SSR DEGREE COLLEGE (AUTONOMOUS)
SEMESTER-I
Unit Wise Important Questions

Unit – I

Short Questions (4Marks)

1. Define food, nutrition, and nutrients.
2. Write any two functions of carbohydrates.
3. What is a balanced diet?
4. Write the uses of a food guide pyramid.
5. Write two differences between cereals and millets.
6. Mention two nutrient losses during cereal processing.
7. Give two examples of sugar cookery.
8. What is jaggery? Mention its nutritive value.

Long Questions (10Marks)

1. Explain the classification of food groups based on functions and origin.
2. Discuss the composition, nutritive value, and nutrient losses of cereals.
3. Explain the nutritive value of millets and their importance in diet.
4. Write about sugar cookery – types, stages, and uses in cookery.
5. Discuss the nutritive value of jaggery and honey.

Unit II – Pulses, Legumes, Nuts & Oil Seeds, Fats & Oils

Short Questions (4Marks)

1. Write the nutritive value of pulses.
2. Mention two antinutritional factors in pulses.
3. What is germination? Write its importance.
4. What is rancidity of oils?
5. Write two toxins present in nuts and oilseeds.
6. Mention physical properties of fats.
7. Define malting.
8. Write two functions of fats in the body.

Long Questions (10Marks)

1. Discuss the composition, nutritive value, and nutrient losses of pulses.

2. Write in detail about germination and malting of pulses and their significance.

3. Explain the nutritive value of nuts and oil seeds and their role in cookery.

4. Discuss the composition, nutritive value, and properties of fats and oils.

5. Explain rancidity of oils, its types, and prevention methods.

Unit III – Vegetables, Fruits & Food Preservation

Short Questions (4Marks)

1. Write two changes that occur in vegetables during cooking.

2. What is enzymatic browning?

3. Mention two methods of food preservation.

4. Write two factors affecting fruit storage.

5. Mention two losses of nutrients during vegetable cooking.

6. Define ripening of fruits.

7. What are preservatives?

8. Give two examples of high temperature food preservation.

Long Questions (10Marks)

1. Explain the classification, composition, and nutritive value of vegetables.

2. Discuss the classification, composition, nutritive value, and storage of fruits.

3. Write about enzymatic browning and its prevention.

4. Discuss the principles and methods of food preservation (dehydration, low temperature, high temperature, preservatives).

5. Explain the effect of cooking on nutritive value of vegetables.

Unit IV – Animal Foods & Food Adulteration

Short Questions (4Marks)

1. Write the nutritive value of milk.

2. Mention two examples of fermented milk products.

3. Define food adulteration.

4. What is pasteurization?

5. Mention two qualities of a good egg.

6. Write any two adulterants in milk.

7. Give two examples of non-fermented milk products.

8. Write nutritive value of poultry meat.

Long Questions (10Marks)

1. Discuss the composition, nutritive value, and products of milk.

2. Write about fermented and non-fermented milk products in detail.

3. Explain the nutritive value and quality of eggs.

4. Discuss the classification, composition, and nutritive value of poultry.

5. Write about food adulteration – common adulterants in milk and eggs, their health hazards.

Contents

UNIT-I

INTRODUCTION TO FOOD GROUPS, CEREALS & MILLETS & PURE CARBOHYDRATES

UNIT-II

PLUSES & LEGUMES,NUTS & OIL SEEDS AND FATS & OILS

UNIT-IV

ANIMAL FOODS AND FOOD ADULTERATION

UNIT-I

INTRODUCTION TO FOOD GROUPS, CEREALS & MILLETS & PURE CARBOHYDRATES

Definition - Food, nutrition, nutrients; food groups based on functions, origin and nutritive value; Food guide pyramid, balanced diet

Cereals and Millets - Composition, nutritive value and nutrient losses during processing; breakfast cereals

Sugars - Types of sugars and stages of sugar cookery

Jaggery - Manufacture and stages of jaggery cookery

1.1 Food, Food groups based on functions, Origin & Nutritive Value

Food

Food is any substance consumed to provide nutritional support for the body. It is usually of plant or animal origin and contains essential nutrients, such as carbohydrates, fats, proteins, vitamins, and minerals. Food is typically ingested orally and used by organisms to provide energy and to facilitate growth. Some foods are edible in their natural state, while others must be prepared or processed in order to be edible.

Types of Food

- **Carbohydrates** - Provide the body's main source of energy. Examples include breads, grains, pasta, rice, potatoes, fruits, and vegetables.
- **Proteins** - Help build and repair tissues in the body. Examples include meat, poultry, fish, eggs, dairy, beans, lentils, and nuts.
- **Fats** - Provide concentrated energy and help absorb certain vitamins. Examples include oils, butter, nuts, and avocados.
- **Vitamins** - Essential organic compounds required in small amounts for proper growth and metabolism. Examples include vitamins A, B, C, D, E, and K.
- **Minerals** - Inorganic elements required for various bodily functions. Examples include calcium, iron, sodium, and potassium.
- **Water** - A key component of cells and essential for many bodily processes.

Food Sources

- **Plant-based foods** - Fruits, vegetables, grains, legumes, nuts, seeds
- **Animal-based foods** - Meat, poultry, fish, eggs, dairy
- **Processed foods** - Breads, pastas, snacks, frozen meals, canned goods

Nutritional Requirements

- The specific amounts and types of food needed can vary by age, gender, activity level, health conditions, and other factors.
- Dietary guidelines recommend balanced diets with appropriate portions of different food groups.
- Overconsumption or deficiencies of certain nutrients can lead to health issues.

Preparation and Safety

- Many foods must be cooked, preserved, or otherwise prepared to be edible and safe.
- Proper food handling, storage, and cooking helps prevent foodborne illnesses.
- Cultural and personal preferences also influence how food is prepared and consumed.

Nutritional Composition

- **Macronutrients** - Carbohydrates, proteins, and fats are the three main macronutrients that provide calories and fuel the body.
- **Micronutrients** - Vitamins and minerals are required in smaller amounts but are still essential for proper bodily function.
- **Fiber** - Found in plant-based foods, fiber aids digestion and provides other health benefits.
- **Water** - Makes up a large percentage of most foods and is crucial for hydration.

Dietary Guidelines:

- Government health organizations publish recommended dietary allowances (RDAs) for different age groups and populations.
- These guidelines suggest the optimal daily intake of macronutrients, vitamins, minerals, and other food components.
- They also promote balanced, varied diets with appropriate portion sizes from different food groups.

Food Production and Supply

- Agriculture, fishing, and food manufacturing are major global industries.
- Factors like weather, technology, transportation, and trade policies impact food availability and prices.
- Concerns around sustainability, environmental impact, and food security are growing.

Dietary Patterns and Trends

- Diets can vary greatly by culture, religion, personal preference, and health needs.
- Popular diet styles include vegetarian, vegan, low-carb, Mediterranean, and others.
- Nutrition research continuously evolves, leading to shifts in dietary recommendations over time.

Food Safety and Regulation

- Governments have agencies that set standards and enforce regulations around food production, labeling, and distribution.
- Issues like foodborne illnesses, food allergies, and food adulteration are continually monitored.
- Ongoing research aims to improve food safety and quality control processes.

Orgin of food

The origins of food can be traced back to the earliest forms of life on Earth and the subsequent evolution of human societies. Here's a more detailed look at the origins of food:

Prehistoric Origins

- The very first forms of life, such as primitive single-celled organisms, obtained energy and nutrients directly from their surrounding environment.
- As life became more complex, the first multicellular organisms developed the ability to obtain and process nutrients through the ingestion of other organisms or organic matter.
- The evolution of photosynthetic organisms, like algae and plants, marked a critical turning point, as they could produce their own food from sunlight, water, and carbon dioxide.

Early Human Diets

- The earliest human ancestors, such as Australopithecines and Homo erectus, were primarily hunter-gatherers, relying on the foraging of wild plants, fruits, nuts, and the hunting of animals for sustenance.
- The development of stone tools and the controlled use of fire allowed early humans to expand their dietary options and improve the digestibility of certain foods.
- The transition to agriculture, beginning around 10,000 years ago, was a transformative shift that enabled the reliable cultivation of crops and domestication of animals.

Ancient Civilizations

- The rise of ancient civilizations, such as those in Mesopotamia, Egypt, China, and India, led to more sophisticated and organized food production, storage, and distribution systems.
- These societies developed advanced irrigation techniques, crop rotation, and food preservation methods, which allowed for the production of a greater variety of foods.
- Regional cuisines, spice trade, and the exchange of culinary knowledge between civilizations began to shape the diverse food cultures we see today.

Technological Advancements

- The Industrial Revolution in the 18th and 19th centuries brought about significant changes in food production, processing, and distribution.
- Innovations like canning, pasteurization, and the development of refrigeration enabled the storage and transportation of food over longer distances.
- The 20th century witnessed a "Green Revolution" in agriculture, with the introduction of high-yielding crop varieties, synthetic fertilizers, and pesticides, leading to a dramatic increase in food production.

Contemporary Food Systems

- Today, the global food system is highly complex, involving advanced technologies, international trade, and complex supply chains.

- Concerns over sustainability, environmental impact, and public health have driven the development of alternative food production methods, such as organic farming, hydroponics, and cellular agriculture.
- Ongoing research in areas like genetics, microbiology, and nutritional science continues to shape our understanding of the origins and evolution of food.

1.1.1 Nutrition, Nutrients

Nutrition, Nutrients

Nutrition and Nutrients are closely related concepts that are fundamental to understanding food and its role in supporting human health.

Nutrition

- Nutrition is the science that studies the relationship between food, its components (nutrients), and their impact on the human body. It encompasses the processes of ingestion, digestion, absorption, utilization, and excretion of food substances. The goal of nutrition is to ensure the proper intake of essential nutrients to maintain health, support growth and development, and prevent deficiencies or imbalances that can lead to illness.

Nutrients

Nutrients are the specific chemical compounds found in food that the body needs to function properly. The six main classes of nutrients are:

- **Carbohydrates** - Provide the body's primary source of energy. Examples include sugars, starches, and dietary fiber.
- **Proteins** - Essential for building and repairing tissues, enzymes, and hormones. Composed of amino acids.
- **Fats (Lipids)** - Concentrated sources of energy that also support cell structure and function. Include saturated, unsaturated, and trans fats.
- **Vitamins** - Organic compounds required in small amounts for various metabolic processes. Examples include vitamins A, B, C, D, E, and K.
- **Minerals** - Inorganic elements necessary for regulating body functions. Examples include calcium, iron, sodium, and potassium.
- **Water** - The primary component of the body, essential for virtually all bodily processes.

Importance of Nutrition

- Proper nutrition is crucial for maintaining overall health and preventing chronic diseases.
- It supports key bodily functions like energy production, tissue repair, immune function, and organ health.
- Good nutrition during critical life stages (childhood, pregnancy, aging) is especially important.
- Malnutrition, whether from deficiencies or overconsumption, can lead to a range of health problems.

Macronutrients vs. Micronutrients

- Macronutrients (carbs, proteins, fats) are needed in larger amounts and provide calories/energy.

- Micronutrients (vitamins, minerals) are required in smaller doses but are equally essential.
- Both macros and micros work together to facilitate proper bodily function.

Nutrient Absorption and Utilization

- The body has complex mechanisms to digest, absorb, and use the nutrients in food.
- Factors like food preparation, nutrient interactions, and individual metabolism affect bioavailability.
- Excess or deficiencies of certain nutrients can impair their proper utilization.

Dietary Recommendations

- Government health agencies provide recommended daily intakes (RDIs) for each nutrient.
- These guidelines account for age, gender, life stage, and activity level to ensure adequate nutrition.
- They also advise on optimal ratios of macronutrients and limit intakes of certain nutrients.

Special Dietary Needs

- Certain health conditions, allergies, and intolerances require modified nutrient intake.
- Vegetarians, vegans, and other special diets need to carefully plan to meet all nutrient requirements.
- Supplements may be needed to address specific nutrient deficiencies.

1.1.2 Food Guide Pyramid

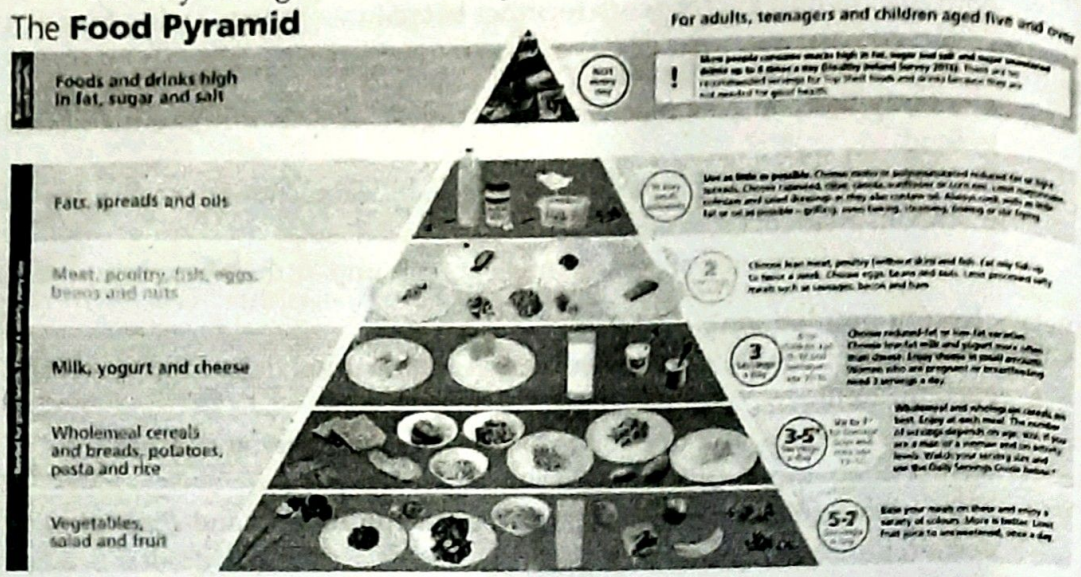
The food guide pyramid, also known as the dietary guidance graphic, is a visual representation of the recommended proportions and types of foods that make up a healthy, balanced diet. The food guide pyramid has evolved over time, with different versions developed by various countries and health organizations.

Generations of Americans are accustomed to the food pyramid design, and it's not going away. In fact, the Healthy Eating Pyramid and the Healthy Eating Plate (as well as the Kid's Healthy Eating Plate) complement each other.

Consumers can think of the Healthy Eating Pyramid as a grocery list:

- Vegetables, fruits, whole grains, healthy oils, and healthy proteins like nuts, beans, fish, and chicken should make it into the shopping cart every week, along with a little yogurt or other dairy foods if desired.
- The Healthy Eating Pyramid also addresses other aspects of a healthy lifestyle—exercise, weight control, vitamin D, and multivitamin supplements, and moderation in alcohol for people who drink—so it's a useful tool for health professionals and health educators.
- The Healthy Eating Plate and the companion Healthy Eating Pyramid summarize the best dietary information available today. They aren't set in stone, though, because nutrition researchers will undoubtedly turn up new

information in the years ahead. The Healthy Eating Pyramid and the Healthy Eating Plate will change to reflect important new evidence.



1.1.3 Balanced Diet

A balanced diet is an approach to eating that aims to provide the body with the right proportions of essential nutrients to maintain overall health and well-being. Here are the key components of a balanced diet:

Macronutrients

1. **Carbohydrates (45-65% of total calories):** Provide the body's primary source of energy. Focus on whole grains, fruits, vegetables, and fiber-rich carbs.
2. **Proteins (10-35% of total calories):** Essential for tissue repair, growth, and maintenance. Include a variety of lean proteins like meat, fish, eggs, legumes, and dairy.
3. **Fats (20-35% of total calories):** Necessary for hormone production, nutrient absorption, and energy. Emphasize healthy unsaturated fats from sources like nuts, seeds, avocados, and olive oil.

Micronutrients

1. **Vitamins and minerals:** Crucial for a range of bodily functions. Ensure adequate intake of vitamins A, C, D, E, B-complex, as well as minerals like calcium, iron, magnesium, and potassium.
2. **Antioxidants:** Help protect cells from damage. Find these in a variety of fruits, vegetables, and whole grains.

Fiber

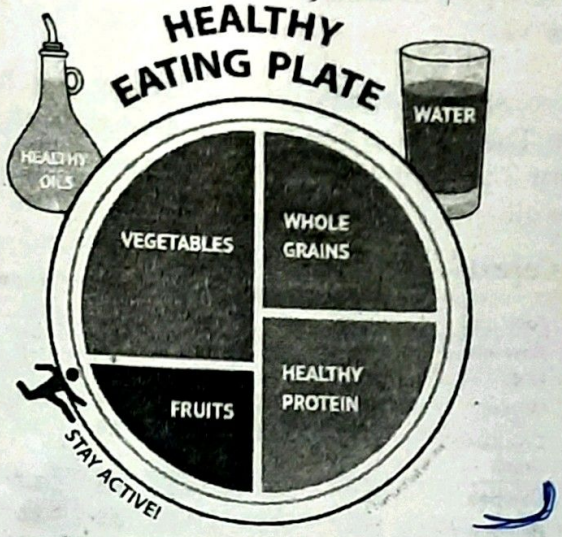
1. **Soluble and insoluble fiber:** Promotes digestive health, heart health, and blood sugar regulation. Aim for 25-30 grams of fiber per day from whole foods.

Hydration

1. **Water:** Essential for bodily functions like temperature regulation, nutrient transport, and waste removal. Drink adequate amounts of water throughout the day.

Balance and Moderation

1. **Variety:** Eat a diverse range of foods to ensure you're getting a wide array of nutrients.
2. **Portion control:** Avoid overconsumption of any one food or nutrient.
3. Limit processed, high-sugar, and high-fat foods: Consume these in moderation as part of an overall healthy diet.



