutrition.

3.4 Toxicity of Vitamin E

At present there are no reports regarding the adverse effects resulting due to the consumption of vitamin E from natural foods. It is one of the least toxic vitamin. Both humans as well as animals

are capable of tolerating relatively high intake levels of more than 100 times the estimated requirement. At very higher doses, vitamin E is thought to impair the utilization of the fat soluble vitamins in the body. For instance, animals that were supplemented high doses of vitamin E were shown to have developed impaired bone mineralization, impaired storage of hepatic vitamin A and prolonged blood coagulation.

3.5 RDA of Vitamin E

There are very limited data on vitamin E (alpha tocopherol) requirements. Alpha tocopherol content of vegetable oils and invisible fat in cereals and other foods is generally adequate to meet the daily requirement. Requirement is limited to essential fatty acids. Alpha tocopherol requirement is related to its major role in protecting antioxidant property of essential fatty acid content in the diet and the suggested intake is 0.8 mg per g of EFA. This roughly contributes about 8-10 mg tocopherol/d, depending on the type of edible oil used. Vegetable oils and invisible fat from cereals and other foods like nuts and vegetables contributes adequate tocopherol in Indian diets.

(4) VITAMIN K: Vitamin K was the last fat soluble vitamin to be discovered. Vitamin K was appeared to have very limited functional role in humans i.e. its major role in initiating blood clotting mechanism. This vitamin was discovered in 1934 by a Danish scientist Dam. He explored the fact that bleeding in chickens could be prevented by feeding decayed fish meal.

Vitamin K is also referred to as coagulation vitamin, antihemorrhagic vitamin and prothrombin factor. Vitamin K is highly indispensable for maintaining normal blood coagulation system in both humans as well as other experimental animals.

In general, it exists in two forms in nature.

- Vitamin K₁ is widely distributed among plant kingdom and is termed as phylloquinone.
- The other form is K₂ which was isolated from putrid fish and is called as menaquinone.
- The last form is K₃ known as menadione and it is of purely synthetic form. This vitamin can be synthesized by intestinal flora. It is considered as one of the most important nutrients during infancy because intestinal synthesis is insufficient and it needs to be provided externally.

4.1 Functions of Vitamin K

The well-known function of vitamin K is its role in the synthesis of blood clotting factors. Vitamin K is considered as one of the most essential nutrients required for catalyzing the conversion of the precursor of prothrombin to thrombin. In-turn prothrombin in the blood catalyzes the conversion of fibrinogen to fibrin, a factor involved in blood coagulation. The level of prothrombin in the blood is a major determinant of the rate at which the blood will clot. There are mainly two pathways- extrinsic and intrinsic and are thought to have involved in the process of generating prothrombin and thrombin. The clotting process is proposed to be initiated by the absorption of factor XII into collagen which further leads to into activation into XIIa. This in turn cleaves IX and is known to be vitamin K dependent. Once it is carboxylated it binds with calcium and phospholipids and converts X to Xa which is also a vitamin K dependent factor. Further Xa hydrolyzes prothrombin to thrombin. This is the final step which results in the conversion of fibrinogen to fibrin and initiates the clot formation.

4.2 Sources of Vitamin K

Vitamin K is widely distributed in plant foods. Green vegetables are known to contain highest concentration. Dark green leafy vegetables such as kale, parsley and spinach would have been estimated to contain about 300-600 μ g/100g. Broccoli, Brussels sprouts and lettuce are the intermediary sources having about 100-200 μ g/100g. non leafy vegetables such as green beans, cauliflower and cucumber are also considered as significant sources which contains on an average 20-50 μ g/100g. certain vegetables oils such as soy bean, rapeseed and olive oils are known to contain relatively higher amount which ranges from 50-200 μ g/100g. Fermented foods such as cheese are also known to contain considerable amounts. Apart from this intestinal bacterial synthesis is also known to provide significant amount.

4.3 Deficiency of Vitamin K

Deficiency is rare among adults. Primary deficiency normally referred to as neonatal haemorrhage is occasionally seen among infants. This could be mainly due to the fact that infants when they are born their stomach is completely sterile and is free from bacterial contamination. This could become a causative factor for the infants to develop deficiency particularly when they are fed for long periods on cow's and human milk as they are known to contain relatively smaller amounts of vitamin K. Antibiotics, and salicylic acid-based medications are known to intestinal

bacterial flora. Symptoms of deficiency is mainly manifested as prolonged blood coagulation time and increased susceptibility to haemorrhage.

4.4 RDA of Vitamin K

The incidence of deficiency is very rare among Indians and ICMR considered that no such recommendation is needed. A dose of 0.5-1.0mg of vitamin K can be administered intramuscularly to infants suffering from deficiency. The committee on medical aspects of food policy of the United Kingdom declared that an intake of 1µg/kg/day is thought to be safe and adequate for adult age group.

CONCLUSION Adequate intake of fat soluble vitamins is very essential for maintaining normal physiological functions. They could also be consumed as a means of correcting and preventing the disorders resulting due to the deficiency of these vitamins. Foods composed of fat soluble vitamins are widely distributed in nature and a regular intake of such food would help to meet the daily requirement. Since fat soluble vitamins can be stored in appreciable amounts in the body it is safer to consume them at a level designated by the nutrition expert committees in order to prevent the adverse effects.

B) WATER SOLUBLE VITAMINS -Water-soluble vitamins are not accumulated in the body, but are readily excreted. In the case of a deficiency, the clinician should be able to recognize the syndrome caused by a lack of the particular vitamin. In this country of abundant and varied food supply, the individual should instead think in terms of what a specific vitamin does rather than what disease it prevents.

The water-soluble vitamins are chemically different, so are heterogeneous in nature. Since, they are soluble in water, are subjected to subsequent cooking losses. They are readily excreted through urine because of the solubility in water. Their continuous supply is needed by the body

as there no reserved forms in body. They are usually non-toxic. They function as a coenzyme and participates in various metabolic pathways, for eg. Energy metabolism. It is reported that 50-90% of B vitamins are absorbed and only marginal deficiencies are more common. Generally, deficiencies due to water soluble vitamins are multiple rather than individual with overlapping symptoms.

Water-soluble vitamins are members of the B-complex and vitamin C (ascorbic acid). Most of the B-complex group can be further divided according to general function: energy releasing or hematopoietic. Other vitamins cannot be classified this narrowly because of their wide range of functions.