1.2 Cereals and Millets

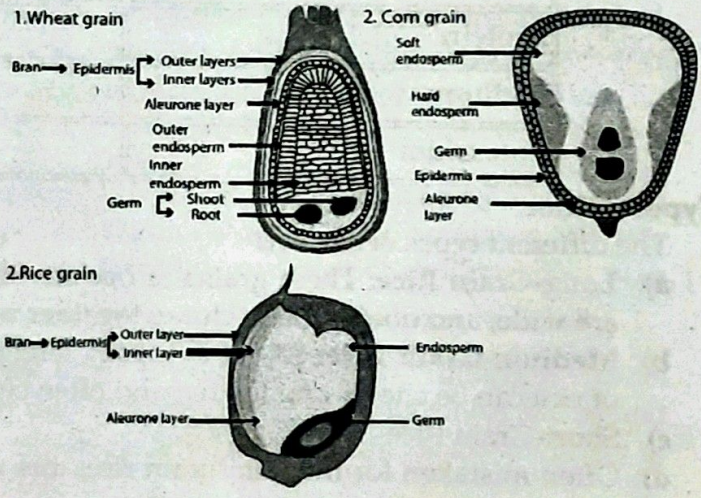
Definition Cereals

A cereal is any grass cultivated for its edible grain (botanically, a type of fruit called a caryopsis), which is composed of an endosperm, a germ, and a bran.

Cereal grain crops are grown in greater quantities and provide more food energy worldwide than any other type of crop and are therefore staple crops. They include rice, wheat, rye, oats, barley, millet, and maize. Edible grains from other plant families, such as buckwheat, quinoa, and chia, are referred to as pseudo cereals.

Structure of cereal grains

All grains have the same basic structure. The seed coat consists of an epidermis (outer layer) and several inner layers. Just underneath the seed coat is the aleurone layer, which contains oils, and other nutrients like minerals, proteins and vitamins.



The seed coat and aleurone make up the outer layer called the bran, which

represents about 13 percent of the grain. The aleurone layer surrounds the endosperm, which is the largest part of the grain (usually about 85 percent).

The endosperm consists of storage cells containing starch granules embedded in a matrix of protein. The germ is the sprouting section of the grain. In wheat, it comprises only about 2 percent of the seed, but contains 65 percent of the B group vitamins and 33% of oil.

The endosperm consists of storage cells containing starch granules embedded in a matrix of protein. The germ is the sprouting section of the grain. In wheat, it comprises only about 2 percent of the seed, but contains 65 percent of the B group vitamins and 33% of oil.

Nutritive Value of Cereals

Food crop	Energy (k Cal)	Protein (g)	Fat (g)	Fibre (g)	Minerals (g)
Raw milled rice	362	6.8	0.5	1.0	0.6
Wheat	348	11.8	1.5	2.0	1.5
Chick pea/ Gram	360	17.1	5.3	3.0	3.0
Cowpea	323	24	1.0	3.8	3.2
Red gram	335	22.3	1.7	3.5	3.5

RICE

Rice the major carbohydrate of rice is starch which is 72-75 percent. Protein content of rice is 7 percent.

Nutritive value of Rice

When it comes to caloric content, calories per 100 grams of rice amount to 130. Beyond the calories in rice, knowing all about its nutritional values is important as well. Hence, here are nutrition facts about 100 gms of rice.

Rice Nutrients (100 grams)	Values
Carbohydrates	28 grams
Fats	0 grams
Protein	2 grams
Sodium	1 mg
Potassium	35 mg

Types of Rice

The different types of rice are:

a) **Long-Grain Rice:** These grains of rice are about 4-5 times longer than they are wide, and don't tend to clump together when cooked.

b) **Medium-Grain Rice:** About 2-3 times longer than their width, these types of rice can be chewy and tender, and often clump together.

c) Short-Grain Rice

d) Often mistaken for medium-grain rice, this variety is slightly longer than it is wide, and clumps together easily.

e) **Parboiled Rice:** This is a type of rice prepared in a unique way; rather than removing the outer hull to cook brown rice, the outer shell is left on while this rice is steamed and dried. Then the outer shell is taken off for a less clumpy and more nutrient-dense variety of rice.

f) **Polished rice:** Polished rice is rice that has been milled, which effectively strips away much of the protein and vitamin content. Traditional white rice is considered a polished rice, and therefore less nutrient-dense than other varieties.

g) **Brown rice:** Brown rice is rice in which the inner husk is not removed meaning that it hasn't been milled and thus provides a much higher content of fiber and nutrients. It is unpolished whole grain which contains 100 percent bran, germ and endosperm constituents. Brown rice is nutritionally superior to hand pounded rice, under milled and polished rice because it has higher amounts of protein, dietary fibre, vitamins and minerals.

h) **Black rice:** It has a very high concentration of anthocyanins, which gives it the black color. It is high in nutrients and relatively rare, this rice variety is slowly becoming popular in our Indian cuisine.

i) **Basmati rice:**

j) Traditionally grown, found and used in India, for making biriyanis and pulaos, Basmati rice is a long-grain variety with a very delicate texture.

k) **Sticky Rice:** is a rice variety primarily grown in Asia, also known as glutinous rice.

l) **Red rice:** Red rice is similar to black rice in that it is colored due to its unique anthocyanin content. ¬is provides the red color to the husk, which can either be partially or fully removed before preparing this type of rice.

Different Types of Rice Products

- **Rice flour:** Rice starch granules are quite small and are embedded in a protein matrix. It is used in puddings, ice creams and custard powder.
- **Rice bran:** Bran includes several sub layers within the pericarp and the aleuronic layer. Bran is a good source of antioxidants. Oil is taken from rice bran.
- **Broken rice:** It is mainly used in making upma.
- **Parched rice products:** This includes parched rice, puffed rice and flaked rice. They are easily digestible and hence good for children and old people. It adds variety in the diet. Rice flakes are a good source of iron.

WHEAT

Wheat grains are ovoid in shape rounded in both ends. Wheat proteins are rich in glutamic acid and low in tryptophan. Whole wheat is a good source of thiamin, riboflavin, niacin, folic acid, calcium, phosphorus, zinc, copper and iron. Wheat is also a good source of fiber.

Wheat is consumed mostly in the form of flour obtained by milling the grain while a small quantity is converted into breakfast foods such as wheat flakes and puffed wheat. Wheat is milled to produce flour which is used to make a variety of products including bread across the world.

Wheat contains a protein called gluten which is necessary for the basic structu in forming the dough system for bread, rolls and other baked goods. Many of t foods we consume on a daily basis such as bread, cookies, cakes, pies, pastri cereals, crackers, pasta, flour tortillas and noodles are all made from wheat flour.

Nutritive Value of Wheat per 100 gm grain

Nutrients	Amount
Calories	340 kcal
Water	11 %
Protein	13.2 g
Carbs	72 g
Sugar	0.4 g
Fibre	10.7 g
Fat	2.5 g
Saturated	0.43 g
Monounsaturated	0.28 g
Polyunsaturated	1.17 g
Omega-3	0.07 g
Omega-6	1.09 g

Product of Wheat

- **Whole wheat flour:** It contains the finely ground bran, germ an endosperm of the whole kernel. It is used in making chapathis, puris, whol wheat bread, etc.
- **Wheat bran:** Wheat Bran is a concentrated source of insoluble fibre an provides health benefits.
- **Wheat germ:** It is a great source of vegetable protein, along with fiber an healthy fats. It is also a good source of vitamin E, magnesium, thiamin folate, potassium and phosphorus.
- **Wheat rava:** Broken wheat or wheat rava is used in the making of upm bisi bela bath, pongal, etc.
- **Wheat flakes:** They are used as breakfast cereals. They are packed wit dietary fibre and most varieties are fortified with numerous essentia vitamins and minerals.
- **Maida:** It is also known as refined flour. e bran and germ are separated i making white flour or maida. Maida bakes uniformly into a loaf of greate volume and it is more bland in taste and more easily digested. e more th refinement, the lesser the nutritional quality.
- **Semolina:** It is coarsely ground endosperm and its chemical composition i similar to that of white flour. Macaroni products: ese products are als called pasta. ese products include macaroni, spaghetti, vermicelli and noodles.
- **Oats:** Oats are whole grains. Both the bran nor germ is removed in differen forms of oats and hence all forms like oat meal, oat flakes and oat bran ar

nutritious. In oats there are significant amounts of beta glucans, soluble fibre which reduces serum cholesterol.

- **Barley:** Barley malt is used in bakery, processed foods and in vinegar and syrup making.

Health Benefits of Cereals

1. **Good source of energy:** When we consume food that is low in nutrients, there is a chance that our body will deplete energy quicker than it should. Cereals are a good source of nutrients. This contributes to the fact that integrating cereals in everyday diet can help you retain your energy levels throughout the day.
2. **Good for kids:** Children need a lot of nutrients in their day to day life. Considering the activities they like to indulge in, nutrients are important to keep their energy levels intact. Eating cereals every day also ensures that the kids consume approximately 10% of fiber everyday.
3. **Good source of fiber:** Fiber is essential for the optimum functioning of the body. One of which is preventing heart disease which can be fatal. Consuming enough fiber per meal can reduce the risk of heart blockages and also aid in digestion.
4. **Rich in vitamin:** Vitamins are essential in maintaining healthy bones. Calcium and vitamin D go hand in hand to ensure the integrity of bones. Cereals, rich in calcium and vitamin D will help you strengthen the bones. This, in addition, will prevent the premature aging of the bones.
5. **Rich in proteins:** The human body requires proteins to build muscles and tissues. They are also important for skin, cartilages, bones, and blood. Different cereals contain different level of protein. When your body lacks proteins, a sure way to bridge that gap is adding breakfast cereals to your diet.
6. **Rich in minerals:** Just like vitamins and proteins, our body requires minerals to grow and stay healthy. Minerals provided by cereals helps generate hormones, keep our heartbeat steady, helps transmit nerve impulses and keep our bones strong. Cereals contain minerals such as magnesium: helps in nerve and muscle function; potassium: helps in lowering the blood pressure. Calcium: helps keep the bones strong.
7. **Prevents heart diseases:** Fatty foods can lead to heart diseases. Eating street food dipped in unhealthy oils will lead to premature heart attacks. Unhealthy eating habits can also cause the arteries of the heart to block because of the accrued fats. Ingesting food that has appropriate amounts of fat is beneficial. Only the fats that our body requires to function is essentially provided by whole grains and cereals.
8. **Help keep healthy sugar levels:** Food rich in carbohydrates makes your glucose levels skyrocket. Adding cereals and whole grain food can help maintain blood levels and decrease the need for eating at short intervals.
9. **Helps in easy bowel movement:** With the increase in age, it becomes hard for the body to process food. Cereals, high in fiber, help with a healthy bowel movement and also keep your weight in check. A regular bowel movement also prevents constipation.

10. **Aids in maintaining weight:** Cereals are less in calories. Their structur complex, taking more time to get processed in the system eliminates feeling of wanting to eat more. Maintaining weight while consuming cere and whole grains every day can keep you satiated and less prone to bi eating.

1.2.1 Millets

Definition

Millets are small grained cereals belonging to the family Gramineae and th include major millets and minor millets. Millets are quite important from the po of food and nutritional security at regional and house hold level.

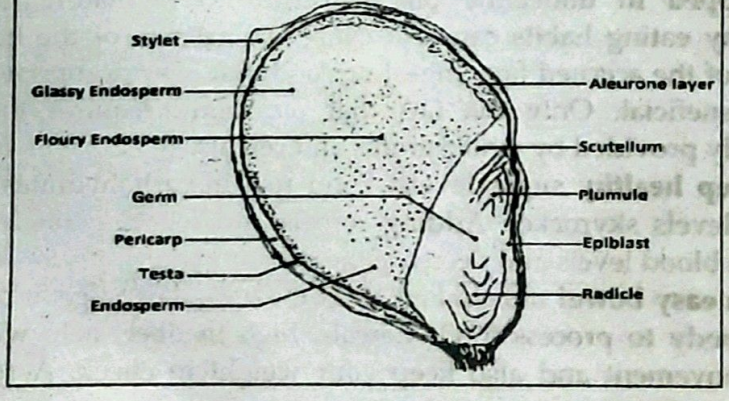
In India's dry lands, they play a significant role in meeting food and fodd requirements of farming communities. Millets are found to have high nutriti value comparable and even superior to major cereals with respect to prote energy, vitamins and minerals.

They are also rich sources of phytochemicals and micronutrients. Since millet gluten-free, it is an excellent option for the people who are suffering fro atherosclerosis, diabetics and heart disease.

In the face of increasing population and stagnant wheat and rice productio millets can be a promising alternative in solving the problem of food insecurity a malnutrition, because of their sustainability in adverse agro-climatic conditio These crops have substantive potential in broadening the genetic diversity of t food basket and ensuring improved food and nutrition security.

Structure of Millets

All millets have a single layer aleurone that completely encircles th endosperm. The aleurone cells are rectangular with thick cell walls, and the contain protein, oil, minerals and enzymes. The peripheral corneous and flour endosperm areas are beneath the aleurone, in that order.



Nutritive Value of Millets

NUTRITIONAL CONTENT IN MILLETS

Millet	Iron (in mg)	Calcium (in mg)	Minerals (in g)	Fibre (in g)	Protein (in g)
Pearl millet	16.9	38	2.3	1.3	10.6
Finger millet	3.9	344	2.7	3.6	7.3
Foxtail millet	2.8	31	3.3	8.0	12.3
Proso millet	0.8	14	1.9	2.2	12.5
Kodo millet	0.5	27	2.6	9	8.3
Little millet	9.3	17	1.5	7.6	7.7
Barnyard millet	15.2	11	4.4	10.1	11.2

Source: Millet Network of India

Types

- **Pearl Millet / Bajra /Kambu:** India is the largest producer of Pearl millet. is millet is an excellent source of phosphorus which is essential for the structure of body cells. It has the same quantity of protein as wheat.
- **Finger Millet / Nachani / Kezhvaragu:** It is also known as finger millet, ragi and red millet. It is well known in Southern India. is millet is rich in protein. e major proteins of ragi are prolamins and glutelins and they appear to be adequate in all essential amino acids. Ragi is rich in minerals especially calcium with good source of iron. The malted ragi flour can be used along with germinated green gram flour to formulate a high calorie-dense weaning food having excellent nutritional qualities. Ragi our can be used with milk beverages.
- **Foxtail Millet /Kangni / Thinai:** Foxtail millets are rich in iron and pest-free. Foxtail acts as anti pest agents which helps to store the delicate pulses like green gram.
- **Kodo millet/Kodra/Varagu:** Kodo millet contains high amount of polyphenols which acts as an antioxidant. It is rich in fiber and low on fat.
- **Little Millet / Kutki / Saamai:** The seeds are smaller in comparison to other millet such as foxtail millet. Little millet has high amount of iron content and fiber like Kodo.
- **Barnyard Millet / Jhangora / Kuthiravali**: Barnyard millets are good source of fiber, phosphorous as well as calcium.
- **Sorghum /Jowar /Cholam:** Sorghum is mostly cultivated due to its high fodder value. Sorghum is rich in nutrients with high amount of protein, unsaturated fats, fiber and minerals such as phosphorus, calcium, potassium and iron.

Health benefits of millets

The various health benefits of millets are:

1. **Healthy heart:** Millets are rich in magnesium which helps to lower the blood pressure and also decreases the chances of strokes, heart attacks and antherosclerosis.

2. **Balance cholesterol level:** The high amount of fiber found in Millet helps lower the cholesterol.
3. **Prevent diabetes:** It helps to reduce the risk of Type 2 diabetes as possesses an adequate amount of magnesium.
4. **Assist digestion:** Since millets are rich in fibre, it helps to enhance th gastrointestinal health and eradicate the ailments such as excess ga constipation, cramping and bloating.
5. **Prevent cancer:** Research shows that fibre is the simplest way to prevent th outbreak of breast cancer in women. Since millets are rich in fiber, it ca prevent occurance of breast cancer.
6. **Detoxication:** Millet contains antioxidants which help to neutralize the fre radicals that can lead to cancer and also clears up the toxins from the live and kidney.
7. **Respiratory health:** Research shows that Millet helps to improve th respiratory health and also prevent asthma. Replace rice or wheat wit millets in preparations such as: Sambar rice , Curd rice, Upma, Kozhukatta Pongal, Idli ,Dosai ,Adai.

1.2.2 Processing of Cereals

Primary Processing

- Θ Primary processing of cereals e main purpose of primary processing o whole cereal grains is to separate the outer layers of the grain from the inne section.
- Θ When the grain is milled to produce white our, the germ and the bran ar discarded.
- Θ The milling process grinds and pounds the grains.
- Θ The process used for milling each grain type is slightly different.
- Θ After milling of the grain, the products can be described in the followin ways:
  - o **Wholegrain or wholemeal products** means the whole of the grain ha been used that is the bran germ and endosperm. Because the oi component in the germ can go rancid after a time, wholemeal product can develop off flavours.
  - o **Refined products** refer to products made only from the endosperm (starch). The bran and germ are removed. Refined products have a longer shelf life but are nutritionally poor because they contain mostly carbohydrate.
  - o **Enriched products** have vitamins and minerals added, usually to give them similar nutritive properties to wholemeal products, but without the fibre content.
  - o **Flour** is the powdered form of the grain after grinding or milling.

- **Meal** is a more coarsely ground product than flour.
- **Instant or quick-cook products** have been cooked, or partially cooked, then dehydrated. When reconstituted they require very little preparation time. Examples include instant porridge, quick-cook rice and instant Asian style noodles.

Secondary Processing

Secondary processing of cereals secondary processing of cereals results in a variety of products.