(I) ASCORBIC ACID -Vitamin C, anti-scorbutic factor

(II) B-COMPLEX VITAMIN-

1. THIAMINE -Vitamin B₁(Thiamine), antineuretic factor, anti-beri-beri factor
2. RIBOFLAVIN-Vitamin B₂, Vitamin G, lactoflavin, hepatoflavin, ovoflavin
3. NIACIN-Vitamin B₃, pellagra-preventive factor, Nicotinic acid, Nicotinamide, Niacinamide.
4. PANTOTHENIC ACID -Vitamin B₅, “Anti-Stress vitamin” Its name derives from the Greek word *pantothern* meaning from “everywhere”.
5. PYRIDOXINE-Vitamin B₆, Pyridoxal, Pyridoxamine
6. BIOTIN-Vitamin B₇, Vitamin H, anti-eggwhite injury factor
7. FOLATE-Vitamin B₉, Folic Acid, vitamin M, vitamin Bc, Folacin, Pteroylglutamic acid (PGA)
8. CYANOCOBALAMIN-Vitamin B₁₂ (Cobalamin, anti-pernicious anemia factor)

(I) VITAMIN C: The chemical name for Vitamin C is ascorbic acid. It was discovered in 1747 by demonstrating that citrus fruit juices prevented and cured scurvy. Vitamin C functions in oxidation-reduction reactions and is synthesized from glucose and galactose by plants and most animals. However, humans and other primates, lack the enzyme l-gulonolactone oxidase and thus cannot biosynthesize the factor, which for them consequently is a vitamin.

1.1. Effects of Deficiency: Prolonged deficiency of vitamin-C produces a disease condition called as 'scurvy' in both infants and adults. Scurvy is typically manifested when the total body vitamin-C pools fall below about 300mg and plasma vitamin-C concentrations drop to <0.2mg/dL. Scurvy is fatal if untreated. The four Hs-

hemorrhagic signs, hyperkeratosis of hair follicles, hypochondriasis (psychological manifestation), and hematologic abnormalities (associated with impaired iron absorption)—are often used as a mnemonic device for remembering scurvy signs.

a. Infantile scurvy: There will loss of appetite, failure to gain weight, irritability, palor, defective growth of bones. Haemorrhage occurs under the skin. There will be defective formation of teeth and gums will be swollen (Figure 2a). The ends of the ribs become prominent resulting in beaded appearance called scorbutic rosary.



Scorbutic gums. Unlike other lesions of the mouth, scurvy presents a symmetrical appearance without infection.

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Pinpoint hemorrhages. Small red spots appear in the skin, indicating spontaneous bleeding internally.



Scorbutic Rosary



Follicular Hemorrhages

b. Adult Scurvy:

i. General manifestations are fever, susceptibility to infection, lethargy, fatigue, rheumatic pains in the legs, muscular atrophy and delayed wound healing.

ii. Anaemia: Microcytic hypochromic anaemia develops due to failure of absorption of iron.

iii. Gums become spongy and bleed easily. Gums become swollen, ulcerated and eventual tooth loss.

iv. The blood vessels become fragile and porous due to defective formation of collagen. Joints become swollen and tender.

v. Clinical symptoms appear when total body pool of vitamin-C decreases. Skin becomes rough and dry. There will be small petechial hemorrhages around hair follicles.

(II) B COMPLEX VITAMINS

1. THIAMINE (B₁)

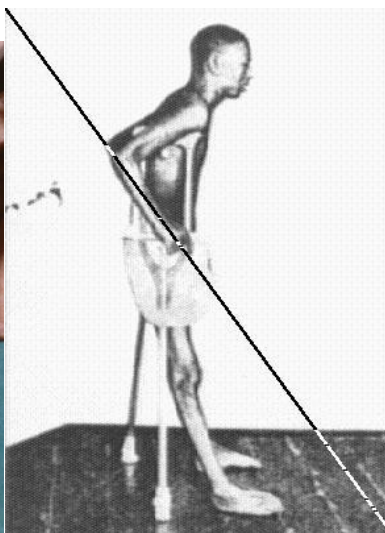
Thiamine is known as Vitamin B₁. Deficiency of thiamine leads to beriberi. This condition is widely prevalent among population whose diet contains more of polished cereals.

1.1. Effects of Deficiency: Deficiency of thiamine is associated with low calorie intake. Severe deficiency of thiamine produces a disease known as beriberi (beri means “weakness”) One of the first symptoms of thiamin deficiency is a loss of appetite (anorexia) and thus weight loss. As the deficiency worsens, cardiovascular system involvement (such as hypertrophy and altered heart rate) and neurological symptoms (such as apathy, confusion, decreased short-term memory, and irritability) appears. There are three types of beriberi

a. Dry beriberi

b. Wet beriberi

c. Acute/Infantile beriberi



a.Dry beriberi: Found predominantly in older adults. Deficiency is of result from a chronic low thiamin intake, especially if coupled with a high carbohydrate intake. Dry beriberi is characterized by muscle weakness and wasting, loss of appetite, tingling numbness and burning sensation in hands and feet. Calf muscles will become tender. Knee and ankle jerks will be sluggish. In later stages complete loss of sensation in hands and legs will occur. It is characterized by foot and waist drop. Mental depression and confusion occurs.

b.Wet beriberi: In this case, there is enlargement of heart and the cardiac output is high. Oedema or accumulation of fluid in legs, face and trunk is observed. Palpitations are marked.

c.Acute/Infantile beriberi: It occurs in first few months of life if the diet of the mother is deficient in thiamine.

Symptoms are anorexia, vomiting, restlessness, sleeplessness, constipation, enlargement of the heart and breathlessness. Thiamin deficiency is often associated with alcoholism. Wernicke's encephalopathy or Wernicke Korsakoff syndrome, a neuropsychological complication, is also commonly found in those with alcoholism and AIDS, and in those receiving parenteral nutrition that is high in dextrose and low or absent in thiamin. People with alcohol dependency are particularly prone to thiamin deficiency because of:

- Decreased intake of the vitamin from decreased food consumption
- Increased requirement for the vitamin because of liver damage
- Decreased thiamin absorption

Wernicke's encephalopathy is characterized by ophthalmoplegia (paralysis of the ocular muscles), nystagmus (constant, involuntary eyeball movement), ataxia (impaired muscle coordination), loss of recent memory and confusion.

2. RIBOFLAVIN (B₂)

Riboflavin or Vitamin B₂ is the yellow enzyme which is heat stable unlike other B Vitamins. Riboflavin in the combined form with proteins form flavo proteins or yellow enzymes.

2.1. Effects of Deficiency: A deficiency of riboflavin, known as ariboflavinosis, rarely occurs in isolation but most often is accompanied by other nutrient deficits. Riboflavin deficiency is prevalent mainly among the low-income groups particularly the vulnerable group and the elderly

adults. Riboflavin deficiency becomes manifest after several months of deprivation of the vitamin.

Riboflavin deficiency is characterized by

- i. Soreness and burning of the mouth and tongue.
- ii. Lesions at the angles of the mouth called Angular Stomatitis (cracks in the skin at the corners of the mouth-Figure 4a).
- iii. The inflammation of the tongue called glossitis
- iv. Dry chapped appearance of the lip with ulcers termed cheilosis.
- v. The skin becomes dry and results in seborrhoeic dermatitis.
- vi. Photophobia, lacrimation, burning sensation of the eyes and visual fatigue.
- vii. Decreased motor co-ordination
- viii. Normocytic anaemia



3. NIACIN

The term niacin (vitamin B₃) is considered a generic term for nicotinic acid and nicotinamide. Niacin is required by all the cells of our body. Like thiamine and riboflavin it plays a vital role in the release of energy from carbohydrates, protein, fat and alcohol. Like thiamin, which was discovered through its deficiency disorder beriberi, niacin was discovered through the condition pellagra in humans and a similar condition, called black tongue, in dogs.

3.1. Effects of Deficiency: Deficiency of niacin causes a disease known as pellagra (Figure 5). It is characterized by three D's - Dermatitis, Diarrhoea and Dementia.

a. Dermatitis—Name pellagra comes from pelle-skin and agra-rough. Marked changes occur in the skin especially in the skin exposed to sun and friction areas like elbows, surfaces of arms, knees. Lesions are symmetrically distributed, in the affected parts. At first there is reddening, thickening and pigmentation of the skin. Later on, there is exfoliation leading to ultimately parchment of skin –butterfly like appearance.

b.Diarrhoea—Diarrhoea enhances the deficiency state. There are structural and absorptive defects in the small intestine. Tongue appears raw, and mucous membrane of the tongue is inflamed. Gastrointestinal manifestations include glossitis, cheilosis, stomatitis, nausea, vomiting, and diarrhea or constipation.

c.Dementia—There is irritability, depression, poor concentration and loss of memory. Delirium is a common mental disturbance.



4. PANTOTHENIC ACID (B₅)

Pantothenic acid consists of β -alanine and pantoic acid joined by a peptide bond/amide linkage. The vitamin was once called vitamin B₅.

4.1. Effects of Deficiency:“Burning feet syndrome” is characterized by numbness of the toes and a sensation of burning in the feet. The condition is exacerbated by warmth and diminished with cold and is thought to result from pantothenic acid deficiency.

Other symptoms of deficiency include vomiting, fatigue, weakness, restlessness, and irritability. Deficiency of pantothenic acid is thought to occur more often in conjunction with multiple nutrient deficiencies, as for example in malnutrition. Some conditions that may increase the need for the vitamin include alcoholism, diabetes mellitus, and inflammatory bowel diseases. Increased excretion of the vitamin has been shown in people with diabetes mellitus.



5. PYRIDOXINE (B₆)

Pyridoxine is unique among B-complex Vitamins in that it functions primarily in protein metabolism. Pyridoxine denotes related substances such as Pyridoxine, Pyridoxal and Pyridoxamine are three forms in which it is present in our body. Pyridoxine represents the alcohol form, pyridoxal the aldehyde form, and pyridoxamine the amine form. Some of the initial research was aimed at correcting dermatitis in rats.

5.1 Effects of Deficiency: Vitamin B₆ deficiency leads to abnormalities in protein metabolism which is manifested as poor growth, convulsions, anaemia, and skin lesions. Severe deficiency leads to microcytic hypochromic anaemia.

Symptoms such as weakness, nervousness, irritability, insomnia and difficulty in walking is predominant.

Deficiency also alters calcium and magnesium metabolism, impairs niacin synthesis from tryptophan, and inhibits metabolism of homocysteine. The last results in hyperhomocysteinemia, a risk factor for heart disease. Groups particularly at risk for vitamin B₆ deficiency are the elderly, who have a poor intake of the vitamin; people who consume excessive amounts of alcohol and people on a variety of drug therapies.

6. BIOTIN (B₇)

Biotin's discovery was based on the research investigating the cause of what was called "egg white injury." Eating raw eggs was known to result in hair loss, dermatitis, and various neuromuscular problems. In 1931 a substance was found (now called biotin) in liver that could

cure and prevent the condition. Biotin was once called vitamin H (the H refers to haut in German and means “skin”) as well as vitamin B₇.

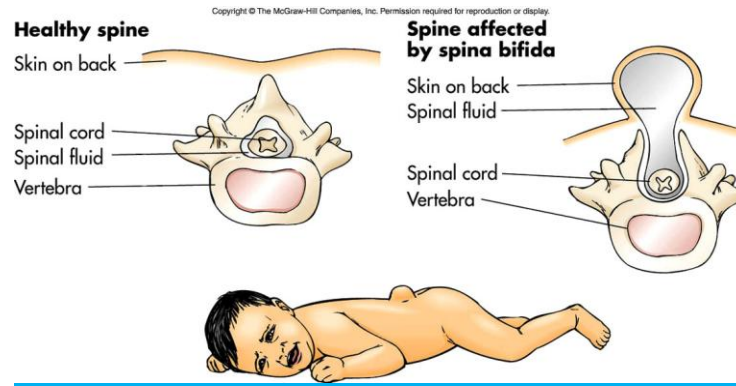
6.1 Effects of Deficiency: Biotin deficiency in humans is characterized by lethargy, depression, hallucinations, muscle pain, paresthesia in extremities, anorexia, nausea, alopecia (hair loss), and scaly, red dermatitis. A diet devoid of biotin can result in decreased plasma biotin and in reduced biotin excretion in about 2-4 weeks.

Biotin deficiency or poor biotin status, though fairly rare, occurs in various populations. People who ingest raw eggs in excess amounts are likely to develop biotin deficiency because of impaired biotin absorption. Impaired biotin absorption also may occur with gastrointestinal disorders such as inflammatory bowel disease and achlorhydria (lack of hydrochloric acid in gastric juices), in people on anticonvulsant drug therapy, or in chronic consumers of excessive amounts of alcohol. Biotin status has been shown to decline in some women during pregnancy.

7. FOLIC ACID (B₉)

Folic acid is the term used to refer to the oxidized form of the vitamin found in fortified foods and in supplements. Folate refers to the reduced form of the vitamin found naturally in foods. The Latin word folium means “leaf,” and the word folate from Italian means “foliage”. Folic acid was first extracted from dark green leafy vegetables. Folate’s and vitamin B₁₂’s discovery resulted from the search to cure the disorder megaloblastic anemia, a problem in the late 1870s and early 1880s. As with many of the other vitamins, eating liver was shown to cure the condition.

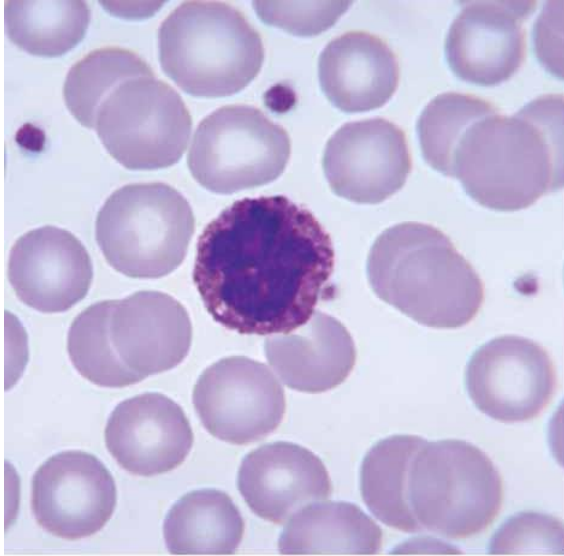
7.1. Effects of Deficiency: Simple folate deficiency results in the bone marrow producing immature cells (megaloblasts cells) and few matured red blood cells. This results in reduced oxygen-carrying capacity causing anaemia termed Megaloblastic anaemia. Folate deficiency during pregnancy causes neural tube disorders of the foetus. Folate deficiency impairs the ability of the immune system to fight infection.