The main products are as follows:

- **Breakfast cereal production** may involve other processes such as rolling and baking to make flakes. Eg. Wheat flakes.
- **Bread and other bakery items** such as savoury crispbreads, sweet biscuits, cakes and pastries require the additional processes of sifting, mixing, kneading, proving and baking. Some breads and cakes are leavened with raising agents such as yeast and baking powder.
- **Extruded snack foods** – commercially produced using a dough or batter that is extruded and cooked into novelty shapes. Eg. macaroni.
- **Pasta** is formed from our-based dough and formed into shapes by hand or machine.
- **Noodles and dumplings** are manufactured from our-based doughs and shaped, then simmered or poached in liquid.

Milling of Cereals

Cereal processing is complex. e principal procedure is milling, i.e., the grinding of the grain so that it can be easily cooked and rendered into attractive foodstuff. The steps involved in the process of milling are:

- Rice is passed through two stone rubber discs rotating at different speeds and by shearing action on the grain, the hull is pulled away.
- This is then milled in a machine called pearlor to remove coarse outer layers of bran and germ by the process of rubbing, resulting in unpolished milled rice.
- Unpolished rice is liable to develop rancidity and so it is next polished in a brush machine which removes the aleurone layer and yields polished rice.
- Sometimes the polished rice is further treated in a device known as trumbol to give a coating of sugar and talc to produce a brighter shine on the rice. e percentage of losses of different nutrients during milling are: protein 15 percent, fat 82 percent, thiamine 85 percent, riboflavin 70 percent and pyridoxine 50 percent.
- The degree of milling determines the amount of nutrients removed.

Parboling

Parboiling is a process in which rice has been partially boiled in the husk. Th makes rice easier to process by hand, boost its nutritional prole and change texture.

Conventional process

This consists of the following steps:

- Steeping paddy in cold for 2 or 3 days in large cement tanks.
- Steaming of the soaked paddy for 5-10 minutes,
- Drying in the sun.

Hot soaking process

This consists of the following steps:

- Soaking of paddy in water at 65-70°C for 3-4 hours.
- Draining of water and steaming of soaked paddy in the same vessel for 5- minutes.
- Drying of the paddy in the sun or in mechanical driers.

Advantages of parboiling

- ✓ Dehusking of parboiled rice is easy.
- ✓ Milled parboiled rice has greater resistance to insects and fungus.
- ✓ Loss of nutrients due to the removal of husk and bran in milling a decreased.
- ✓ Loss of water soluble nutrients due to washing of rice is less in parboile rice compared to raw rice.
- ✓ Parboiling improves digestibility.

Malting of Cereals

Malting is a controlled germination process, which activates the enzymes of th resting grain resulting in the conversion of cereal proteins and othe macromolecules.

Generally, barley is used in the production of malt. Other grains used in the preparation of malt includes wheat, jowar and ragi.

The process of malting of cereal grains consists of the following steps:

1. **Selection of grain and cleaning.**
2. **Steeping** in cold water for 36 hours with 2 to 3 changes in water.
3. **Germination:** The grains are spread on wire mesh trays and kept for 3 days Water is sprinkled over each of these trays.
4. **Kilning:** The germinated grains are dried at slow rate on kilns. Amylase rich food (ARF) is germinated cereal ours which are extremely rich in the enzyme alpha-amylase. ARF are excellent weaning foods because they reduce the bulk of weaning foods and are energy dense.

Malt is used in commercial proprietary foods, breakfast cereals, malted milk confectionaries, infant foods, bakery products and in brewing.

Cereals Cookery

- **Gelatinisation:** Starch granules do not dissolve readily in cold water but they will form a temporary suspension with the starch tending to settle out as soon as the mixture is allowed to stand.
- When heated with water, the grains absorb water and swell. is process is called as gelatinisation.
- **Gluten formation**: Although all cereals are more or less similar in protein content, the unique presence of glutelin and gliadin in the wheat makes it suitable for certain recipes. Glutenin or glutelin is the protein which gives toughness and rubberiness to gluten. Gliadin gives elasticity. Due to its elastic properties, the dough can be rolled to prepare chapathi or poori.
- **Dextrinisation:** Dry heat also brings changes to starch granules through a process known as dextrinisation. If a starch product is subjected to dry heat, carbohydrate compounds called dextrins are formed. When these are dissolved in water they have a sweet taste. Colour and avor changes also occur. Extensive dextrinisation reduces the thickening power of starches. Eg. Toasted bread.

Fermented Cereals Products

The term fermentation refers to the breakdown of carbohydrates into simpler substances.

The advantages of fermentation are:

- ❖ Flavour and texture of the product are improved.
- ❖ Vitamin B and C content is increased.
- ❖ The product is easily digestible.
- ❖ Acid by- products formed during fermentation inhibits the growth of harmful microorganisms.
- ❖ It provides variety in the diet.
- ❖ Some of the fermented cereal products are: Idly, Dosai, Dhokla, Appam, Bread.

ROLE OF CEREALS IN COOKERY:

1. Cereals are used as thickening agent, eg. corn flour in custard, corn flour in white sauce and macaroni in soups.
2. Cereals are used as coating agent, eg. maida paste in cutlets or bread crumbs in cutlets.
3. Cereals are used in sweet preparations, eg. rice payasam and wheat halwa.
4. Malted cereals are used in the preparation of beverages and weaning mixes.
5. Cereal products like corn flakes and rice flakes are used as ready to use foods.

6. Fermented foods made from cereals are used as breakfast foods or snac eg. idli, dhokla.

1.2.3 Breakfast Cereals

Breakfast cereals have been defined as

- Θ Processed grains for human consumption
- Θ One or more of the cereal grains or milled fractions therefore are inde major constituents of all breakfast cereals, approaching 100% in the case cereals for cooking. The proportion drops well below this in many ready- eat cereals, and to less than 50% in pre-sweetened products. They are ma primarily from corn, wheat, oats, or rice and usually with added flavo and fortifying ingredients.

Classification

Ready-to-eat (RTE) cereals are made primarily from corn, wheat, oats or r usually with added flavour and fortifying ingredients. Breakfast cereals a classified into two major categories: hot cereals and RTE cereals.

Hot cereals are made primarily from oats or wheat nevertheless; hot cere from corn or rice are produced in relatively small quantities. Hot cereals requ cooking at home before they are ready for consumption with the addition of eith hot water or milk.

The processing of RTE cereals involves first cooking the grains with flavouri material and sweeteners. Sometimes more heat stable nutritional fortifying ager are added before cooking. Most RTE cereals are grouped into eight gener categories:

- Θ Flaked cereals
- Θ Gun-puffed cereals
- Θ Extruded gun puffed cereals
- Θ Shredded whole grains
- Θ Extruded and other shredded cereals
- Θ Oven puffed cereals
- Θ Granola cereals
- Θ Extruded expanded cereals

1.3 Sugars

Sugar is a carbohydrate and the simplest form of one. It's found in many different foods – fruit and vegetables contain simple sugars. Cereal grains, root vegetables and tubers are made up of starches, these are complex chains of many sugar molecules – your body breaks these chains down into their simplest form glucose.

These longer chains tend not to be viewed as sugars as such, they are referred to as polysaccharides.

What this means in practical terms is, even the starchy foods you eat are a source of sugar, which can be used to fuel the body. If you don't do enough physical activity and use up this energy it will be laid down in the body for future use.

Sugar is an important source of energy

Sugar in the form of glucose is an important source of energy for our cells and organs. All parts of your body – brain, heart, muscles and liver – need this energy to function.

It is in the form of glucose that energy is transported in the bloodstream as 'blood sugar' for distribution around the body.

Types of Sugars

There are several types of sugars, which are categorized based on their chemical structure and properties:

Monosaccharides

- ✓ **Glucose** - The primary source of energy for the body, found in fruits, honey, and other carbohydrate-rich foods.
- ✓ **Fructose** - Found naturally in fruits, honey, and some vegetables. It is also used as a sweetener in many processed foods.
- ✓ **Galactose** - Produced when lactose (milk sugar) is digested.

Disaccharides

- ✓ **Sucrose** - Table sugar, found in sugarcane and sugar beets.
- ✓ **Lactose** - The sugar found in milk and dairy products.
- ✓ **Maltose** - Formed when starch is broken down, such as during the malting of grains.

Oligosaccharides

- ✓ **Inulin** - Found in many plants, including chicory, onions, and bananas.
- ✓ **Fructooligosaccharides (FOS)** - Found in foods like bananas, onions, and whole wheat.

Polysaccharides

- ✓ **Starch** - The main storage carbohydrate in plants, found in foods like potatoes, rice, and wheat.
- ✓ **Glycogen** - The storage form of glucose in the human body, primarily in the liver and muscles.
- ✓ **Dietary fiber** - Includes cellulose, hemicellulose, and pectin, which are not digested but provide health benefits.

1.3.1 Stages of Sugar Cookery

Making Sugar Syrups and caramel always begins with heating and melt ordinary granulated sugar and recrystallizing it according to need. During heating process the sugar first dissolves into syrup.

As the temperature gets higher the syrup begins to thicken. As the temperat continues to rise and the water evaporates, the sugar begins to caramelize and t a darker color.

As long as there is a lot of water in the syrup mixture the temperature will raise much above the boiling point. As the water begins to evaporate temperature of the mixture also begins to rise. As the water continues to evapora the temperature continues to rise. When most of the water has evaporated temperature of the syrup will begin to rise rapidly. At 320oF there is no water left, the sugar is melted and begins to caramelize, and the sweetness starts to decrea The hotter the caramel gets the darker it becomes, and the deeper and less swe the flavor becomes.

Basically, temperature and the chemical interaction between a given compone and the water molecule determine the component's solubility in water. Sucrose c be kept in solution in pure water at temperatures between 0 and 140°C. temperatures above 100°C, pressurisation is necessary to achieve the solubility. T relatively high solubility of sucrose is an important parameter for its bulking eff in many foods and beverages. The dissolved sugar increases the viscosity of wat based solutions or mixtures, resulting in enhanced mouthfeel. Dissolved sug lowers the freezing point of ice cream by preventing the water molecules fro combining to form ice crystals, which slows down the freezing process. The froz water crystals no longer in solution increase the sugar concentration in t remaining solution and lower the freezing point even further. In bakery produc the solubility, or hygroscopicity, of sugar makes it compete with flour proteins an starch granules for the available water, which minimises gluten formation an decreases gelatinisation of the starch. This makes the final product more moist an tender, and the hygroscopicity of the sugar ensures that it remains that way longe Mixing glucose or invert sugar with sucrose increases the solubility of th combined sugar matrix \and allows for production of products with higher tot sugar solids than when using single components.

Candy making is the preparation of candies and sugar confections. Cand making includes the preparation of many various candies, such as hard candie jellybeans, gumdrops, taffy, liquorice, cotton candy, chocolates and chocola truffles, dragées, fudge, caramel candy and toffee.

Candy is made by dissolving sugar in water or milk to form a syrup, which i boiled until it reaches the desired concentration or starts to caramelize. The type candy depends on the ingredients and how long the mixture is boiled. Cand

comes in a wide variety of textures, from soft and chewy to hard and brittle. Formally the sugar syrup undergoes 6 distinct stages or forms when it has been boiling from room temperature to the utmost temperature of 320 degrees Ferenhite. These stages are named as per the methods used to test the syrup before thermometers became in use. The "thread" stage is the first stage which is tested by cooling a little syrup, and pulling it between the thumb and forefinger. When the correct stage is reached, a thread will form. This stage is used for making syrups.

For subsequent stages, a small spoonful of syrup is dropped into cold water, and the characteristics of the resulting lump are evaluated to determine the concentration of the syrup. A smooth lump indicates "ball" stages, with the corresponding hardness described. At the "soft crack" stage, the syrup forms threads that are just pliable. At the "hard crack" stage, the threads are brittle.

The final texture of candy depends on the sugar concentration. As the syrup is heated, it boils, water evaporates, the sugar concentration increases, and the boiling point rises. A given temperature corresponds to a particular sugar concentration. In general, higher temperatures and greater sugar concentrations result in hard, brittle candies, and lower temperatures result in softer candies. These "stages" of sugar cooking are given in following table

The Seven Stages of Cooking Sugar

Thread	230° to 234° F	The syrup spins a soft, loose, short thread. Types of candy: syrup
Soft Ball	234° to 240° F	The syrup forms a soft, pliable, sticky ball. Types of candy: fudge, fondant, and butter creams
Firm Ball	244° to 248° F	The syrup forms a firm, but still pliable, sticky ball. Types of candy: marshmallows
Hard Ball	250° to 266° F	The syrup forms a hard, sticky ball. Types of candy: nougats and divinity
Soft Crack	270° to 290° F	The syrup forms longer strands that are firm, but yet remain pliable. Types of candy: toffee and butterscotch
Hard Crack	300° to 310° F	The syrup forms stiff strands that are firm and brittle. Types of candy: lollipops, brittle, and glazed fruit
Caramel	320° to 338° F	The syrup changes color, ranging from a light golden to a dark amber brown. It forms hard strands that are firm. Types of candy: caramels and pralines

1.4 Jaggery

Jaggery is a type of traditional unrefined sugar that is commonly used in South Asian cuisines. Here are some key details about jaggery and its culinary uses:

What is Jaggery?

- ✓ Jaggery is a solid, unrefined sugar that is made by boiling and solidifying the juice of sugarcane or date palm.

- ✓ It has a deep, caramelized flavor and a characteristic golden-brown color.
- ✓ Jaggery is minimally processed compared to white refined sugar, retainin more of the natural nutrients and minerals present in the original pla juices.

Culinary Uses of Jaggery

- ✓ Jaggery is widely used in South Asian cuisines, especially in India, Pakistan Bangladesh, and Sri Lanka.
- ✓ It is used to sweeten a variety of savory and sweet dishes, including curries chutneys, sweets, and beverages.
- ✓ Jaggery is a common ingredient in traditional Indian desserts like halwa laddoo, and jalebi.
- ✓ It is also used to make syrups, marinades, and pickles.
- ✓ Jaggery can be used as a substitute for white sugar in baking, though it may impart a different flavor profile.

Varieties of Jaggery

- ✓ Jaggery can be made from different plant sources, including sugarcane, date palm, and coconut palm.
- ✓ The color and flavor of jaggery can vary depending on the source plant and the production process.
- ✓ Common varieties include sugarcane jaggery, palm jaggery, and coconut jaggery, each with its own distinct characteristics.

1.4.1 Manufacturing of Jaggery

The manufacturing of jaggery involves several traditional and labor-intensive steps. Here's a detailed overview of the process:

1. Harvesting and Extraction

- ✓ **Harvesting:** Sugarcane or date palms are harvested when they reach maturity. The cane or palm sap is collected for processing.
- ✓ **Extraction:** For sugarcane, the harvested stalks are cleaned and crushed to extract the juice. For date palms, the sap is collected from the flower buds.

2. Clarification

- ✓ **Juice Filtering:** The extracted juice contains impurities and suspended particles. To clarify it, the juice is filtered to remove dirt and debris.
- ✓ **Clarification Agents:** Sometimes, natural clarifying agents such as lime or alum are added to help settle impurities. These agents are then removed by skimming the surface.

3. Boiling

- ✓ **Initial Boiling:** The clarified juice is poured into large, shallow pans or boiling vessels. It is heated to evaporate excess water. The boiling process is done over a fire or in a specialized boiler.

- ✓ **Consistent Stirring:** The juice is continuously stirred to prevent burning and ensure even concentration. During this stage, impurities that have floated to the surface are skimmed off.

4. Concentration

- ✓ **Thickening:** As the juice boils, it thickens and starts to concentrate into a syrupy consistency. This stage requires careful temperature control to avoid overcooking or burning.
- ✓ **Testing:** The concentration is tested periodically. Traditional methods include using a small sample to check the consistency or using a thermometer to monitor the temperature.

5. Solidification

- ✓ **Cooling and Molding:** Once the syrup reaches the desired consistency (known as the "soft ball" stage), it is poured into molds or spread out to cool and solidify. The syrup is usually poured into rectangular molds or circular discs.
- ✓ **Shaping:** For block jaggery, the syrup is poured into large molds, and for granulated or powdered forms, it may be spread out on a flat surface and allowed to cool and solidify before being broken up or ground.

6. Packaging

- ✓ **Breaking and Grinding:** Once solidified, the jaggery blocks are broken into smaller pieces or granulated. If making powdered jaggery, the pieces are ground into a fine powder.
- ✓ **Packaging:** The jaggery is packaged in airtight containers or wrappers to prevent moisture absorption and contamination. Proper packaging ensures its shelf life and quality.

7. Quality Control

- ✓ **Inspection:** The final product is inspected for quality, including color, texture, and taste. Any impurities or defects are removed.
- ✓ **Testing:** In some cases, further tests may be conducted to ensure there are no harmful residues and that the product meets the required standards.

Key Factors in Jaggery Production

- ✓ **Sugar content of the plant juice** - Higher sugar content leads to a better quality jaggery.
- ✓ **Boiling and evaporation time** - Precise control over the boiling and evaporation process is crucial.
- ✓ **Cooling and solidification** - Gradual cooling and controlled solidification help achieve the desired texture.
- ✓ **Cleanliness and hygiene** - Maintaining cleanliness throughout the manufacturing process is important.

1.4.2 Cookery of Jaggery

Jaggery is a traditional sweetener made from sugarcane juice or date palm often used in various cuisines for its rich, caramel-like flavor. Cooking with ja adds depth and complexity to dishes. Here are some common ways to use ja in cooking:

1. Jaggery Syrup:

Ingredients: Jaggery, water

Instructions:

- ✓ Break jaggery into small pieces.
- ✓ Dissolve the jaggery in a pan with a little water over low heat.
- ✓ Stir continuously until the jaggery completely dissolves and the mi thickens into a syrup.
- ✓ Cool and store in a jar. Use as a sweetener for drinks or as a toppin desserts.