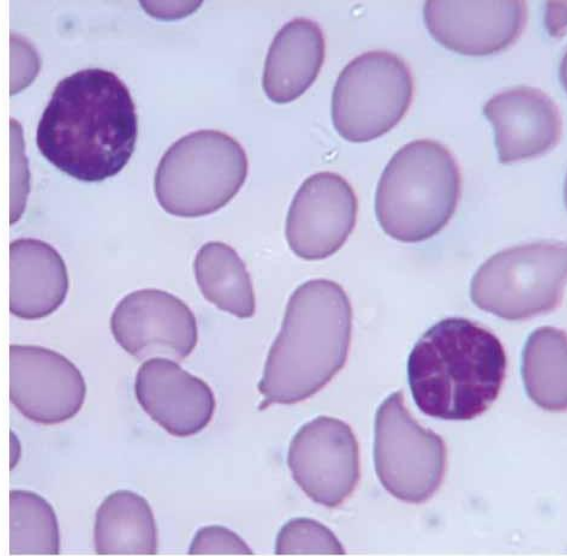
8. CYANOCOBALAMIN (B₁₂)

Vitamin B₁₂, also called Cobalamin, is considered a generic term for a group of compounds called Corrinoids because of their Corrin nucleus. Vitamin B₁₂ was the last vitamin to be discovered. It was isolated in 1940. Eating large amounts of liver could help correct pernicious anemia associated with deficiency of this vitamin. It took about two decades to identify the vitamin in liver.

8.1. Effects of Deficiency: Pernicious anaemia is the major problem arising from an inadequate amount of vitamin B₁₂. Pernicious anaemia is a condition characterized by very large, immature red blood cells with normal amounts of haemoglobin. Most deficiency signs and symptoms are of neurologic and hematologic origin; some signs and symptoms include skin pallor, fatigue, shortness of breath, palpitations, insomnia, tingling and numbness (paresthesia) in extremities, abnormal gait, loss of concentration, memory loss, disorientation, swelling of myelinated fibers, and possibly dementia. Neurological problems occur in about 75% to 90% of deficient people.



Normal blood cells. The size, shape, and color of the red blood cells show that they are normal.



Blood cells in pernicious anemia (megaloblastic). Megaloblastic blood cells are slightly larger than normal red blood cells, and their shapes are irregular.

CONCLUSION Vitamins are required for carrying out vital functions of the body. Though needed in small amounts, they are essential for health and well-being of the body. Vitamins are classified based on their solubility as fat-soluble and water-soluble vitamins. Water-soluble vitamins are members of the B complex and vitamin C.

Deficiency of vitamin-C produces a disease condition called as 'scurvy'. The four Hs—hemorrhagic signs, hyperkeratosis of hair follicles, hypochondriasis, hematologic abnormalities are often used as a mnemonic device for remembering scurvy signs. Deficiency of thiamine leads to beriberi. There are three types of beriberi and they are dry beriberi, wet beriberi and acute/infantile beriberi. A deficiency of riboflavin is known as ariboflavinosis and of niacin is known as pellagra. Pellagra is characterized by three D's -Dermatitis, Diarrhoea and Dementia. Pantothenic acid deficiency leads to Burning feet syndrome and is characterized by numbness of the toes and a sensation of burning in the feet. Vitamin B₆ deficiency leads to abnormalities in protein metabolism and microcytic hypochromic anaemia. Biotin deficiency in humans is characterized by lethargy, depression, hallucinations, muscle pain, paresthesia in extremities, anorexia, nausea, alopecia, and scaly, red dermatitis. Folate deficiency causes Megaloblastic anaemia while, Pernicious anaemia is caused due to vitamin B₁₂ deficiency.

UNIT-X: MINERALS

INTRODUCTION: Later in the nineteenth century, scientists were researching on the lacking nutrients which would be capable of promoting growth and sustaining health. The importance of minerals was not well understood, carbohydrate, fat, protein alone was not sufficient to boost the immunity and maintain good health. Hence, scientists and researchers strived to find out the “missing elements”, namely minerals which were found to be essential for growth and maintenance.

DEFINITION: Minerals are the inorganic substances required for the normal functioning of body processes, including growth, development, water balance and neurological processes.

CLASSIFICATION: Essential minerals are the nutrients which are classified as macro and micronutrients based on the amount needed by humans per day.

Macrominerals are those which are vital to health and that are required in the diet by more than 100mg/day. The essential macrominerals are Calcium, Phosphorous, Magnesium, Sodium, Sulphur, Potassium and Chloride.

Microminerals or trace minerals are those required in the diet less than 20mg per day. Important microminerals of relevance in human nutrition are Iron, Zinc, Copper, Fluoride, Manganese, Chromium, Iodine, Molybdenum and Selenium.

The ultratrace elements without established essentiality for humans, such as Cobalt, arsenic, boron, nickel, vanadium, and silicon, provide a negligible amount of weight.

DISTRIBUTION OF MINERALS IN THE BODY: Minerals represent about 4-5% of body weight, or 2.8 to 3.5 kg in adult women and men, respectively. Approximately 50% of this weight is calcium, and another 25% is phosphorus, existing as phosphates. Almost 99% of the calcium and 70% of the phosphates are found in bones and teeth.

Now, we need to study these minerals thoroughly so as to understand their functions, sources, requirements and deficiency/excess of the minerals.

1. MACROMINERALS PART-I:

1.1. Calcium

Calcium (Ca) is an essential element required for several life processes, representing about 1.5-2% of total body weight, or between ~1,000g in a 60kg human being. Bones and teeth contain about 99% of the body's calcium. The other 1% is distributed in intra- and extracellular fluids.

a. Functions

1. Bone formation: The major mineral ions of the bone is Calcium. For proper calcification of bones, (deposition of minerals on the bone matrix) which occurs during the growing years, adequate supply of Ca is essential.

2. Tooth formation: Calcium is essential for the formation of dentin and enamel.

3. Physiological Process:

i. Calcium is essential for the clotting of blood.

ii. Calcium regulates the permeability of the capillary walls and ion transport across the cell membranes.

iii. It is essential for the contraction of the heart and skeletal muscle.

iv. Ca regulates the excitability of the nerve fibers.

v. Ca acts as an activator for enzymes such as rennin and pancreatic lipase.

b. Deficiency

Calcium related health problems occur due to inadequate intake, improper absorption or utilization of calcium.

i. Osteoporosis:

Osteoporosis is a condition found primarily among middle aged and elderly woman, where the bone mass of the skeleton is diminished. It results due to the following reasons:

a. Prolonged dietary inadequacy

b. Poor absorption and utilization of calcium

c. Immobility

d. Decreased levels of oestrogen in post menopausal women.

e. Hyper parathyroidism

f. Vitamin–D deficiency

ii. Osteomalacia – is a condition in which the quality but not the quantity of bone is reduced.

iii. Tetany- Tetany occurs when Calcium in the blood drops below the critical level.

There is a change in the stimulation of nerve cells resulting in increased excitability of the nerve and uncontrolled contraction of the muscle tissue.

c. Excess

Intake of calcium in amounts up to 2,500 mg daily appears to be safe for most people. The large intake of calcium resulted in hypercalcemia and deposition of calcium in soft tissues. Constipation also can occur when large amounts of calcium are ingested.

1.2. Phosphorus

Phosphorus is second only to calcium in abundance in the body. Approximately 560-850g are present in a 70kg human, representing about 0.8-1.2% of body weight. Of total body phosphorus, about 85% is in the skeleton, 1% is in the blood and body fluids, and the remaining 14% is associated with soft tissue such as muscle.

a. Functions

1. Bone formation: The major mineral ion of the bone is Phosphorous. For proper calcification of bones adequate supply of Phosphorous is essential.

2. Tooth formation: Phosphorous is essential for the formation of dentin and enamel.

3. ATP release & storage: Phosphorous is essential for the storage and release of adenosine triphosphate (ATP) molecules

4. Phosphates plays an important role as buffers to prevent changes in acidity of the body fluids.

5. Phospholipids are major components of cell membrane and intracellular organelles

6. In the DNA and RNA phosphate is an essential part of the nucleic acids

b. Deficiency

Phosphate deficiency is rare, but it could possibly develop in individuals who are taking drugs known as phosphate binders. Symptoms result primarily from decreased synthesis of ATP and other organic phosphate molecules. Neural, muscular, skeletal, hematologic, renal, and other abnormalities occur. Clinical phosphate depletion and hypophosphatemia

can result from long-term administration of glucose or Total Parental Nutrition without sufficient phosphate, excessive use of phosphate binding antacids, hyperparathyroidism or treatment of diabetic acidosis and it may develop in those who have alcoholism with or without decompensated liver disease.

c. Excess

Toxicity from phosphorus is rare. Problems have been reported only in infants when calcium:phosphorus ratios are altered significantly in favor of phosphorus. Phosphorus toxicity is characterized predominantly by hypocalcemia and tetany.

1.3. Magnesium

Like calcium, magnesium is closely associated with skeletal system. About 20-25g magnesium is present in adult human body and about 60-70% of it occurs in the bone, 25-30% in the muscle, 6-8% in soft tissues and 1% in the extracellular fluid.

a. Functions

- 1. The major function of magnesium is to stabilize the structure of ATP in ATPdependent enzyme reactions.**
- 2. Magnesium is a cofactor for more than 300enzymes involved in the metabolism of food components.**
- 3. Magnesium plays a role in neuromuscular transmission and activity**
- 4. In a normal muscle contraction, calcium acts as a stimulator, and magnesium acts as a relaxant. Magnesium acts as a physiologic calcium-channel blocker.**

b. Deficiency

Poor magnesium status may be related to cardiovascular disease, renal disease, diabetes mellitus, toxemia of pregnancy, hypertension, or postsurgical complications. Symptoms of abnormal neuromuscular function occur in magnesium depletion associated with malabsorption syndromes like inflammatory bowel disease or sprue, primary idiopathic hypomagnesemia and severe protein energy malnutrition. In severe deficiency, the subjects suffer often from tetany and convulsions. Hypomagnesemia, hypocalcemia and hypokalemia are always associated with magnesium deficiency and are reversed by magnesium repletion. A syndrome of magnesium-dependent, vitamin D-resistant rickets is observed.

c. Excess

Although excess magnesium can inhibit bone calcification, magnesium excesses from dietary sources, including supplements, are very unlikely to result in toxicity. The only cases of toxicity that have been reported involve smelter workers who inhale.

1.4. Sodium

Approximately 30% of the ~105g of sodium in the body (70kg human) is located on the surface of bone crystals. The remainder of the body's sodium is in the extracellular fluid, primarily plasma, and in nerve and muscle tissue. Sodium constitutes about 93% of the cations in the body, making it by far the most abundant member of this family.

a. Functions

Within the body, sodium plays important roles in the maintenance of fluid balance, nerve transmission/impulse conduction, and muscle contraction. Sodium, potassium and chloride display the most movement across cell membranes to maintain osmotic pressure and thus fluid balance. Sodium's roles in nerve transmission and muscle contraction involve sodium as part of the Na⁺/K⁺-ATPase pump found in the plasma membrane of cells.

b. Deficiency

Dietary deficiencies of sodium do not normally occur because of the abundance of the mineral across a broad spectrum of foods. Excess sodium in the diet is said to contribute to hypertension in genetically prone individuals. Symptoms include muscle cramps, nausea, vomiting, dizziness, shock and coma.

c. Excess

Apart from its relationship to hypertension, at intakes of 590-680mmol daily, healthy individuals can develop fluid retention.

1.5. Potassium

Potassium is the major intracellular cation. About 95-98% of the body's potassium is found within body cells. Potassium constitutes up to ~0.35% of total body weight, or upto ~245 g in a 70 kg human

a. Functions

Potassium contributes to intracellular osmolality. Enzymes involved in glycolysis and oxidative phosphorylation are potassium-dependent. It is involved in the maintenance of acid-base balance. Potassium is vaso-active, increasing blood flow and sustains metabolic needs of the tissue. Potassium supplements lower blood pressure. Potassium influences the

contractility of smooth, skeletal and cardiac muscle and profoundly affects the excitability of nerve tissue.

b. Deficiency

Hyperkalemia is toxic, resulting in severe cardiac arrhythmias and even cardiac arrest. Similarly, hypokalemia does not occur by dietary deficiency because of the abundance of potassium in common foods. Hypokalemia is associated with cardiac arrhythmias, muscular weakness, nervous irritability, hypercalciuria, glucose intolerance, and mental disorientation and can result from profound fluid loss, such as the losses that occur with severe vomiting and diarrhea or with use of some diuretic medications. A moderate deficiency of potassium is associated with elevations in blood pressure, increased urinary calcium excretion, and abnormal bone turnover.

c. Excess

Hyperkalaemia can be fatal and result in cardiac arrest. Individuals with subclinical/clinical renal failure are at risk of hyperkalaemia.

1.6. Chloride

Chloride is the most abundant anion in the extracellular fluid, with approximately 88% of chloride found in extracellular fluid and just 12% intracellular. Its negative charge neutralizes the positive charge of the sodium ions with which it is usually associated. In this respect, it is of great importance in maintaining electrolyte balance. Total body chloride content is about 0.15% of body weight, or about 105g in a 70kg human.

a. Functions

Chloride has important functions in addition to its role as a major electrolyte. The formation of gastric hydrochloric acid requires chloride. Chloride is released by white blood cells during phagocytosis to assist in the destruction of foreign substances.

b. Deficiency

Dietary deficiency of chloride does not occur under normal conditions. As is the case for the other electrolytes, deficiency arises chiefly through gastrointestinal tract disturbance such as severe diarrhea and vomiting.