2. Jaggery Rice (Chakkara Pongal):

Ingredients: Rice, jaggery, milk, ghee, cardamom, nuts (cashews, almonds) raisins

Instructions:

- ✓ Cook rice in milk until tender.
- ✓ Add jaggery to the cooked rice and stir until melted and well comb
- ✓ In a separate pan, heat ghee and fry nuts and raisins until golden b
- ✓ Add the ghee, nuts, and raisins to the rice and mix well.
- ✓ Sprinkle cardamom powder before serving.

3. Jaggery Chutney:

Ingredients: Jaggery, tamarind paste, chili powder, cumin powder, salt

Instructions:

- ✓ Dissolve jaggery in a little water over low heat.
- ✓ Add tamarind paste, chili powder, cumin powder, and salt.
- ✓ Simmer until the chutney thickens slightly.
- ✓ Cool and serve with snacks or as a side dish.

4. Jaggery Cake:

Ingredients: Flour, jaggery, butter, eggs, baking powder, milk, vanilla extra

Instructions:

- ✓ Preheat your oven and grease a baking pan.
- ✓ Melt jaggery with a bit of water and let it cool.
- ✓ Cream butter and jaggery together until light and fluffy.
- ✓ Add eggs one at a time, mixing well after each addition.
- ✓ Mix flour and baking powder and add to the wet ingredients alter with milk.

- ✓ Pour into the prepared pan and bake until a toothpick inserted comes out clean.
- ✓ Cool before serving.

5. Jaggery Ladoo:

Ingredients: Besan (gram flour), jaggery, ghee, cardamom, nuts (optional)

Instructions:

- ✓ Heat ghee in a pan and roast besan until it turns golden brown and releases a nutty aroma.
- ✓ Add jaggery and mix well until it melts and blends with the besan.
- ✓ Stir in cardamom powder and nuts if using.
- ✓ Allow the mixture to cool slightly, then shape into small balls (ladoo).

Tips for Cooking with Jaggery:

- **Texture:** Jaggery can vary in texture from soft and sticky to hard and crystalline. You may need to adjust the amount of liquid in your recipe based on its texture.
- **Flavor:** Jaggery has a distinct flavor that can be stronger than refined sugar. Start with a smaller amount and adjust according to taste.
- **Storage:** Store jaggery in an airtight container in a cool, dry place to prevent it from hardening.

MULTIPLE CHOICE QUESTIONS

1. Which of the following has highest protein content ? [d

   a) Bajra b) Ragi c) Wheat d) Oat

2. _____is the outer layer of the kernel. [a

   a) Bran b) endosperm c) germ d) Epidermis

3. Cereals are deficient in amino acid. [a

   a) lysine b) methionine c) cysteine d) germ

4. Parboiling reduces the loss of vitamin [b

   a) A b) B c) C d) D

5. The process of removing bran and germ is called as . [a

   a) milling b) parboiling c) malting d) boiling

6. Which of the ____ components are major nutrients in our food? [d

   a) Carbohydrates b) Lipids and Proteins

   c) Vitamins and Minerals d) All of the above

7. Which of the following food components is required for the [d

   growth and maintenance of the human body?

   a) Proteins b) Vitamins c) Minerals d) Both (a) and (b)

8. _____used as preservatives in jams and jellies. [b

   a) Salt b) Sugar c) Vegetable oil d) Jaggery

FILL IN THE BLANKS

1. If a starch product is subject to dry heat, it is called as ____. **(Gelatinisation)**
2. Pulses give calories per 100 grams is _____. **(340)**
3. Soyabean contains about _____percent of proteins. **(42)**
4. The _____food components give energy to our body. **(Carbohydrates)**
5. Eating a _____ diet keeps us healthy and protects against chroni disease. **(well-balanced)**
6. 10 grams jaggery provides _____ calories of energy. **(38)**
7. _____used as preservatives in jams and jellies. **(Sugar)**
8. Crystallisation of sugar is used in preparations of_____. (Ladoo)

UNIT-II	PLUSES & LEGUMES,NUTS & OIL SEEDS AND FATS & OILS **Pulses & Legumes** - Composition, nutritive value, nutrient losses during processing, importance of germination and malting; anti nutritional factors **Nuts & Oilseeds** - Nutritive value, toxins and role in cookery **Fats & Oils** - Composition, nutritive value, properties- physical and chemical, functions of oils and fat in foods **Rancidity of Oils** - Types and prevention

2.1 Pulses & Legumes

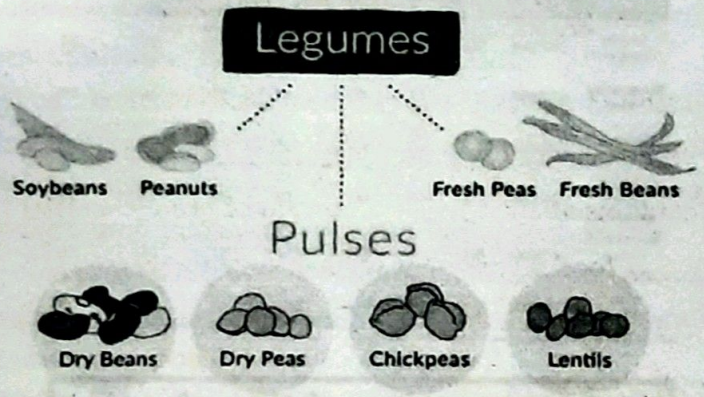
Definition

A legume refers to any plant from the Fabaceae family that would include its leaves, stems, and pods. A pulse is the edible seed from a legume plant. Pulses include beans, lentils, and peas. For example, a pea pod is a legume, but the pea inside the pod is the pulse.

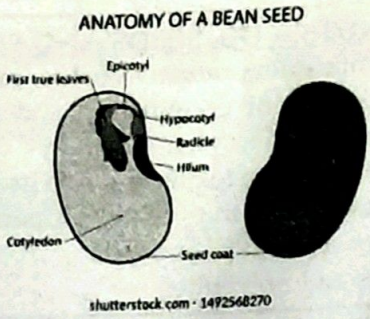
Pulses are edible fruits or seeds of pod bearing plants. Pulses are the edible seeds of plants in the legume family. Pulses grow in pods and come in a variety of shapes, sizes and colors. Different varieties of pulses are grown around the globe. The major pulses or dhals which find important place in Indian diet are red gram dhal, Bengal gram dhal, black gram dhal and green gram dhal. Some pulses like Bengal gram, green gram, rajmah, soya bean dry peas are used as whole grams. A legume is a plant or its fruit or seed. Well known legumes include chickpeas, channa and soyabean.

Structure of Legumes and Pulses

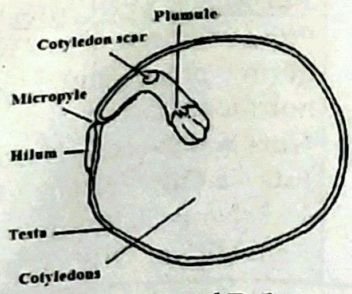
The typical legume seed consists of the seed coat (testa), hilum, lens, micropyle, and embryo. Coloration of the seed coat can be black, brown, reddish, purple, green, yellow, or mottled.



Pulses all have a similar structure, but differ in color, shape, size, and thickness of the seed coat. Mature seeds have three major components: the seed coat, the cotyledons, and the embryo. The seed coat or hull accounts for 7-15% of the whole seed mass.



Structure of Legumes



Structure of Pulses

2.1.1 Nutritive Value of Legumes & Pulses

Legumes are surprisingly nutritious. They contain protein, fiber, B vitam iron, folate, calcium, potassium, phosphorus, and zinc. They're also low in fat calories.

The high lysine and folate content makes pulses perfect for making composite flours with cereals. Pulses and cereal grains have similar t carbohydrate, fat, niacin, riboflavin, thiamine and vitamin B6 contents. Howe pulses has higher protein, folate, iron, magnesium, potassium and zinc content t cereals

Pulses	Protein (gram/kg)	Fat (gram/kg)	Calories (kcal/kg)
Red gram	223	17	3350
Bengal gram	208	56	3720
Green gram	245	12	3480
Masur	251	7	3430
Black gram	240	14	3470
Peas	197	11	3150
Other pulses	220	12	3400

Source: Gopalan *et al.* (1996)

Nutrient profile (per 100g EP)

Pulse	Energy (kcal) (kJ)	Protein (g)	Fat (g)	CHO (g)	Fiber (g)	Fe (mg)	Zn (mg)	Ca (mg)
Lentils, dried, raw	(297)1249	25.8	1.0	39.8	30.5	7.0	3.9	205
Beans, white, dried	(333)1429	22.1	1.5	47.1	16.7	3.7	3.8	196
Cowpea, dried, raw	(336)1360	21.2	1.3	47.2	15.5	7.3	4.6	117
Chickpea, mature seeds, raw	(378)1560	20.8	6.0	62.9	12.2	4.3	2.8	197
Beans, pinto, mature seeds, raw	(347)1540	21.4	1.2	63.3	15.5	5.1	2.3	325
Bean, garbanzo, raw	(329)1377	20.9	1.3	61.2	19.4	6.0	2.9	

2.1.2 Importance of Germination

Whole pulses are soaked overnight, water should be drained away and t seeds should be tied in a loosely woven cloth and hung. Water should be sprinkl twice or thrice in a day. In a day or two, germination takes place.

Adantages of Germibation

- Nutritive value is improved during sprouting.
- During sprouting, minerals like calcium, zinc and iron are released from bound form.
- Vitamin C is synthesised during germination.
- Sprouting decreases cooking time.
- Thickening power of starch is reduced due to conversion of starch to sugars.
- Germination improves taste and texture.
- Germinated pulses add variety to the diet.

Forms of Pilses

Pulses are used in different forms such as:

- Whole legumes
- Decuticled split legumes with and without skin
- Germinated or fermented pulses
- Flour of pulses
- Parched pulses like Bengal gram and peas

SOYABEAN

Soyabean with its high protein contents is considered as a substitute for meat protein which is expensive. Soyabean has 42 grams of protein per 100 grams of the product. Soyabean can be processed to obtain the following products:

1. **Soya flour:** Soya flour is used in combination with wheat flour in preparation of chapathis. It can also be incorporated in the batter used in the preparation of bajji, vadai and pakoda.
2. **Soya milk:** The milk is prepared by grinding soaked beans with water. It is then passed through a mill in a stream of water. e emulsion that is obtained is filtered and transferred to a boiler and mixed with vitaminised margarine to which sugar, salt, calcium and malt are added. e mixture is cooked for 20 minutes, emulsified and then dried.
3. **Tofu:** It can be used like paneer in various preparations.
4. **Textured vegetable protein (TVP):** It is prepared using defatted soya flour from which most of the oil and carbohydrates are removed. It is quick to cook with a protein content compared to certain meats.
5. **Soya protein isolates:** Soya protein isolates are protein granules, isolated by processing. It is fortified with vitamins and minerals and used as a complementary food.
6. **Soya Grits:** Soya grits are made from lightly toasted soya beans that have been ground into coarse pieces. e toasting brings out their pleasant, nutty flavor.

Roleof Pulses in Cookery

1. Pulses are rich in protein and vitamins B and improve the quality of cereal proteins.
2. Pulses give satiety due to high protein and fibre content.
3. Pulses improve flavor and consistencyof dhal sambhar and rasam.
4. They contribute to fermentation in Idli and Dosai batter.
5. They are used in snacks like sundal, bajji, etc.
6. They are used in salads, eg. sprouted gram.
7. They are used in desserts like dhal payasam and sweets like mysorepak and ladoos.
8. They are used as thickening agents, eg. Bengal gram flour in gravies.
9. Roasted pulses are used in chutneys and chutney powders.
10. They are used as seasonings and curries.

Health Benefits of Pulses

1. **Good for Your Heart:** Pulses are high in fiber and potassium which is useful in lowering blood pressure and reducing the risk of heart diseases.
2. **Lower Risk of Diabetes:** Pulses are a low-glycemic index food. Including pulses in the diet can make it easier to manage the blood sugar.
3. **High in Protein:** Pulses also make a healthy and inexpensive source of protein.
4. **Good Source of Folate:** Pulses also are a good source of folic acid, a B vitamin needed to produce and maintain new cells.
5. **Pulses can help maintain and lose weight:** The fibre in pulses increase the satiety value and helps in reducing and maintaining weight.

2.1.3 Anti Nutrituonal Factors of Pulses

Trypsin inhibitors

- Trypsin inhibators are proteins that inhibit the activity of trypsin in the gut and interfere with digestability of dietary proteins and reduce their utilisation.
- Pancreas enlargement and growth retardation occur in animals that consume diet containing trypsin inhibators.
- They are generally heat labile and moist heat treatment like pressure cooking destroys them.
- Autoclaving at 120°C for 15-30 minutes inactivates almost all trypsin inhibators.
- These inhibitors prevent degradation of storage proteins during seed maturation.
- They are present in red gram, Bengal gram, cowpea, double bean, soyabean and dry peas.

- Trypsin inhibitors are proteins that inhibit the activity of trypsin in the gut and interfere with digestibility of dietary proteins and reduce their utilisation.

Lathyrogens

- Lathyrism is a nervous disease that cripples man.
- It is known to result from an excessive consumption of the pulse kesari dhal (Lathyrissativus).
- It affects young men between the age of 15 to 45 yrs.
- Lathryus is known by the common name "Khesari Dal".
- The dehusked seeds resemble Bengal gram dal or red gram dal.
- Hence, sometimes kesari dhal is used as an adulterant in other dals.
- The symptoms of lathyrism are muscular rigidity, weakness, paralysis of the leg muscle.

Haemagglutinins

- These are proteins in nature and they occur widely in leguminous seeds.
- Haemagglutinins reduce the food intake resulting in poor growth.
- These are proteins in nature and sometimes referred to as phyto agglutinins or lectins.
- Haemagglutinins are isolated from soya bean, field bean, white bean, double bean and horse gram.
- Haemagglutinins are heat labile.

Favism

- Favism is a disease characterised by haemolytic anaemia that occurs when individuals who are deficient in glucose – 6 - phosphate dehydrogenase consume faba beans or broad beans.
- Three different compounds present in faba beans have been implicated as playing a causative role in the disease.
- Two of these are glycosides known as vicine and covicine and the third is an amino acid derivative known as dihydroxy phenyl alanine, DOPA.
- Germinating and boiling reduce these toxic substances.

Cyanogenic glycoside

- cyanogenic glycosides include linamarin from cassava and amygdalin from the seeds of stone fruit. The amount of cyanogenic glycosides in plants is usually reported as the level of releasable hydrogen cyanide.
- Ingestion of cyanogenic glycoside-containing plants can cause acute poisoning. Symptoms are seen usually within a few hours of exposure, include apprehension, ataxia, weakness, hyperventilation, recumbency, cardiac arrhythmias and death.

Saponins

- These are present in soyabeans, Saponoins cause nausea and vomiting.
- These toxins can be eliminated by soaking prior to cooking.

Goitrogens

- These substances interfere with iodine uptake by thyroid gland.
- They are present in soyabean and groundnuts.
- Excessive intake of these foods may lead to precipitation of goitre.

Tannins

- They have high amount of seed coat in most legumes.
- Tannins bind with iron irreversibly and interfere with iron absorption.
- Tannins also bind proteins and reduce their availability.
- These toxic constituents can be removed during processing and cooking.

2.1.4 Nutrional Losses During Processing of Pulses & Legumes

Processing of pulses and legumes, such as beans, lentils, and chickpeas, ca lead to nutritional losses. The extent of these losses depends on the type o processing and the specific nutrient in question. Here's a general overview:

1. Cooking
   - **Vitamins:** Cooking can lead to the loss of water-soluble vitamins such as vitamins (especially folate) and vitamin C. For example, boiling beans ma reduce their folate content significantly.
   - **Minerals:** The leaching of minerals (like potassium and magnesium) int the cooking water can occur. However, some minerals are less affected b cooking.
   - **Proteins and Carbohydrates:** Cooking generally makes proteins mor digestible and carbohydrates more available, though some protein might b lost in the cooking water.
2. Soaking
   - **Vitamins:** Soaking pulses can cause the loss of water-soluble vitamins similar to cooking.
   - **Phytates:** Soaking can reduce the levels of phytic acid, which is an anti-nutrient that can inhibit the absorption of minerals like iron and zinc.
3. Dehulling and Milling
   - **Fiber:** Removing the outer hull or bran can reduce the fiber content of pulses. The hull contains a significant amount of dietary fiber, so dehulled pulses have lower fiber levels.
   - **Vitamins and Minerals:** The outer layers also contain some vitamins and minerals, so milling or dehulling can reduce these nutrient levels.
4. Drying
   - **Vitamins:** Drying can lead to losses in certain vitamins, particularly those sensitive to heat and oxidation.

- **Minerals and Proteins:** Generally, drying has a lesser impact on minerals and proteins compared to other processing methods.

5. Sprouting

- **Vitamins:** Sprouting can increase the content of certain vitamins, such as vitamin C and B vitamins, and enhance their bioavailability.
- **Phytates:** Sprouting can also reduce phytic acid content, improving mineral absorption.

6. Fermentation

- **Vitamins:** Fermentation can enhance the availability of some nutrients and produce beneficial compounds, but it might also reduce levels of certain vitamins.
- **Digestibility:** Fermentation can improve the digestibility and nutritional quality of pulses by breaking down anti-nutrients and enhancing nutrient availability.