1.7. Sulphur

Although sulfur has long been studied as a mineral, it functions almost entirely as a component of organic molecules. Sulfur exists in the body as a constituent of three amino acids-cystine, cysteine, and methionine-and of many other organic molecules.

a. Functions

Sulfhydryl groups of proteins participate in diverse cellular reactions. The sulfur of cysteine is involved photosynthesis, nitrogen fixation and oxidative phosphorylation. In the broadest sense, sulfur can be considered an antioxidant. Sulfur exists as a component of heparin, an anticoagulant found in liver and some other tissues and as chondroitin sulfate in bone and cartilage. Sulfur is also an essential component of three vitamins-thiamin, biotin and pantothenic acid.

b. Deficiency and Excess

Excess inorganic sulfur generated as a result of hepatic or renal metabolism is excreted in the urine as sulfates. These sulfates are thought to combine with calcium ions in the glomerular ultrafiltrate, thereby reducing the renal tubular resorption of calcium. Sulfur deficiency or toxicity is highly unlikely.

2. Ultratrace elements

2.1. Cobalt

Most of the cobalt in the body exists with vitamin B12 stores in the liver. Blood plasma contains approximately 1mcg of cobalt per 100.

a. Functions

The well-known essential role of cobalt is as a component of vitamin B12 (cobalamin) which is essential for the maturation of red blood cells and the normal function of all cells. In addition, methionine aminopeptidase, an enzyme involved in the regulation of translation is the only enzyme in humans known to have an established requirement of this trace element.

b. Deficiency

A cobalt deficiency develops only in relation to a vitamin B12 deficiency. Insufficient vitamin B12 causes a macrocytic anemia and genetic defect limiting vitamin B12 absorption results in pernicious anemia.

c. Excess

A high intake of inorganic cobalt in animal diets produces polycythemia (an overproduction of red blood cells), hyperplasia of bone marrow reticulocytosis, and increased blood volume.

2.2. Arsenic

More than any other ultratrace mineral, arsenic, which is colorless and odorless, conjures an image of toxicity as a poison rather than of nutritional essentiality.

a. Functions

Arsenic appears to be needed to form and use methyl groups, generated in methionine metabolism to S-adenosylmethionine (SAM). SAM is a major methyl donor in the body and functions in synthesizing a variety of compounds and in methylating compounds needed for DNA synthesis.

b. Deficiency

Arsenic deficiency impairs metabolism of methionine, resulting in decreased SAM concentrations. Arsenic-deficient rats fed, experienced growth deficits compared with arsenic-supplemented rats. Effects of arsenic deprivation in animals include curtailed growth, reduced conception rate, and increased neonatal mortality.

2.3. Boron

Boron, as boric acid and sodium borate (called borax), was used to preserve foods such as fish, meat, cream, butter, and margarine for over 50 years—that is, until about the 1920s, when it was considered dangerous for humans but deemed essential for plants.

a. Functions

Boron is thought to have several functions in the body, including roles in embryogenesis, bone development, cell membrane function and stability, metabolic regulation, and the immune response. Because of its anti-inflammatory effects, boron is purported to reduce the severity of rheumatoid arthritis

b. Deficiency and Excess

Boron deficiency has not been reported in humans, and no toxicity level has been established.

2.4. Nickel

Nickel is used industrially in various capacities, such as production of stainless steel and nickel-cadmium batteries. Nickel's essentiality in human nutrition was first suggested in the 1930s.

a. Functions

A specific role of nickel in human and animal nutrition has not yet been defined, although roles for nickel in plants and microorganisms have been documented.

b. Deficiency

Signs of nickel deprivation continue to be described for some animal species. Among the more consistent signs are depressed growth, altered distribution of some minerals, changes in blood glucose, and impaired hematopoiesis.

c. Excess

Signs of toxicity in humans include nausea, vomiting, and shortness of breath; in animals, signs include lethargy, ataxia, irregular breathing, and hypothermia, among others, possibly including death.

2.5. Vanadium

Vanadium was first discovered in the early 1800s and named for a Swedish goddess, Vanadis. In solution, vanadium produces a range of colors, which accounts for its being named after the goddess. In its pentavalent state it is yellowish orange, whereas in its divalent state it is blue.

a. Functions

No specific biochemical function has been identified for vanadium. Vanadium mimics the action of insulin. Vanadium stimulates glucose uptake into cells, enhances glucose metabolism, and inhibits catecholamine induced lipolysis in adipose tissue. Vanadium also stimulates glycogen synthesis in the liver and inhibits gluconeogenesis. Vanadium also can substitute for other metals such as zinc, copper, and iron in metallo enzyme activity.

b. Deficiency

Vanadium deficiency has suggested that the element is associated with iodine metabolism, thyroid gland function, or both. Controlled depletion of vanadium has been reported to adversely affect growth rate, perinatal survival, physical appearance, hematocrit, and other manifestations in various animal species.

2.6. Silicon

Silicon occupies a unique position among the essential trace elements in that it is second only to oxygen in earthwide abundance.

a. Functions

The physiological role of silicon centers on normal formation, growth and development of bone, connective tissue, and cartilage. Silicon is thought to play both a metabolic and a structural role.

b. Deficiency

Silicon deficiency results in smaller, less flexible long bones and in skull deformation. Silicon deprivation in rats diminished bone collagen formation and increased collagen breakdown.

c. Excess

No tolerable upper intake level has been established for silicon. The major potential adverse effect reported is kidney stone. Toxicity of silicon also has been associated with diminished activities of several enzymes that prevent free radical damage. Silicosis occurs from inhaling dust high in silica; the condition is characterized by a progressive fibrosis of the lungs that leads to respiratory problems.

Table 1: Macrominerals: Recommended Dietary Allowances (RDAs)

TABLE 2:NUTRIENTS: MICROMINERALS Part II

INTRODUCTION

A precise definition for the essential microminerals has not been established. The term micro when applied to microminerals can be defined as minerals that make up <0.01% of total body weight. An element is considered essential if a dietary deficiency of that element consistently results in a suboptimal biological function that is preventable or reversible by physiological amounts of the element. The abnormalities induced by deficiencies are always accompanied by specific biochemical changes.

Each essential micromineral is necessary for one or more functions in the body. Whenever the intake or body concentration is too low or too high, function is impaired and death can result. The body's content of the microminerals ranges from <1mg--4g.

1. Iron

The human body contains ~2-4g iron, or ~38mg iron/kg body weight (BW) for women and ~50mg iron/kg BW for men. Iron exists in a complex form in our body. It is present as

i. Iron porphyrin compounds-hemoglobin (65%) in RBC, myoglobin (10%) in muscle.

ii. Enzymes (1-5%)—peroxidases, succinase dehydrogenase and cytochrome oxidase.

iii. Transport and storage forms (20%): transferrin and ferritin.