Minimizing Nutritional Losses

To minimize nutritional losses, consider the following tips:

- Use minimal water and avoid excessive cooking times to preserve vitamins and minerals.
- Incorporate cooking water into dishes when possible to retain leached nutrients.
- Soak pulses in minimal water and use the soaking water in cooking to retain nutrients.
- Choose whole pulses over dehulled varieties to retain more fiber and nutrients.
- Utilize methods like sprouting and fermentation to enhance nutrient profiles.

2.2 Nuts & Oilseeds

The total development of agriculture, especially the growth of "nuts and oils" is connected with bio instrumentation. In Indian agriculture, various kinds of "nuts and oilseed" are found. Nut is generally fallen in the category of peanuts, walnuts, almond hazelnut, brazil nut etc. The oilseed is generally fallen into the sunflower, flax, sesame, squash etc. Nuts and oils are generally found as a good source of healthy nutrients but it is also found that they lack the fiber in entire nuts, that is examined in the process of bioinstrumentation. Walnut oil can be found the highest in omega 3s. In general "nuts and oils "are used in salads and numerous delicious foods." Nuts and oils are both very useful for health. Walnut oil is considered to be a rich source of nutrients and antioxidants. It is found to be helpful in increasing a person's memory as well as concentration. Most walnuts are used to reduce fat from the body. "Nuts and oils" are very useful in order to prevent the risk of heart

attack and other heart diseases. It is radically found that walnuts are most useful for health and they have the most oil that is obtained through the process of bioinstrumentation. Bioinstrumentation is an application that is used to measure the quality and the virtues of "nuts and oils". From the cultivation of "nuts and oilseed", and it contributes to Indian economic development.

Importance of Nuts & Oilseeds

Oilseeds and nuts contain good fats, vitamins, fibres, proteins and minerals. They aid in shedding weight because their fats are not soaked up. It also helps to burn down energy and control food intake.

According to a study, making nuts a regular part of a diet aids in controlling your weight and safeguards against chronic diseases (such as heart disease and diabetes)

Due to unsaturated fatty acids, these nuts and oilseeds are exceptional in producing oil from them. Mostly peanut and sunflower oil is extracted, and the most precious is flaxseed oil. These seeds have the goodness of omega-3 fatty acids which prevent atherosclerosis-related heart diseases.

Nuts

Almonds, cashew nuts, Brazil nuts, hazelnuts, pecans, macadamias, pine nuts, walnuts, pistachios, and peanuts are the most widely used nuts in the world.

The Dietary Guidelines recommend 30 grams of nuts on most days of the week. These nuts and oilseeds are a vital source of unsaturated fatty acids with minimal saturated fat and contain zero cholesterol levels.

They also contain proteins, minerals (calcium, magnesium, zinc, iron, selenium), vitamins, essential fatty acids, polyunsaturated fatty acids and phytochemicals.

The quantity to be eaten in a day is significantly less, so the amount of protein supplied to our body is undoubtedly less.

Health Facts About Nuts

- Nuts are loaded with nutrients like unsaturated fats, omega-3 fatty acids, vitamins and fibre and reduce the risk of heart diseases.
- Pistas, walnuts, etc., combat inflammation in healthy people and those with medical conditions like diabetes and kidney stones.
- They are loaded with antioxidants that protect the fats in your cells from being damaged by oxidation.
- Though nuts like almonds and pistas may be high in energy and fats, consuming them is not linked with weight gain. In fact, in one of the studies, nuts have been shown to reduce weight.

- They maintain blood vessels' health for proper blood pressure and lower inflammation as they are high in antioxidants.
- They are an excellent source of monosaturated and polyunsaturated fats and are low in saturated fats.

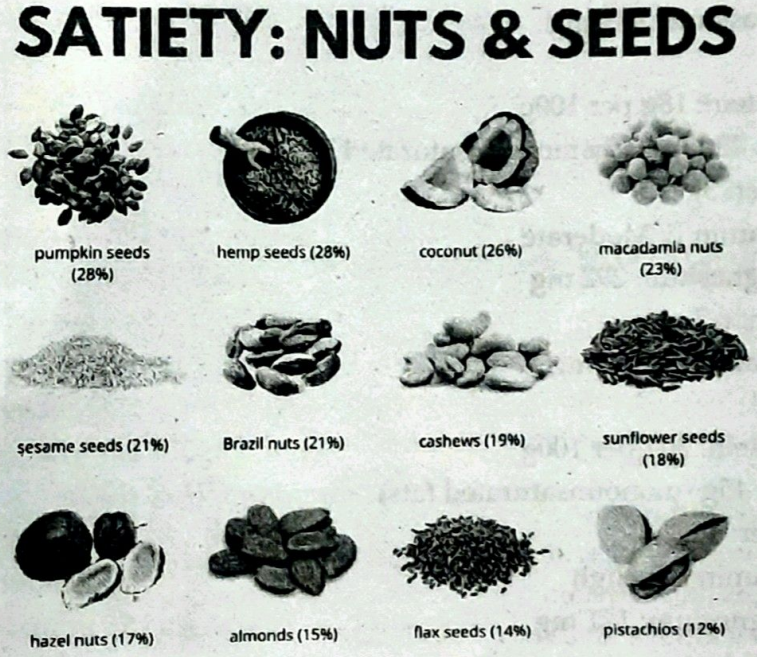
Seeds

Pumpkin seeds, poppy seeds, sesame seeds, psyllium seeds, sunflower seeds, flax seeds, and chia seeds are distinct forms of seeds.

Not only are seeds good for fats and vitamins, but they also provide fibre and carbohydrates. The sources like sunflower also contain reasonable amounts of vitamin E, which is considered to have anti-ageing properties.

Benefits of Seeds

- Seeds are a significant source of dietary fibre, which keeps your digestion system healthy.
- They aid in shedding weight.
- They reduce the inflammation level in the body, ward off ageing, and lower the risk of heart disease.
- They are rich in minerals like magnesium, selenium, copper and zinc, which are essential for our body.
- Reduces the risk of diabetes



2.2.1 Nutritive value

There is the recognition that nuts are a good source of many nutrients, including monounsaturated and polyunsaturated fatty acid profile, vitamins E and K, selected minerals such as magnesium, copper, potassium, and selenium, dietary fibers, carotenoids, and phytosterols with potential antioxidant action

Nuts and seeds are nutrient-dense foods, offering a range of essential nutrients that contribute to overall health. Here's a breakdown of the key nutrients found in common nuts and seeds:

1. Nuts

Almonds

- ✓ Protein: 21g per 100g
- ✓ Fat: 49g (mostly monounsaturated fats)
- ✓ Fiber: 12g
- ✓ Vitamin E: High (an antioxidant)
- ✓ Calcium: 269 mg
- ✓ Magnesium: 270 mg
- ✓ Iron: 3.7 mg
- ✓ Potassium: 733 mg

Walnuts

- ✓ Protein: 15g per 100g
- ✓ Fat: 65g (high in polyunsaturated fats, including omega-3 fatty acids)
- ✓ Fiber: 7g
- ✓ Vitamin E: Moderate
- ✓ Magnesium: 158 mg
- ✓ Iron: 2.9 mg
- ✓ Potassium: 441 mg

Cashews

- ✓ Protein: 18g per 100g
- ✓ Fat: 43g (mostly monounsaturated fats)
- ✓ Fiber: 3g
- ✓ Vitamin E: Moderate
- ✓ Magnesium: 292 mg
- ✓ Iron: 6.7 mg
- ✓ Potassium: 565 mg

Pistachios

- ✓ Protein: 20g per 100g
- ✓ Fat: 45g (monounsaturated fats)
- ✓ Fiber: 10g
- ✓ Vitamin B6: High
- ✓ Magnesium: 121 mg
- ✓ Iron: 4 mg
- ✓ Potassium: 1025 mg

Brazil Nuts

- ✓ Protein: 14g per 100g
- ✓ Fat: 66g (mostly polyunsaturated fats)
- ✓ Fiber: 8g

- ✓ Selenium: Extremely high (a key antioxidant)
- ✓ Magnesium: 376 mg
- ✓ Iron: 2.4 mg
- ✓ Potassium: 659 mg

2. Seeds

Chia Seeds

- ✓ Protein: 17g per 100g
- ✓ Fat: 31g (high in omega-3 fatty acids)
- ✓ Fiber: 34g
- ✓ Calcium: 631 mg
- ✓ Magnesium: 335 mg
- ✓ Iron: 7.7 mg
- ✓ Potassium: 407 mg

Flaxseeds

- ✓ Protein: 18g per 100g
- ✓ Fat: 42g (high in omega-3 fatty acids)
- ✓ Fiber: 27g
- ✓ Calcium: 255 mg
- ✓ Magnesium: 392 mg
- ✓ Iron: 5.7 mg
- ✓ Potassium: 813 mg

Pumpkin Seeds

- ✓ Protein: 19g per 100g
- ✓ Fat: 49g (mainly monounsaturated and polyunsaturated fats)
- ✓ Fiber: 6g
- ✓ Magnesium: 592 mg
- ✓ Iron: 8.8 mg
- ✓ Zinc: 7.8 mg
- ✓ Potassium: 809 mg

Sunflower Seeds

- ✓ Protein: 21g per 100g
- ✓ Fat: 51g (mostly polyunsaturated fats)
- ✓ Fiber: 8g
- ✓ Vitamin E: High
- ✓ Magnesium: 325 mg
- ✓ Iron: 5.0 mg
- ✓ Potassium: 645 mg

Sesame Seeds

- ✓ Protein: 18g per 100g
- ✓ Fat: 50g (mostly unsaturated fats)
- ✓ Fiber: 11g

- ✓ Calcium: 975 mg
- ✓ Magnesium: 351 mg
- ✓ Iron: 14.6 mg
- ✓ Potassium: 468 mg

Food	Energy K.cal	Protein g.	Fat g.	Carbohydrates g.	Calcium mg.	Iron mg.	B-carotene	Thiamine mg.	Riboflavin mg.	Niacin mg.
Almond	655	20.8	58.9	10.5	230	5.1	0	0.24	0.57	4.4
Cashew nut	596	21.2	46.9	22.3	50	5.8	60	0.63	0.19	1.2
Coconut dry	662	6.8	62.3	18.4	400	7.8	0	0.08	0.01	3.0
Coconut fresh	444	4.5	41.6	13.0	10	1.7	0	0.05	0.10	0.8
Ground nuts	567	25.3	40.0	26.1	90	2.5	37	0.90	0.13	19.9
Mustard seeds	541	20.0	39.7	23.8	490	7.9	162	0.65	0.26	4.0
Soybean	432	43.2	19.5	20.9	240	10.4	426	0.73	0.39	3.2
Walnut	687	15.6	64.5	11.0	100	2.6	6	0.45	0.40	1.0

2.2.2 Toxins in Nuts and Oil Seeds

Despite of so many health benefits, nuts & oilseeds have some demerits in th form of toxic constituents present in them or developed due to inadequate storag conditions. Some of them are described below:

- ✓ The aflatoxins are a group of toxic fungal metabolites (mycotoxin produced by certain moulds of the genus Aspergillus growing on a numbe of raw food commodities like oilseeds, groundnuts , pistachios, brazilnuts sunflower seeds, black pepper, figs, maize etc The highest levels are usually found in commodities from warmer regions of the world where there is a great deal of climatic variation of temperature, rainfall and humidity.At high enough exposure levels, aflatoxins can cause acute toxicity, and potentially death, in animals and humans. The liver is the principal organ affected, followed by lungs, kidneys, brains and hearts. Acute necrosis and cirrhosis of the liver is typical, along with bleeding and oedema. Pre-harvest control of aflatoxins is best achieved through good agricultural practices. The production of toxins can be controlled by treating with a quick lime-ammonia mixture, Around 100 countries around the world have regulations governing aflatoxins in food and most include maximum permitted, or recommended levels for specific commodities.
- ✓ Lectins present in some nuts and seeds can irritate the gut lining and create inflammation. Enzyme inhibitors present in them can prevent the digestion

of proteins. Therefore it is recommended to cut down all the nuts & oilseeds from the diet of people with digestive & autoimmune problems.

- ✓ Phytic acid present in nuts, binds minerals like calcium, iron & magnesium and prevent them from being absorbed. The Phytic acid content of Cashews is 1866 mg, Hazelnuts 1620 mg, Almonds 1280 mg,,Walnuts 760 mg and Chestnuts 47 mg per 100gm of nuts. Soaking nuts overnight in salted water is an easy way to get rid of most of the Phytic acid and other antinutrients. After soaking nuts can be rinsed, dried in sun or dehydrator and then stored for future use.
- ✓ High amount of Polyunsaturated fat (PUFA) also contribute to chronic and metabolic diseases like Diabetes, Heart diseases and Obesity, if nuts are consumed in greater quantities along with Fructose i.e. fruit sugar.
- ✓ Another toxin is Gossypol, produced by pigment glands of cotton seeds endosperm. It is largely removed during oil refining. Varieties of cotton seeds devoid of the glands are safe from this toxin.

2.2.3 Role in Cookery in Nuts and Oil Seeds

Nuts and oilseeds are used in cookery as whole, halved, flaked, nibbed, ground or desiccated.

- ✓ Nuts are used in fresh, raw, roasted or boiled or salted forms and also fried forms.
- ✓ Nuts are used as thickening agents. Coconut, poppy seeds and cashewnuts are used as thickening agents in the preparation of gravy.
- ✓ Chutneys can be made and used from nuts, e.g., groundnut and coconut.
- ✓ Sweets are made and used from nuts, e.g., chikki, burfi, kozhukattai, cashewnut cake.
- ✓ Oil is used as cooking media for frying and seasoning. Oil is also used as preservative in pickles.
- ✓ Powders made out of nuts like groundnut and coconut are used as chutneys and salad dressing.
- ✓ Nuts are also used in ice-creams, cakes, pastries, payasams and chocolate.
- ✓ Nuts are also used in beverages, e.g., badam kheer.
- ✓ Peanut butter is used as a topping on the bread or as a side dish along with chapattis.
- ✓ Oilseed cakes are used as weaning food or as a thickening agents in vegetables like capsicum
- ✓ Nuts are used as garnishing material – raw, roasted, salted or boiled forms.

For kitchen use the following types of prepared nuts are available

- ✓ **Ground-** almonds, groundnuts.
- ✓ **Nibbed** – almonds, peanuts for decorating iced dishes, pastry goods

- ✓ **Flaked-** almonds for decoration cakes and pastries halwa.
- ✓ **Halved-** almond, walnuts for salads, in cakes, decorating cakes.
- ✓ **Whole-** almonds, hazelnuts for decorating cakes and pastries.
- ✓ **Desiccated-** coconut for flavoring cakes, decorating cakes curries.
- ✓ **Essence –** almond for flavouring cakes and fillings.

2.3 Fats & Oils

Fats

In nutrition, biology, and chemistry, fat usually means any ester of fatty acids or a mixture of such compounds, most commonly those that occur in living beings or in food.

They are solid at room temperature. There are two types of fats that are solid at room temperature. They are saturated fats and trans fats.

Saturated fat is also known as solid fat. Saturated fat in fish and poultry is less when compared to animal fat or red meat. This fat can increase your cholesterol levels. Tropical oils such as cocoa butter, coconut oil, and palm oil also have saturated fats. It is mostly found in non-dairy products and snacks in large quantities. Cakes, butter, and cookies are some examples of food containing maximum saturated fats.

A fat is changed to increase its shelf life. The process to make this change happen is called hydrogenation. This fat is harder at room temperature. The importance of trans fat is that it makes flakier pie crusts and crispier crankers. It is found in cookies, chips, processed food etc. Avoid eating or consuming fewer foods containing trans fats as it increases your cholesterol levels.

Oils

Fats that are liquid at room temperature are called oils.

Unsaturated fats belong to this category. Consuming food containing unsaturated fat helps improve cholesterol levels. There are two types of unsaturated fats. Monounsaturated fats and polyunsaturated fats.

Monounsaturated fat is found in nuts, vegetable oils and avocado. Consuming food that is rich in monounsaturated fats helps in controlling cholesterol levels by keeping high good HDL cholesterol and lowering bad LDL cholesterol.

Polyunsaturated fat is found in oils such as sunflower, corn and soybean. Seafood majorly consists of these fats. Replacing saturated fat with polyunsaturated fat in food consumption may help in lowering LDL cholesterol. There are two types of polyunsaturated fats. They are Omega 3 and Omega 6.

Difference between Fats and Oils	
Fats	**Oils**
Solid at room temperature	Liquid at room temperature
Saturated and trans are its types	Unsaturated fats like monounsaturated and polyunsaturated are its types
Mostly derived from animal	Mostly derived from plants
Increases cholesterol levels	Improves cholesterol levels
Mainly comes from animal food but also through vegetable oil by process called hydrogenation	Mainly comes from plants or fish
Example: Butter, beef fat	Example:Vegetable oil, fish oil
Contains 9 cal/gm	Contains 9 cal/gm

2.3.1 Composition

Oils and fats are primarily composed of triglycerides, which are molecules made up of three fatty acids attached to a glycerol backbone. The composition of fats and oils can vary depending on the type of fat, the source, and the presence of other compounds. Here's a breakdown of the main components and types of fats and oils:

1. Fatty Acids

Fatty acids are the building blocks of fats and oils. They are classified based on their chemical structure into several categories:

Saturated Fatty Acids

- ✓ **Structure:** No double bonds between carbon atoms (fully saturated with hydrogen atoms).
- ✓ **Sources:** Animal fats (butter, lard) and some plant oils (coconut oil, palm oil).
- ✓ **Health Impact:** Typically solid at room temperature; excessive intake may be linked to higher cholesterol levels and increased risk of heart disease.

Monounsaturated Fatty Acids (MUFA)

- ✓ **Structure:** One double bond in the fatty acid chain.
- ✓ **Sources:** Olive oil, avocado oil, canola oil, nuts (e.g., almonds, cashews).
- ✓ **Health Impact:** Generally liquid at room temperature; considered heart-healthy and may help lower bad LDL cholesterol while raising good HDL cholesterol.

Polyunsaturated Fatty Acids (PUFA)

- ✓ **Structure:** Two or more double bonds in the fatty acid chain.
- ✓ **Sources:** Fish oil, flaxseed oil, sunflower oil, walnuts.

- ✓ **Health Impact:** Liquid at room temperature; includes omega-3 (e.g., and DHA) and omega-6 fatty acids. Omega-3s are beneficial for h health, while omega-6s are essential but should be balanced with ome intake.

2. Types of Fats and Oils

Saturated Fats

- ✓ **Composition:** High in saturated fatty acids.
- ✓ **Examples:** Butter, lard, coconut oil, palm oil.
- ✓ **Properties:** Solid at room temperature.

Monounsaturated Fats

- ✓ **Composition:** High in monounsaturated fatty acids.
- ✓ **Examples:** Olive oil, canola oil, avocados.
- ✓ **Properties:** Liquid at room temperature but can solidify when chilled.

Polyunsaturated Fats

- ✓ **Composition:** High in polyunsaturated fatty acids.
- ✓ **Examples:** Fish oil, flaxseed oil, sunflower oil.
- ✓ **Properties:** Liquid at room temperature and remains liquid even w chilled.

Trans Fats

- ✓ **Composition:** Created through hydrogenation of unsaturated fats, result in a structure that is partially saturated.
- ✓ **Examples:** Partially hydrogenated oils, some margarine and proces foods.
- ✓ **Properties:** Solid or semi-solid at room temperature.
- ✓ **Health Impact:** Associated with increased risk of heart disease and sho be minimized in the diet.

3. Other Components

- ✓ **Phytosterols:** Plant compounds found in vegetable oils, nuts, and seeds t can help reduce cholesterol levels.
- ✓ **Tocopherols (Vitamin E):** Antioxidants present in oils like sunflower a wheat germ oil.
- ✓ **Polyphenols:** Antioxidants found in olive oil and some other plant-base oils that can provide additional health benefits.

2.3.2 Nutritive Value of Fats & Oil

Fats and oils are important to us for energy and some essential nutrients:

- ☑ As you may have already studied in Unit 5 of Block 1, fats are the riche source of energy. One gram of fat provides 9 Kcal of energy which is mo than double the amount provided by the same amount of carbohydrates o proteins. As fats are rich in energy, they make our diet less bulky. Yo should however, not consume too much of fats because if taken in exces these are stored in the body and lead to over-weight. Fats and oils provid

us vitamins A, D, E and K. Fats from animal sources like ghee and butter are especially rich in Vitamin A. Vitamin A and D are added to vanaspati. As you have read in Unit 4 of Block 1, vitamin A keeps our eyes healthy, and vitamin D is needed for healthy bones and teeth.

- ☑ Oils are a source of some important fatty acids which keep our skin and heart healthy. They protect the skin from eczema and reduce the chances of heart attacks in elderly people.
- ☑ Fats give us a feeling of satisfaction and fullness. This is so because fats take more time to get digested and so remain in the stomach for a longer time.

Nutritional significance of fats and oils

- ☑ Concentrated source of energy (9 k.cal / 1 gm) . By weight provides 2.25 times more energy than proteins and Carbohydrates.
- ☑ Reduce bulk in the diet.
- ☑ Excellent sources of fat soluble vitamins A, D, E and K.
- ☑ Play important role in the bio-synthesis of several long chain fatty acids.
- ☑ Provide EFA (linoleic acid) are components of membranes of living cells.
- ☑ Used in prostaglandlin synthesis which is involved in large variety of vital physiological functions, like reducing the blood clotting rate and presents clot blocking of coronary arteries.
- ☑ Slow in leaving stomach and lance retard digestion. Thus delays the pangs of hunger.
- ☑ Digestibility – 95 to 98%
- ☑ Digestibility depends on melting point (M.P)
  - ⊖ Melting point – < 430C – completely digested
  - ⊖ Melting point – > 430C – slowly digested.

Here's a general idea of the composition of some common oils:

Olive Oil

- **Fatty Acids:** ~73% monounsaturated (oleic acid), ~11% polyunsaturated, ~14% saturated.
- **Vitamin E:** High.
- **Other Compounds:** Polyphenols, antioxidants.

Canola Oil

- **Fatty Acids:** ~62% monounsaturated, ~32% polyunsaturated (including omega-3), ~7% saturated.
- **Vitamin E:** Moderate.
- **Other Compounds:** Low levels of other nutrients.

Coconut Oil

- **Fatty Acids:** ~90% saturated (mostly medium-chain triglycerides like lauric acid), ~6% monounsaturated, ~2% polyunsaturated.

- **Vitamin E:** Low.
- **Other Compounds:** Contains some antioxidants.

Flaxseed Oil

- **Fatty Acids:** ~55% polyunsaturated (omega-3 fatty acids), ~2 monounsaturated, ~9% saturated.
- **Vitamin E:** High.
- **Other Compounds:** Lignans (plant compounds with antioxid properties).

2.3.3 Properties of Fats and Oils (Physical & Chemical)

Contrary to what you might expect, pure fats and oils are colorless, odorle and tasteless. The characteristic colors, odors, and flavors that we associate w some of them are imparted by foreign substances that are lipid soluble and ha been absorbed by these lipids. For example, the yellow color of butter is due to t presence of the pigment carotene; the taste of butter comes from two compounds diacetyl and 3-hydroxy-2-butanone—produced by bacteria in the ripening crea from which the butter is made.

The analysis of the physical properties of oils and fats allows us to understa the behavior and characteristics of these elements, as well as their differences.

Physical Properties of Fats and Oils

- **State:** At room temperature, fats are generally solid or semi-solid, while o are liquid. This is due to the differences in the fatty acid composition.
- **Melting Point:** Fats have higher melting points compared to oils, typicall ranging from 20°C to 40°C. The melting point is influenced by the degree saturation, chain length, and the presence of double bonds in the fatty acids
- **Boiling Point:** Fats and oils have high boiling points, typically above 300°C due to their high molecular weight.
- **Density:** Fats and oils have a lower density than water, with typical value ranging from 0.90 to 0.93 g/cm³.
- **Viscosity:** Oils generally have a lower viscosity than fats, which is influenced by temperature, degree of saturation, and molecular weight.
- **Color and Appearance:** Fats and oils can range in color from clear to yellow, depending on the source and degree of refinement.

Fats and oils are organic compounds that, like carbohydrates, are composed of the elements carbon (C), hydrogen (H), and oxygen (O), arranged to form molecules. There are many types of fats and oils and a number of terms and concepts associated with them, which are detailed further here.

Chemical Properties of Fats and Oils

- **Fatty Acid Composition:** Fats and oils are composed of fatty acids, which can be saturated, monounsaturated, or polyunsaturated. The specific fatty acid composition determines many of the chemical and nutritional properties.
- **Saponification:** Fats and oils can be saponified (reacted with a base) to produce soap and glycerol. This reaction is important in the production of soap and biodiesel.
- **Hydrolysis:** Fats and oils can undergo hydrolysis, where the ester bonds between the glycerol and fatty acids are broken down, resulting in the formation of free fatty acids and glycerol.
- **Oxidation:** Fats and oils are susceptible to oxidation, which can lead to the development of off-flavors, rancidity, and the formation of harmful compounds. The degree of unsaturation and the presence of antioxidants influence the oxidative stability.
- **Iodine Value:** The iodine value is a measure of the degree of unsaturation in fats and oils. It is used to determine the susceptibility of the oil to oxidation and the overall quality.
- **Acid Value:** The acid value is a measure of the free fatty acid content in fats and oils, which can indicate the degree of hydrolysis or rancidity.

2.3.4 Functions of Oil and Fat in Food

Oils and fats supply calories and essential fats and help your body absorb fat-soluble vitamins such as A, D, E and K. The type of fat is just as important for health as the total amount of fat consumed. That's why it's important to choose healthier unsaturated fats. Eating too much and the wrong kinds of fats, such as saturated and trans fats, may raise unhealthy LDL cholesterol and lower healthy HDL cholesterol. This imbalance can increase your risk of high blood pressure, hardening of the arteries (atherosclerosis), heart attack and stroke.

Fats and oils serve several important functions in the body:

- **Energy storage:** Fats are the most concentrated source of energy in the diet, providing 9 calories per gram compared to 4 calories per gram for carbohydrates and proteins. Excess calories are stored as fat for later use as energy.
- **Insulation and protection:** Subcutaneous fat provides insulation to help maintain body temperature. Fats also cushion and protect internal organs.
- **Nutrient absorption:** Fats are required for the absorption of fat-soluble vitamins (A, D, E, and K) and facilitate the transport of these nutrients throughout the body.
- **Cell membrane structure:** Fats are a key structural component of cell membranes, which control the passage of substances in and out of cells.

- **Hormone production:** Cholesterol, a type of fat, is a precursor fo production of steroid hormones like estrogen, testosterone, and cortisol.
- **Taste and texture:** Fats provide a rich, creamy mouthfeel and contribu the palatability of foods.

Oil and fat play several crucial roles in food, both in terms of flavor and te Here are some of their key functions:

- **Flavor:** Fat and oil enhance the flavor of foods by carrying and intensif flavors. Many flavor compounds are fat-soluble, so they dissolve in fa can be better perceived by the taste buds.
- **Texture:** They contribute to the texture of foods, making them tender rich. In baking, for instance, fats help create a flaky or crumbly textu pastries and cookies.
- **Moisture:** Fats help retain moisture in baked goods and other fo preventing them from becoming dry. They can also help create a m succulent texture in meats.
- **Cooking Medium:** Oils are used as cooking mediums for frying, saut and roasting. They can reach high temperatures without burning, whi essential for many cooking techniques.
- **Emulsification:** Fats help in emulsifying ingredients that don't norm mix well, such as oil and water. This is crucial in making products mayonnaise and salad dressings.
- **Richness:** They add richness and body to foods, making them feel m satisfying and indulgent.
- **Preservation:** Fats can act as a preservative by creating a barrier that li the exposure of food to air, which can help prevent spoilage.
- **Appearance:** In baking and cooking, fats can contribute to the color gloss of the finished product, such as the golden-brown crust on ba goods or the shiny surface of sautéed vegetables.

Each type of fat (saturated, unsaturated, trans fats) has its own uni properties and uses in cooking, which can affect both health and culin outcomes.

2.4 Rancidity of Oils - Types and prevention

When food containing fat and oil come in contact with surrounding oxygen a these auto-oxidation leads to bad smell and change in taste, the whole proces said to be rancidity. Most any food can technically become rancid. The te particularly applies to oils. Oils can be particularly susceptible to rancidity beca their chemistry which makes them susceptible to oxygen damage.

Oxidation of fats is caused by a biochemical reaction between fats and oxyg In this process the long-chain fatty acids are degraded and short-chain compou

are formed. One of the reaction products is butyric acid, which causes the typical rancid taste. Rancidification is the decomposition of fats, oils and other lipids by hydrolysis or oxidation, or both. Hydrolysis will split fatty acid chains away from the glycerol backbone in glycerides.

These free fatty acids can then undergo further auto-oxidation. Oxidation primarily occurs with unsaturated fats by a free radical- mediated process. These chemical processes can generate highly reactive molecules in rancid foods and oils, which are responsible for producing unpleasant and noxious odors and flavors. These chemical processes may also destroy nutrients in food. Under some conditions rancidity leads to the destruction of vitamins in food.

Oil Reversion

The most important components present in oil such as soyabean oil is unsaturated fatty acid. Soyabean oil has a triglyceride composition rich in monounsaturated (23% oleic acid) and polyunsaturated fatty acids (57% linoleic acid; 7% linolenic acid). The linolenic acid contains three unsaturated bond and which can be easily undergone oxidation process. Because of the presence of high content of linolenic and linolenic acid, oil undergoes oxidative degradation and develops color change and fishy or painty smell. This process is called oil reversion.

Mechanism of Oil Reversion:

Oxidation is the primary mechanism involved in the oil reversion. When it comes to oxidation, linolenic acid is about ten times more vulnerable than linoleic acid and about one hundred times more than oleic acid. The oxidation of double bonds is a radical-driven process.

Types of Rancidity

Oxidative Rancidity

The specific types of rancidity involving oxygen damage to foods are called "oxidative rancidity." During the process, oxygen molecules interact with the structure of the oil and damage its natural structure in a way that can change its odor, its taste, and its safety for consumption, i.e. fat is oxidized and decomposes into compounds with shorter carbon chains such as fatty acids, aldehydes, and ketones all of which are volatile and contribute to the unpleasant odor of rancid fats. Oxidative rancidity leads to the formation of both unpalatable and toxic compounds.

Three distinct classes of substance occurring in oxidized fat have been shown to be toxic:

i. Peroxidised fatty acids (peroxidised fatty acids destroy both vitamin A and E in foods).
ii. Polymeric material (under normal food processing conditions these appear in small enough quantities to be insignificant).

iii. Oxidized sterols (thought to be involved in the causation of atherosclero disease).

Hydrolytic Rancidity

Fats are enzymatically hydrolyzed, the release of free fatty acids f glycerides, cause some rancid odor. This process is called hydroiytic rancid Hydrolysis will split fatty acid chains away from the glycerol backbon glycerides. These free fatty acids can then undergo further auto-oxidation lead oxidative rancidity.

Prevention of Rancidity:

Rancidity can be prevented by several ways which are mentioned briefly:

1. Addition of Antioxidants:

The best method used to prevent food item from rancidity is the additio antioxidants. Antioxidants are added to fat-contain-ing foods in order to retard development of rancidity due to oxidation.

Natural antioxidants include flavonoids, polyphenols, ascorbic acid (vitamin and tocopherols (vitamin E). Synthetic antioxidants include butyla hydroxyanisole (BHA), butylated hydroxytoluene (BHT), propyl-3, 4, trihydroxybenzoate (also known as propyl gallate) and ethoxyquin. Nat antioxidants tend to be short-lived, but synthetic antioxidants give longer shelf and better action.

The effectiveness of water-soluble antioxidants is limited in preventing di oxidation within fats, but is valuable in intercepting free radicals that tra through the watery parts of foods. A combination of water-soluble and fat- solu antioxidants is ideal, usually in the ratio of fat to water.

2. Addition of Sequestering Agents:

Sequestering agents bind metals, thus preventing them from catalyzing au oxidation. Examples of sequestering agents include EDTA (ethylene diamine te acetic acid) and citric acid.

3. Proper Storage of Fats and Oil Food:

Another method for preventing rancidity of food is the proper storage, keepi away from the action of oxygen. Rancidification can be decreased by storing fa and oils in a cool, dark place with little exposure to oxygen or free radicals, sin heat and light accelerate the rate of reaction of fats with oxygen.

Do not add fresh oil to vessels containing old oil. The old oil will trigger reaction and the new oil will become rancid far more rapidly than, if the oil w stored in a clean empty vessel. Avoid using vessels that are wet, this will also spe up the problems associated with oxidation, allow tanks to drain and dry adequate before use.

MULTIPLE CHOICE QUESTIONS

1. Fats and oils have less than ____ Specific gravity that is why they float on water. [a]

   a) One b) Two c) Three d) Four

2. Which of the following are unsaturated fat containing foods? [a]

   a) Vegetable oils b) Meats c) Butter d) Dairy products

3. Hydrogenated oil in India is known as [a]

   a) Vanaspathi b) Butter c) Miargarine d) Ghee.

4. Which of the following does not belong to the legume family? [c]

   a) Chickpeas b) Lupine **c) Quinoa** d) Kidney beans

5. What characterizes pulses? [c]

   a) They grow in a pod b) Rich in oligosaccharides

   c) Both a & b d) None

6. Which of these nuts is known as the smiling nut? [b]

   a) Peanuts b) Walnuts c) Pistachio d) Culinary

FILL IN THE BLANKS

1. _____ is made from vegetable oils like cottonseed oil, soya bean oil, corn oil, groundnut oil, coconut oil and meat fat. (Margarine)
2. _____causes oxygen damage to a food substance. (Oxidative Rancidity)
3. _____added to some foods to slow down or eliminate oxidative deterioration. (Antioxidants)
4. Pulse protein is deficient in _____ aminoacids.**(Methionine)**
5. Germination increases the vitamin _____content of pulses.**(C)**
6. Protein sourced from pulses costs ____ as much as protein from beef. **(1/3rd)**
7. Oils, nuts and oil seeds give us _____. **(Energy and protein)**

UNIT-III	VEGETABLES, FRUITS & FOOD PRESERVATION **Vegetables** - Classification, composition and nutritive va changes during cooking, loss of nutrients during cooking, sto factors affecting storage **Fruits** - Classification, composition, nutritive value, storage ripening, Enzymatic browning and its prevention **Food preservation** - principles, methods- dehydration, temperature, high temperature and preservatives.

Introduction

Vegetables and fruits are nature's marvellous gift to the humankind. Vegeta and fruits are very important commodities in our daily diet. They are enhancing medicines packed with vitamins, minerals, antioxidants and m phytonutrients (Plant-derived micronutrients). Vegetables and fruits are availa throughout the year and they can be consumed fresh and eaten raw. They are absolute feast to our sight because of their colour and have a unique nutrient pro that helps the human body to be fit, rejuvenate, and free of diseases.