The total amount of iron found in a person not only is related to BW but also is influenced by other physiological conditions, including age, gender, pregnancy, and state of growth.

a. Functions

The chief functions of iron in the body are:

- 1. Iron forms a part of the protein–haemoglobin which carries oxygen to different parts of the body.**
- 2. It forms a part of the myoglobin in muscles which makes oxygen available for muscle contraction.**
- 3. Iron is necessary for the utilization of energy as part of the cell’s metabolic machinery.**
- 4. As part of enzymes iron catalyzes many important reactions in the body.**

Examples are

- i. Conversion of β -carotene to active form of Vitamin-A**
 - ii. Synthesis of carnitine, purines, collagen**
 - iii. Detoxification of drugs in the liver**
- b. Deficiency**

Iron deficiency occurs most often due to inadequate iron intake. Iron intake is frequently inadequate in four population groups:

- Infants and young children (6 months to about 4 years), because of the low iron content of milk and other preferred foods, rapid growth rate, and insufficient body reserves of iron to meet needs beyond about 6 months.**
- adolescents in their early growth spurt, because of rapid growth and the needs of expanding red blood cell mass.**
- females during childbearing years, because of menstrual iron losses.**
- pregnant women, because of their expanding blood volume, the demands of fetus and placenta, and blood losses to be incurred in childbirth. In addition, many nonpregnant females during childbearing years fall short of the RDA for iron because of restricted energy intake and inadequate consumption of iron-rich foods.**

Dietary iron deficiency leads to nutritional anaemia. Nutritional anaemia is defined as the condition that results from the inability of the erythropoetic tissue to maintain a normal haemoglobin concentration. Anaemia occurs when the haemoglobin level falls below 12gm/dl in adult man and woman. During pregnancy haemoglobin level below 11gm/dl is termed anaemia.

The major cause of anemia in India is because of Iron and folic acid deficiency.

Nutritional anemia is manifested as:

- 1. Reduced Haemoglobin level**
 - 2. Defects in the structure, function of the epithelial tissues**
 - 3. Paleness of skin and the inside of the lower eyelid is pale pink**
 - 4. Finger nails becoming thin and flat and eventually (spoon shaped nails) koilonychia develops.**
 - 5. Progressive untreated anaemia results in cardiovascular and respiratory changes leading to cardiac failure. The general symptoms include lassitude, fatigue, breathlessness on exertion, palpitations, dizziness, sleeplessness, dimmness of vision, and increased susceptibility to infection.**
- Symptoms of iron deficiency, mostly demonstrated in children, include pallor, listlessness, behavioral disturbances, impaired performance in some cognitive tasks, some irreversible impairment of learning ability, and short attention span.**

c. Excess

Accidental iron overload has been observed in young children following excessive ingestion of iron pills or vitamin/mineral pills. Other people susceptible to iron overload have a genetic disorder known as hemochromatosis. In most people with hemochromatosis iron absorption generally continues, despite high iron stores. The absorbed iron is progressively deposited within joints and tissues, especially the liver, heart, and pancreas, causing extensive organ damage and ultimately organ failure.

2. Zinc

The human body contains ~1.5-2.5g of zinc. Zinc is found in all organs and tissues and in body fluids. Largest stores of Zinc is present in the bones. Zinc forms a constituent of the blood. Zinc is an important element performing a range of function in the body as it is a cofactor for a number of enzymes.

a. Functions

Zinc functions in association with more than 300 different enzymes. It participates in reactions involving either synthesis/degradation of major metabolites carbohydrates, lipids, proteins-and nucleic acids. It plays important structural role in brain cells. Zinc is involved in the stabilization of protein and nucleic acid structure as well as in transport processes, immune function and expression of genetic information. It plays a major role in the

synthesis of DNA and proteins, and a constituent of the hormone insulin. Zinc appears in the crystalline structure of bone, in bone enzymes. It is thought to be needed for adequate osteoblastic activity, formation of bone enzymes such as alkaline phosphatase and calcification.

b. Deficiency

Some population groups, especially the elderly and vegetarians, have been found to consume less than adequate amounts of zinc. Conditions associated with an increased need for intake include alcoholism, chronic illness, stress, trauma, surgery and malabsorption. Signs and symptoms of zinc deficiency are growth retardation, skeletal abnormalities, defective collagen synthesis or cross-linking, poor wound healing, dermatitis, delayed sexual maturation in children, hypogeusia (blunting of sense of taste), alopecia (hair loss), impaired immune function and impaired protein synthesis.

c. Excess

Excessive intake of zinc can cause toxicity. An acute toxicity with 1-2g zinc sulfate (225–450mg zinc) can produce a metallic taste, nausea, vomiting, epigastric pain, abdominal cramps and bloody diarrhea.

3. Copper

The adult body contains approximately about 80mg Copper. Concentrations of copper are highest in the liver, brain, heart and kidney. Muscle contains a low level of copper, but, because of its large mass, skeletal muscle contains almost 40% of all the copper in the body.

a. Functions

Copper is a component of many enzymes and symptoms of copper deficiency are attributable to enzyme failures. Copper in ceruloplasmin has a well-documented role in oxidizing iron before it is transported in the plasma. Lysyl oxidase, a copper containing enzyme, is essential in the lysine-derived cross-linking of collagen and elastin. Copper has roles in mitochondrial energy production. As part of copper containing enzyme such as superoxide dismutase, copper protects against oxidants and free radicals and promotes the synthesis of melanin and catecholamines

b. Deficiency

Clinical manifestations associated with copper deficiency. are hypochromic anemia, leukopenia, hypopigmentation or depigmentation of skin and hair, impaired immune function, bone abnormalities, cardiovascular and pulmonary dysfunction. The likelihood of copper deficiency increases in persons consuming excessive amounts of zinc (40mg/day) or antacids as well as in persons with conditions that promote increased loss of copper from

the body, as occurs with nephrosis or gastrointestinal malabsorptive disorders such as celiac disease, tropical sprue, and inflammatory bowel diseases.

c. Excess

Copper toxicity is fairly rare. A tolerable upper level for copper is set at 10mg per day. Copper intake of 64mg (250mg copper sulfate) has resulted in epigastric pain, nausea, vomiting, and diarrhea. Other symptoms of toxicity include hematuria, liver damage resulting in jaundice, and kidney damage resulting in oliguria or anuria. Wilson's disease, a genetic disorder characterized by copper toxicity, results from mutation(s) in the gene coding. In Wilson's disease, copper accumulates in organs, resulting in disturbed function of organs, especially the liver, kidneys, and brain. Kayser-Fleischer (greenish gold) rings caused by copper deposition also are visible in the cornea.

4. Fluoride

Fluoride is found in natural element in nearly all drinking water and soil and in the human body in trace amounts. Fluoride is not considered an essential nutrient, but it is clearly recognized as important for the health of bones and teeth.

a. Functions

Fluoride is essential for tooth enamel. Fluoride incorporation into enamel produces more stable apatite crystals. Fluoride also acts as an antibacterial agent in the oral cavity, serving as an enzyme inhibitor.

b. Deficiency

Fluoride deficiency in test animals has been reported to result in curtailed growth, infertility and anemia. In humans, an optimal level of fluoride helps to reduce the incidence of dental caries and perhaps also to maintain the integrity of skeletal tissue.

c. Excess

Chronic toxicity of fluoride, called fluorosis, is characterized by changes in bone, kidney, nerve and muscle function. Dental fluorosis or mottling of teeth has been observed in children receiving 2-8mg fluoride/kg BW. Acute toxicity manifests as nausea, vomiting, diarrhea, acidosis, and cardiac arrhythmias.