3.1 Vegetables – Classification

Definition:

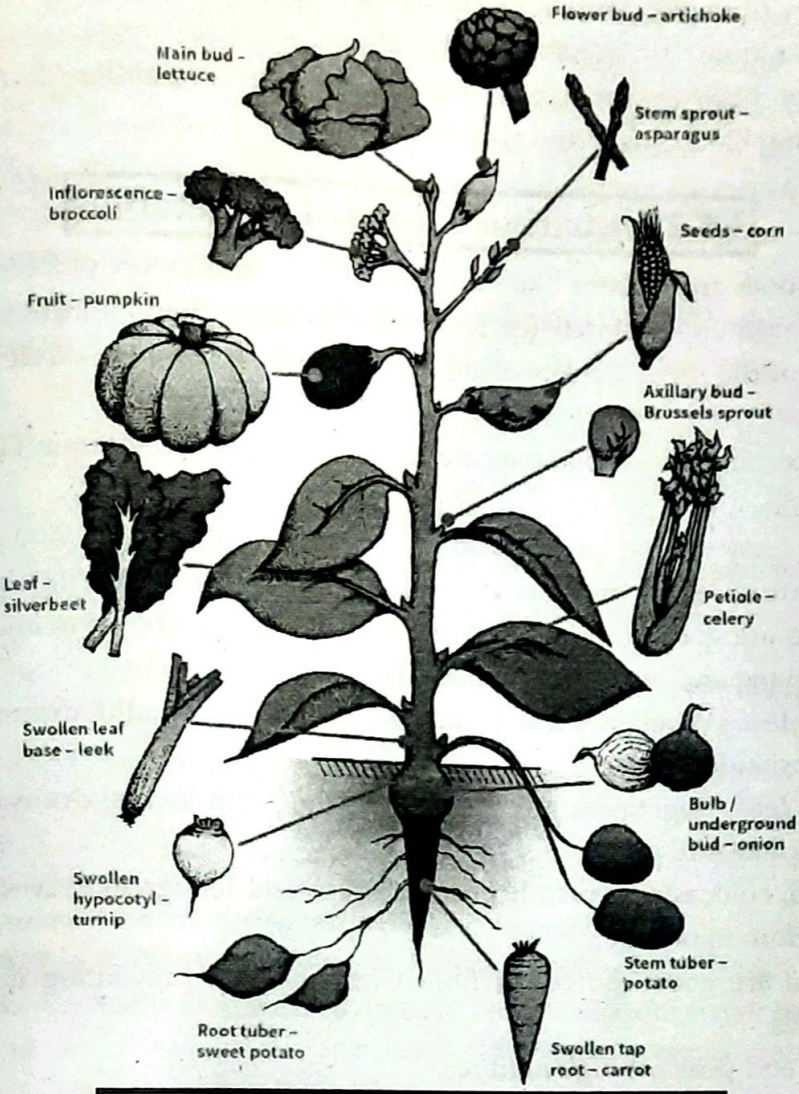
Vegetable, in the broadest sense, any kind of plant life or plant product, nam "vegetable matter"; in common, narrow usage, the term vegetable usually refers the fresh edible portions of certain herbaceous plants—roots, stems, leaves, flowe fruit, or seeds. These plant parts are either eaten fresh or prepared in a numbe ways, usually as a savory, rather than sweet, dish.

CLASSIFICATION OF VEGETABLES:

Vegetables are classified according to the part of the plant consumed, colour the vegetable or according to the nutritive value.

Table 3.1 Classification of vegetables based on parts of plants consumed

Parts of plants	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 seeds)	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 and grens



3.1.1 Composituon of Vegetables

- Vegetables contain a high amount of water. They also contain carbohydrates, dietary fibre, protein, vitamins and other nutrients that are important for human health.
- Lettuce, cucumbers and leafy vegetables contain about 95% water, therefore only 5% of their mass is dry matter.
- Hard vegetables like carrot and pumpkin have around 12-15% dry matter. Carbohydrates are the main component of vegetables and fruit represent more than 90% of their dry matter.
- Carbohydrates are present as starch, sugars and dietary fibre. Starch is mainly found in root vegetables, such as potatoes and sweet potatoes.
- The main sugars that are present in vegetables and fruits are glucose, sucrose and fructose.
- Although more usually associated with fruit, sugars are an important component of flavour in vegetables such as carrots, sweet corn and peas.

- Dietary fibre compounds like cellulose, lignin, pectins and other sub are also found in vegetables and fruits.
- Dietary fibre in vegetables and fruits have several health benefit lowering blood sugar and cholesterol levels.

3.1.2 Nutritive values of Vegetables

- ✓ The Roots and tubers like carrots, potatoes and sweet potatoes con large amount of starch (carbohydrates), hence they contribute to e value of the food. Carrots contain a large amount of Beta carotene (Vi A).
- ✓ Potatoes and sweet potatoes are rich in Vitamin B6, Vitamin C, Pota and Iron.
- ✓ Green leafy vegetables are good sources of phosphorus, calcium and iro
- ✓ They are excellent in carotene are also good antioxidants (Vitamin A).
- ✓ Greens are good sources of vitamin-B particularly riboflavin and folic But drying and withering reduce vitamin-B.
- ✓ Green leafy vegetables also contain vitamin-C eg., Agathi, drumstick le and coriander leaves.
- ✓ Green leafy vegetables are rich in iron. Eg., Mint leaves, drumstick le paruppukeerai.
- ✓ Agathi, colocasia leaves, drumstick leaves and fenugreek leaves contri to calcium in our diet.
- ✓ Greens are good sources of fibre which help in preventing degenera diseases.
- ✓ Beans and peas are high in fibre.
- ✓ Fiber increases stool bulk and prevents constipation.
- ✓ Beans, peas, and lentils are also rich sources of some vitamins and mine such as folate, iron, potassium and magnesium.
- ✓ Folate and iron are important for preventing anaemia, as well maintaining normal metabolic functions.
- ✓ Potassium and magnesium are important for muscle and nerve function

PURCHASE OF VEGETABLES

- ❖ Most fresh vegetables retain their freshness for a short time under i conditions of storage.
- ❖ They belong to the category of perishables (green leafy vegetables) and s perishables (garlic, onion, roots and tubers).
- ❖ In general freshness, uniformity of size, colour, degree of ripeness and b free from defects are the qualities most sought after while purcha vegetables.

- When purchasing, select fresh vegetables which are firm, crisp, bright in colour with no visible bruises or signs of decay and wilting.
- Select clean leafy vegetables which are fresh, tender, crisp, brightly coloured and free from flowers, insects, mud and spots or holes in the leaves.
- While selecting roots and tubers ensure that they are heavy, firm, free from sprouts, heavy in relation to size, with shallow eyes and without green discolouration.
- At the peak of season, each vegetable and fruit has the highest nutrient content, flavour and is available at a reasonable price. It is therefore, advisable to buy vegetables and fruits which are in season, as the quality is high and the price is low.

COOKING OF VEGETABLES

Vegetables are cooked to improve the colour, flavour and texture by which overall palatability is improved. Digestibility is also improved.

The fibre becomes softened, starch gets gelatinised and protein gets coagulated. Cooking vegetables adds variety to the diet. Cooking also destroys micro-organisms. While cooking vegetables, water soluble nutrients like thiamine, riboflavin, nicotinic acid, pantothenic acid, pyridoxine, folic acid and vitamin C may be dissolved in the cooking water and the nutrients may be lost.

The different methods used in the cooking of vegetables are

- **BOILING IN WATER:** This is one of the common methods used in homes. The vegetables are washed, cut, cooked in excess of water for 20-30 minutes and the excess of water is rejected. This leads to considerable loss of water soluble vitamins and minerals.
- **STEAMING:** The vegetables are washed and cut and placed in vessels containing small amounts of water and steamed in a cooker under ordinary pressure for 20-30 minutes. The losses of nutrients are minimal in this method of cooking.
- **PRESSURE COOKING:** The vegetables are washed and cut and placed in vessels containing small amounts of water and cooked in steam under pressure for 10-15 minutes. The losses of nutrients are similar to those occurring in steaming under atmospheric pressure.
- **ROASTING IN PAN WITH FAT:** The vegetables are washed and cut into pieces. They are transferred to a hot pan containing oil and condiments. Salt is added. The vegetables are roasted for 15- 20 minutes till it becomes soft and well-cooked. The losses of vitamins in this method of cooking are greater than those occurring in steam cooking.
- **BAKING:** Baking is carried out with some types of foods such as potato, etc., in baking ovens or over fire. The losses of vitamins are similar to those occurring in vegetables roasted in oil

❖ **DEEP FAT FRYING:** Some vegetables, ex. potato chips are fried in deep
The losses of vitamins in this method of cooking are high as the tempera
attained by the product is high leading to destruction of vitamins by hea

3.1.3 Changes During Cooking of Vegetables

Vegetables are cooked to improve the colour, flavor and texture by wh
overall palatability is improved. Digestibility is also improved. The fibre becom
softened, starch gets gelatinized and protein gets coagulated. Cooking destr
microorganisms.

WATER CONTENT

- Water may be absorbed if the vegetable is cooked submerged in water
steam.
- Removal of water occurs during baking.
- Excess water absorption tends to produce sogginess in the cook
vegetable.
- The bulk of the leafy vegetables is greatly decreased as they wilt duri
cooking.
- Cellulose and peptic substances.

CELLULOSE AND HEMICELLULOSE ARE SOFTENED BY COOKING

- The pectic substances undergo some chemical changes. Pectic substanc
make it easier to chew and cut cooked vegetables.
- Sodium bicarbonate added to the cooking water disintegrates t
hemicelluloses and cellulose and produces a soft texture in a short cooki
period.
- Potatoes should be boiled or fried before adding to tomatoes or acid
medium.
- Calcium chloride or saturated solution of calcium hydroxide has the effe
of making the vegetable tissues more firm forming insoluble calcium sal
with pectic substances.
- Calcium chloride is used to prevent softening of canned tomatoes.

OTHER CARBOHYDRATES

- Gelatinisation of starch takes place during boiling e.g., potatoes g
gelatinized during boiling.
- Dextrinisation of starch takes place when potatoes are fried.
- Hydrolysis of starch occurs and they are converted to simple sugars.
- Caramelisation of sugar occurs when vegetables get scorched or burnt eg
onions.

PROTEIN

- Protein gets coagulated completely or partly during cooking.

3.1.4 Loss of Nutrients During Cooking

- Losses begin from pre-preparation onwards, like peeling the vitamins presents under the skin may be lost.
- Carrots have a valuable layer of nutrients under the skin so they should be scraped but not peeled thick.
- Throwing away outer leaves of cabbage can result in loss of carotene.
- Beet root, carrot and cauliflower leaves are very nutritious, hence discarding these leaves results in loss of nutrients.

Solvent action of water

Water soluble nutrients may be dissolved in the cooking water and the nutrients may be lost. Losses by solution can be reduced by the following methods:

- Cut the vegetable into bigger pieces so that the exposure of the vitamins to water is less.
- When carrots are cut in crosswise the loss of ascorbic acid is greater than that when they are cut lengthwise.
- Soaking or washing time should be reduced. So that enough time is not given for the water soluble nutrients to get dissolved in water.
- Wash the vegetables with the skin and later should be peeled and cut.
- Use as small quantity of water as possible so that there is no extra water at all.
- Cook for a short time. As period of cooking increases more and more of ascorbic acid leaches into the water.
- Cook the vegetables by steaming and pressure cooking, where no additional water is added.
- Cover the vessel with a lid to hasten the cooking process.
- Cook the vegetables with the skin so that the leaching of vitamins into the water would be less.
- Leached water can be used in cooking.

Oxidation and chemical decomposition

- Losses of nutrients can occur by chemical decomposition which may be caused by the reaction of the cooking water or by heat.
- Vitamin C is readily oxidisable and if this proceeds beyond the stage of dehydro- ascorbic acid, all vitamin activity is permanently lost.
- Oxidation may be accelerated by enzymatic action, by heat, by an alkaline medium by traces of copper and by free access to atmospheric oxygen.
- Vitamin A gets oxidized by dehydration or application of dry heat.

Prevention of losses by oxidation or chemical decomposition:

- Cut the vegetables into bigger pieces so that the exposure is less.
- Cut and use it immediately. By grinding, the losses will be more due to greater atmospheric exposure. By extraction of juice the losses are greater.

- Start cooking with boiling water. The greatest destruction of ascorbic acid occurs during the first minute or two of the cooking period. This destruction is the result of the presence of both oxygen and of oxidizing enzymes in the plant tissue.
- Water should be boiling when the vegetable is put to cook to expel oxygen from the tissues which catalases the oxidation of ascorbic acid.
- Cover the pan so that there is no direct contact with the atmospheric oxygen.
- Use a sharp knife. When sharp knife is used to cut cabbage bruising is avoided and loss of ascorbic acid is reduced.
- The more alkaline the solution, the faster is the rate of destruction especially temperature and time of heating are increased.
- Ascorbic acid is protected to some extent when heated in the natural acids of certain foods such as tomatoes, vinegar, tamarind and lime juices.
- The use of baking soda increases the loss of thiamine and vitamin C.
- After cooking, the food has to be consumed immediately; even if it is kept in the refrigerator, the losses continue to occur.
- Riboflavin and niacin are stable even at 1000C. Riboflavin is sensitive to light. Foods which are exposed to sunlight before cooking causes riboflavin loss.
- Minerals are not destroyed by cooking.
- There is maximum retention in steaming and pressure cooking because there are less losses due to leaching.
- The richer the vitamin C in the raw vegetable, the more is the retention in steaming and pressure cooking.

Addition of baking soda:

- Sometimes, baking soda is added to vegetables to improve the colour or to hasten cooking process.
- At alkaline PH, thiamine are unstable and vitamin C.
- Alkaline medium increases losses due to heat. Folic acid is also lost in alkaline medium.

3.1.5 Storage of Vegetables

- Some fresh vegetables are best stored at cool temperatures, between 40°F and 60°F (4°C and 16°C), ideally in a separate produce refrigerator.
- These include winter squash, potatoes, onions, shallots, and garlic. If a produce refrigerator is not available, store these vegetables at room temperature in a dry area with good ventilation.
- Do not store them in a refrigerator set at conventional temperatures. Colder temperatures convert the starches in these vegetables to sugars, changing their texture and flavor.

- Most other vegetables benefit from cold storage at temperatures between 34°F and 40°F (2°C and 4°C) with relatively high levels of humidity.
- Greens and other delicate vegetables should be stored away from apples, tomatoes, bananas, and melons, as the latter give off a great deal of ethylene gas.
- Preservation techniques are designed to extend the shelf life of vegetables.
- These methods include irradiation, canning, freezing, and drying. Except for drying, these techniques do not substantially change the vegetable's texture or flavor. Canning and freezing can also be used to preserve cooked vegetables.

3.1.6 Factors Affetcing Storage of Vegetables

Harvest Place & Time

- Precise harvest times must be respected for produce to retain its peak quality.
- Vegetables may be harvested at different stages of maturity depending on the type of crop, distances they travel, as well as storage conditions they're expected to withstand.
- As a rule of thumb, it's always best to buy locally sourced produce.
- This is because retail (non-wholesale produce) may undergo post-harvest treatment to last long days on trucks and market shelves.
- And so, the optimal choice remains to buy from local farmers' markets or wholesalers sourcing local crops, properly matured at harvest.

Temperature

- With storage temperatures, consistency is the key. According to the USDA, with every 10 degrees of variation (rise or decrease in temperature), the shelf life of your stored foods halves.
- So make sure you know the optimal temperature ranges for storing different categories and keep them steady if you want your produce to maintain its full nutritional value.
- One more temperature tip: before you place any vegetable in your fridge, make sure it's cool first (or at least match room temperature).
- That's because warmth causes sweating, encouraging mold to develop quicker.

Relative Humidity

- Another factor you have to monitor is moisture (or humidity), which plays a crucial role in the storage life of vegetables.
- Relative humidity refers to the moisture content of the air, which determines how fast or slow your produce loses water (transpiration rates).

- It's usually expressed as a percentage. Takeaway: generally, veggies like cool spaces with high humidity, which translates to less airflow (still, keep some room for it!).
- That's precisely why so many of them thrive in the pantry or the crisper drawers of your refrigerator (depending on the temperatures they love).
- But keep an eye out for exceptions. For instance, root crops like onions, garlic, and beetroot decay more quickly at high humidity levels.
- To know each crop's exact optimal temperature and relative humidity, we recommend referring to this table (courtesy of the University of Main).

Packaging & Containers

- If purchased with any, remove the packaging for all veggies stored at room temperature (like tomatoes, potatoes, eggplant, garlic, onions).
- Then place them loosely in a cool, dark place, preferably a tidy pantry.
- Now, for most leafy greens, you can use an airtight container with a damp cloth to keep them from drying out, which often happens when they're thrown in the fridge without a second thought.
- Vegetables can be purchased in a special containers or simply use the crisper drawers already present in fridge.
- Closing the latter creates a high-humidity environment (because there is less airflow going on) perfect for leafy greens (like lettuce, salad, arugula, fresh herbs) and most fresh vegetables (things like broccoli, peppers, eggplant, cauliflower, green beans, and peas).

Role of Vegetables in Cookery

Vegetables are used universally in all recipes.

- They are used in curries, salads and in sambar.
- Used as garnishing agents eg. shredded carrot and coriander leaves.
- Used as stuffing in samosa and parathas.
- Used as thickening agents in gravies and soups.
- Used in chutneys (onion) and pickles (tomato, onion).
- Used as part of recipes like pulao, avial and non-vegetarian dishes.
- Used as preserved foods like vathal in the dehydrated form.

3.2 Fruits

Fruits are formed from flowers and they are the ripened ovary or ovaries of a flowering plant together with the adjacent tissues. Most fruits are fleshy and pulpy or juicy and are pleasantly sweet and have a distinct appealing flavour when ripe. Fruits provide several health benefits and eating the recommended amount of fruit every day can reduce the risk of chronic diseases.