3. Manganese

Although widely distributed in nature, manganese occurs in only trace amounts in animal tissues. The body of a healthy 70kg man is estimated to contain a total of 10-20mg of the metal.

a. Functions

Manganese is a component of many enzymes, including glutamine synthetase, pyruvate carboxylase and mitochondrial superoxide dismutase. Manganese is associated with the formation of connective and skeletal tissues, growth and reproduction, and carbohydrate and lipid metabolism

b. Deficiency

Manganese deficiency is associated with striking and diverse physiological malfunctions. Manganese deficiency generally does not develop in humans unless the mineral is deliberately eliminated from the diet. Symptoms and signs of deficiency included nausea, vomiting, dermatitis, decreased serum manganese, decreased fecal manganese excretion, increased serum calcium, phosphorus, and alkaline phosphatase, decreased growth of hair and nails; changes in hair and beard color; poor bone formation and skeletal defects; and altered carbohydrate and lipid metabolism.

c. Excess

Manganese toxicity has developed in miners as a result of absorption of manganese through the respiratory tract. The excess, which accumulates in the liver and central nervous system, produces Parkinson-like symptoms. Toxicity has also been reported in patients receiving TPN including manganese. Symptoms include headaches, dizziness.

6. Chromium

Chromium is found in air, water and soil. The chromium content of the human body is estimated at ~4-6 mg.

a. Functions

Chromium potentiates insulin action and as such influences carbohydrate, lipid and protein metabolism. Chromium may regulate the synthesis of a molecule that potentiates insulin action. Another possible role for chromium, similar to that of zinc, is in the regulation of gene expression.

b. Deficiency

Chromium deficiency is seen in people who received intravenous nutrition feeding (total parenteral nutrition) without chromium and without oral food intake. Signs and symptoms of deficiency included weight loss, peripheral neuropathy, elevated plasma glucose concentrations or impaired glucose use, and high plasma free fatty acid concentrations. Severe trauma and stress may increase the need for chromium. Chromium deficiency results in insulin resistance characterized by hyperinsulinemia, a risk factor for heart

disease. Mild chromium deficiency also is a risk factor for metabolic syndrome. Metabolic syndrome increases the risk of heart disease.

c. Excess

Oral supplementation of upto about 1,000µg of chromium appears to be safe. Toxicity is associated with exposure to chromium absorbed through the skin, enter the body through inhalation, or be ingested. Inhalation of or direct contact with chromium may result in respiratory disease or in dermatitis and skin ulcerations. Liver damage may also occur. Ingesting chromium leads to severe acidosis, gastrointestinal hemorrhage, hepatic injury, renal failure and death.

4. 7. Iodine

Iodine is an essential micronutrient, which is required for the synthesis of thyroid hormone for optimal physical growth and development of humans. The healthy human body contains about 20mg of iodine, 70-80% of which is concentrated in the thyroid gland.

a. Functions

Iodine is stored in the thyroid gland, where it is used in the synthesis of triiodothyronine (Tr) and thyroxine (Tq). Uptake of iodide ions by the thyroid cells may be inhibited by goitrogens (substances that exist naturally in foods). Thyroid hormone is degraded in target cells and the liver, and the iodine is highly conserved under normal conditions.

b. Deficiency

Iodine deficiency in the diet causes enlargement of the thyroid gland called as “goitre”, as well as a wide spectrum of disorders, which are termed as iodine deficiency disorders (IDD). IDD includes abortion, stillbirths, low birth weight, cretinism, neonatal chemical hypothyroidism, psycho-motor defects, impaired coordination, mental retardation and hypothyroidism.

Goitre occurs in people staying in hilly regions where the iodine content of water and soil is comparatively less. Goitre can be treated by administration of iodine. If treatment is given in early stages goitre can be corrected. Severe iodine deficiency in children leads to hypothyroidism resulting in retarded physical and mental growth. This condition is known as cretinism.

Goitrogens are substances present in foods which cause goitre. These substances react with iodine present in the food making it unavailable for absorption.

Foods like cabbage, cauliflower, raddish contain goitrogens.

c. Excess

Excessive iodine intake is reportedly occurring because of poor monitoring and higher than necessary supplementation in several countries with supplementation programs. In addition, in some countries, excessive intake occurs from overconsumption of foods naturally high in iodine. Some signs of acute iodide toxicity include burning of the mouth, throat, and stomach; nausea; vomiting; diarrhea; and fever. A tolerable upper intake level for iodine has been set at 1,100µg/day.

5. 8. Molybdenum

The need for molybdenum was established in humans through the observation that a genetic deficiency of specific enzymes that require molybdenum as a cofactor resulted in severe pathology.

a. Functions

Xanthine oxidase, aldehyde oxidase, and sulfite oxidase, all enzymes that catalyze oxidation-reduction reactions, require a prosthetic group containing molybdenum.

b. Deficiency

Molybdenum deficiency has not been established in humans other than patients treated with TPN. Symptoms of molybdenum deficiency include mental changes and abnormalities of sulfur and purine metabolism

c. Excess Molybdenum appears to be relatively nontoxic, with intake upto 1,500µg/day. However, symptoms such as gout have appeared in some people living in regions that contain high soil molybdenum levels and in those with occupational exposure to molybdenum.

9. Selenium

Selenium, a nonmetal, exists in several oxidation states. Selenium is important as it has antioxidant activity. The chemistry of selenium is similar to that of sulfur; consequently, selenium can often substitute for sulfur. The total body selenium content ranges from about 13-30mg.

a. Functions

Glutathione peroxidase is the only selenoprotein enzyme well studied for the biological role of selenium. Deiodinase isoenzymes that are involved in thyroid hormone metabolism are also selenium-containing proteins. Apart from its antioxidant protection against free radicals, selenium was found to be functional in detoxification.

b. Deficiency

Selenium deficiency has been associated with two childhood/adolescent endemic diseases, “Keshan” (cardiomyopathy) and “KashinBeck” (osteoarthritis). These diseases are found to be prevalent in certain areas where the intake of Selenium is very low, 7-11g/d. Poor intake of Selenium is associated with increased risk of cancer or heart disease.

c. Excess

Selenium toxicity, also called selenosis, has been observed both in miners and in people who consume excess selenium from supplements. Signs and symptoms of toxicity include nausea, vomiting, fatigue, diarrhea, hair and nail brittleness and loss, paresthesia, interference in sulfur metabolism and inhibition of protein synthesis.

Acute poisoning selenium is lethal, with damage occurring to most organ systems. Daily intakes above 700µg/d or acute consumption of 1-7mg Selenium/kg/d results in toxicity in humans.