3.2.1 Classification of Fruits

Fruits can be classified as

- **Berries:** Strawberries, gooseberries, blackberries, raspberries, blueberries, cranberries
- **Citrus fruits:** Sweet limes, oranges, tangerines, sour oranges, lime, lemon, grape fruit.
- **Drupes:** Apricot, sweet cherry, peach, plums
- **Grapes:** Green grapes, black grapes, seedless grapes
- **Melons:** Musk melon, water melon
- **Pomes:** Apples, pears
- **Tropical and Subtropical fruits:** Gooseberry, avacado, banana, dates, guava, jack fruit, mango, jambu fruit, papaya, passion fruit, pineapple, pomegranate, sapota, Seetha phal (custard apple).

3.2.2 Composition and Nutritive Value of Fruits

1. Fruits contain high amount of moisture hence they are highly perishable.
2. Fruits are very poor source of protein and fat. Avocado is the exception containing 28 per cent fat.
3. Fruits are not very good sources of calories. Fruits like bananas give fairly good amount of calories. Ripe fruit contains a higher percentage of sugar than unripe fruit and the sugar is chiefly in the form of sucrose, fructose and glucose.
4. Generally fruits are poor source of iron. Seethaphal is also a good source of iron.
5. Mangoes are the excellent source of carotenes. Alphonso variety was found to be the richest source of β- carotene. Banginapally and peddarasalu are fairly good source of β- carotene. Apart from mango, Indian dates and papaya are good sources of β- carotene. Oranges are fairly good source of β- carotene.
6. Guavas are the best source of vitamin C. Citrus fruits are also rich in vitamin C . Cashew fruits are inexpensive and rich in vitamin C. Although there is variation of vitamin content from fruit to fruit most fruits in the raw state contain some ascorbic acid. Amla is the richest source of vitamin C. If fruits are bruised, peeled, cooked or exposed to air, alkali or copper, large amounts of the vitamin may be oxidized.
7. Apples, pears, cherries, grapes and citrus fruits contain flavonoids which act as antioxidants.
8. Fruits also contain fibre and minerals such as sodium, potassium and magnesium. They are not a good source of calcium.

3.2.3 Storage of Fruits

There are five methods of storing fruit: drying, canning, curing and salting, freezing and common storage. Which method is chosen depends upon the type of produce, the quality desired and the facilities available for storage. Regardless of the method chosen, some general rules should be followed:

1. Use only fresh produce.
2. Begin the preservation process immediately after harvest.
3. Avoid damaged, cut, bruised and pest or disease infested produce.
4. Use all preserved produce within one year of storage.

3.2.4 Methods of Preservation

DRYING

- One of the oldest ways to preserve produce is through drying.
- The basic procedure involves removal of moisture from the produce to a point where decay is not likely.
- This can be done by using an oven, a dehydrator or the warm heat of the sun.
- Once finished, the produce should be stored in a dry place in air tight containers.
- Dried produce does not retain the quality and nutritional value found with fresh produce.
- The process is also fairly labor intensive and time-consuming.

CANNING

- A resurgence of interest in canning is taking place as it has become easier with more fool-proof methods and good equipment like regular jars, lids and more reliable and safer pressure cookers.
- With the pressure cooker method, the produce is heated to kill microorganisms that can cause spoilage.
- This action also deactivates enzymes in the produce that affect flavor, texture and color.
- Canning can incur added costs with the purchase of equipment, containers and general supplies.
- It also is labor intensive. For most types of produce, higher food quality can be maintained with canning rather than drying.

CURING AND SALTING

- If certain garden produce is allowed to ferment naturally, it is said to have become "cured."
- This means that microorganisms initiate the fermentation process and change the food quality without causing bad tastes or generating toxins.

- During the fermentation process large amounts of acids are produced which control the fermentation process by ultimately limiting the microbial action as the food becomes more acidic.
- A second way to cure food is by adding organic acid like vinegar to increase the acidity and limit microbial activity. When salt is added in sufficient quality, this too will control microbial action and effectively stop the growth of spoilage organisms.
- Curing and salting is not a common method of preserving garden produce because of the great change that it makes in the quality and overall taste.

FREEZING

- A common and very desirable way to preserve certain types of garden produce is through freezing.
- This method does not improve quality, but is fairly easy to do if one has access to a freezer and takes the time to package properly so that moisture is retained.
- Like other preservation methods, freezing prevents microorganisms from growing causing spoilage.
- One large advantage of freezing is that the nutritional quality remains relatively good, plus food can be kept for many months with little change in color.
- For certain soft produce, the texture may change considerably, though the importance of this is largely depends upon how the food will be subsequently used.

3.2.5 Ripening of Fruits

Ripening is the process by which fruits attain their desirable flavour, quality, colour, palatable nature and other textural properties. Ripening is associated with change in composition i.e. conversion of starch to sugar. On the basis of ripening behavior, fruits are classified as climacteric and non-climacteric fruits.

Climacteric

Climacteric fruits are defined as fruits that enter 'climacteric phase' after harvest i.e. they continue to ripen. During the ripening process the fruits emit ethylene along with increased rate of respiration. Ripe fruits are soft and delicate and generally cannot withstand rigours of transport and repeated handling. These fruits are harvested hard and green, but fully mature and are ripened near consumption areas. Small dose of ethylene is used to induce ripening process under controlled conditions of temperature and humidity.

Climacteric fruits are:

- Mango
- Banana
- Papaya
- Guava
- Sapota
- Kiwi
- Fig
- Apple
- Passion fruit
- Apricot
- Plum
- Pear

These fruit in fully ripe state are too delicate to withstand transportation over long distances and should preferably be ripened near the consumption area.

Non-Climacteric

Non-climacteric fruits once harvested do not ripen further. Nonclimacteric fruits produce very small amount of ethylene and do not respond to ethylene treatment. There is no characteristic increased rate of respiration or production of carbon dioxide.

Non-climacteric fruits are:

- Orange
- Mousambi
- Kinnow
- Grapefruit
- Grapes
- Pomegranate
- Litchi
- Watermelon
- Cherry
- Raspberry
- Blackberry
- Strawberry
- Carambola
- Rambutan
- Cashew

In order to improve external skin colour and market acceptance, citrus like orange, lemon, mousambi and kinnow can be treated with ethylene, as a de-greening agent. Ethylene treatment breaks down the green chlorophyll pigment in the exterior part of the peel and allows the yellow or orange carotenoid pigments to be expressed.

Technologies for ripening of fruits

Lack of easier and rapid methods for uniform ripening poses a major problem in the fruit industry. Almost all methods of ripening, either conventional or the modern chemical methods, come with their own merits and demerits.

There are several simple technologies and methods available today for farmers for proper ripening. Normally, the number of days taken for edible ripening varies for different fruits and prevailing climatic conditions. For instance, it takes about 5 to 6 days for mangoes and 6 to 7 days for sapotas to ripen. Under natural conditions, ethylene, a ripening hormone produced by the plant plays a major physiological role in the ripening process.

A simple technology practiced in households to trigger ripening is to keep unripened and ripened fruits together inside an air tight container. Since the already ripened fruits release ethylene, ripening will be faster.

Another method is to place the fruits intended for ripening inside an air tight room and induce ripening through smoking inside smoke chambers. Smoke emanates acetylene gas. Several fruit traders follow this technique to achieve uniform ripening especially in edible fruits like banana and mango. But the major drawback of this method is that the fruits do not attain uniform colour and flavour. In addition, the persistence of smoke odour on the product impairs its quality.

Spreading unripe fruits as layers over paddy husk or wheat straw for a week to ripen is an another alternative.

Another practice is that some farmers dip unripe mature fruits in 0.1 per cent ethrel solution (1 ml of ethrel solution in 1 litre of water) and wipe it dry.

The fruits are then spread over a newspaper without touching each other and a thin cotton cloth is covered over this. In this method, the fruits will ripen within two days.

In one of the simple and harmless techniques, 10 ml of ethrel and 2 gm of sodium hydroxide pellets are mixed in five litres of water taken in a wide mouthed vessel. This vessel is placed inside the ripening chamber near the fruits and the room is sealed air tight.

About a third of the room is filled with fruits leaving the remaining area for air circulation. Ripening of fruits takes place in about 12 to 24 hours. In order to reduce the cost of chemical, some ethylene releasing fruits such as papaya and banana can also kept in the same room. Ethylene gas filled in pressurized cans promote fruit ripening in 24-48 hours

Fruit ripening using calcium carbide Most climacteric fruits in India are ripened with industrial grade calcium carbide. Industrial-grade calcium carbide usually contains traces of arsenic and phosphorus, and, thus, use of this chemical for this purpose is illegal in most countries. In India too, use of calcium carbide is strictly banned as per PoFA (Prevention of Food Adultration) Act [Section 44AA]. Calcium carbide, once dissolved in water, produces acetylene which acts as an artificial ripening agent. Acetylene is believed to affect the nervous system by reducing oxygen supply to brain. Arsenic and phophorus are toxic and exposure may cause severe health hazards.

CHANGES DURING RIPENING

Fruit ripening involves many complex biochemical changes, including seed maturation, change in colour, abscission from the parent plant, texture softening, production of flavour volatiles, wax development on skin, tissue permeability and change in carbohydrate composition, organic acids and proteins. During ripening the composition of fruit is altered either due to formation of new compounds or degradation of others. Out of various biochemical and physical changes occurring, changes in flavour, colour and texture are of utmost importance, for the acceptability of the fruit.

Colour Changes

Pigments are essential for the attractiveness of fruits and accumulate most often in the skin during the ripening process. Color is often the major criteria used by consumers to determine whether the fruit is ripe or unripe. As fruit matures and ripen, green colour decline and develops yellow, red or other colours due to the presence of accessory pigments, which are characteristic of the various cultivars.

Formation of pigments

During ripening there is the development of the enzymes to catalyse the formation of pigments. The main pigments formed and accumulated are: β-carotene, xanthophyll esters, xanthophylls and lycopene. The anthocyanins are formed partially from acetic acid units and partially from the amino acid, phenylalanine. Carotenoids are terpenoids compounds and as such derive from acetyl CoA via the mevalonic acid pathway. The primary carotene produced is phytoene which is further metabolized to give other carotenoid pigments.

Degradation of pigments

Climacteric fruits show rapid loss of green colour with attainment of optimum eating quality. Some non-climacteric fruits also exhibit a marked loss of green colour with attainment of optimum quality. The green colour loss is due to the degradation of chlorophyll structure. The main factors responsible for chlorophyll degradation are: pH changes (mainly due to leakage of organic acids form the vacuole), oxidative systems and enzyme chlorophyllase.

Flavour changes

Flavour of a fruit depends upon synthesis of various flavour compounds which are unique to each fruit. Several of these compounds are complex and a large proportion of compounds is volatile in nature and gives the particular flavour. These flavour compounds are present in very low amount and includes alcohols, aldehydes, esters and other chemical groups. In both climacteric and non-climacteric fruits, the most important aroma volatiles that increase during ripening are the esters.

Formation of flavour compounds

Biosynthesis:

The increase in flavor and aroma during fruit ripening is attributed to the production of a complex mixture of volatile compounds and degradation of bitter principles, flavanoids, tannins, and related compounds. Bio-synthesis of volatile molecules is an intact fruit is a complicated process. The alcohols and aldehydes are generated after metabolism of their corresponding amino acid of oxo-sugar. Some of the flavour volatiles are synthesized via mevalonate/ isoprene pathway. Various organic acids also act as substrate for flavour manufacture. Some other important class of flavour compounds i.e. monoterpenes, sesquiterpenes are generated from amino acid, sugars and lipids. Natural plant volatiles, such as aliphatic esters, alcohols, acids and carbonyls are derived from fatty acid metabolism. Most unripe fruits, e.g. apples, bananas and strawberries, produce a variety of fatty acids which, during ripening, are converted into esters, ketones and alcohols via ß-oxidation.

Degradative reactions

Some of the volatiles are produced upon disintegration of fruit/vegetable tissue i.e. the compounds responsible for the characteristic taste and flavour are not present in the intact cucumber but are formed by enzymic breakdown of the fatty acids of the cell membranes which are disrupted when the cucumber cells are cut or chewed. The tannins (secondary metabolite) and other phenolic compounds, present in fruits impart astringency. Small amount of astringency is essential to the taste of many fruits but the high levels found in unripe fruits make them unacceptable. During ripening the tannins, are either partially broken down or polymerised into products which are not astringent. The ripening induces the breakdown of carbohydrate polymers, by various carbohydrases and leads to near total conversion of starch to sugars. This has the dual effect of altering the taste and texture of the produce. The increase in sugar renders the fruit much sweeter and therefore more acceptable. However many exceptions are there. In oranges and grapefruits the acid content drops during ripening, while in lemons, there is an increase in acids. Synthesis of ascorbic acid also occurs in many fruits during ripening.

Generally, the acidity decreases as organic acid are utilized in respiration of fruits. The ratio of sugar to acid and the absolute amounts of both sugar and acid are important in the flavour quality of many ripe fruit. The breakdown of polysaccharides by cellular enzymes not only gives the typical sweetness, but also precursors for many aromatic flavor compounds.

Texture changes

Textural change is the major event in fruit softening, and is the integral part of ripening, which is the result of enzymatic degradation of structural as well as storage polysaccharides. The process of textural softening is of commercial importance as it directly dictates fruit shelf life and consumer acceptability. Cell walls of fruit undergo a natural degradation during fruit ripening, reducing cell wall firmness and intercellular adhesion. This leads firstly to the attainment of a desirable eating texture and then, as senescence begins, to a loss of this desirable texture.

Fruit texture is influenced by various factors like structural integrity of the primary cell wall and the middle lamella, accumulation of storage polysaccharides, and the turgor pressure generated within cells by osmosis. Change in turgor pressure, and degradation of cell wall polysaccharides and starch determine the extent of fruit softening.

Cell wall polysaccharides that undergo modifications during ripening are pectin, cellulose, and hemicelluloses. Amylase activity increases to some extent during ripening of many fruits. Starch is almost completely hydrolyzed to free sugars, thus contributing to loosening of the cell structure and textural softening during ripening. Pectin is the key substances involved in the mechanical strength of the primary cell wall and middle lamellae and contributes to fruit texture. During ripening, softening of fruit is caused by the conversion of protopectin, the insoluble, high molecular weight parent pectin into soluble polyuronides. The solubilisation of pectin is followed depolymerisation and deesterification; These changes are accompanied by an extensive loss of neutral sugars and galacturonic acid, followed by solubilization of the remaining sugar residues and oligosaccharides.

Pectin from ripe fruit exhibit a lower degree of esterification, molecular weight and decreased neutral sugar content compared to pectin from unripe fruits. Ultrastructural studies of ripened fruits have also shown that cell wall breakdown is accompanied by dissolution of middle lamella and gradual dissolution of fibrillar network of primary cell wall. A rapid rise in polygalactouronase enzyme occurs during ripening is responsible for solubilisation of pectin. The other enzymes involved in hydrolysis of pectin are: pectin methyl esterase, pectate lyase, pectin lyase, arabinanase and galactanase.

Firmness is also related to the turgor properties of a tissue or organ. During fruit ripening, there is a decline in turgor which contributes to textural changes probably due partly to an accumulation of osmotic solutes in the cell wall space and partly to postharvest water loss from the ripening fruit. In citrus fruit, softening is mainly associated with change in turgor pressure.

According to softening behaviour, fruits are divided in to two groups. These are:

1. **Very soft fruits:** These fruits are greatly softened after ripening and possess softand melting texture. e. g. apricot, strawberry, peach, plum, kiwifruit, European pear and mostberries.
2. **Moderately soft fruits:** These fruits are softened to little extent after ripening andhave a crisp and fracturable texture. e.g. apple, quince, cranberry, Asian pear, bell pepper andwatermelon. There exist no relationship between climacteric and non-climacteric status of fruit and its texture.

Other changes

1. **Change in protein:** During the onset of ripening the actual concentration of protein increases but the protein has no role in imparting any effect to eating quality. Changes in nitrogenous constituents however indicate variations in metabolic activity during different growth phases. During the climacteric phase of many fruits, there is a decrease in free amino acids which often reflects an increase in protein synthesis. During senescence, the level of free amino acids increases reflecting a breakdown of enzymes and decreased metabolic activity.
2. **Change in cellulose and hemicellulose:** Ripening causes apparent dissolution of cell wall fibrillar network in many fruits. There is often little change in the cellulose structure in fruits during ripening and the activity of enzymes does not correlate with softening changes that occurs. Ripening also involves degradation of hemicellulose. There is a decline in characteristic monomers of hemicelluloses viz. glucose, xylose, and mannose during ripening of fruits but that does not have a very drastic influence on the texture of the product.
3. **Changes in lipid:** Little is known about changes in the lipid fraction. There are speculations about shifts in composition and quantity of phospholipid fraction during ripening.

3.2.6 Enzymatic Browing & Its Prevention

You might have seen apples, pears, potatoes and brinjal that turn brown in color when peeled or cut open. Have you ever thought about it? What is the reason behind this color change? That's because of a naturally occurring process called Oxidation.

Enzymatic browning is an oxidative reaction responsible for browning in vegetables and fruits. When the skin of vegetables and fruits are either cut or broken, cell wall gets ruptured and an enzyme called polyphenol oxidase is released and reacts with the oxygen in the air. As a result vegetables and fruits turn brown or dark leading to changes in flavour and nutritional values.

Measures to prevent enzymatic browning

- There are many ways to prevent fruits and vegetable from getting oxidized with the following methods.
- Squeeze lime juice on fruits such as banana, apples, avocado, pears and vegetables like potatoes, sweet potatoes to prevent oxidative browning.
- The juice of other citrus fruits such as oranges and grape fruits can also be used.
- Soak the cut fruits or vegetables in plain water which helps to slow down the oxidation process.
- Blanching fruits or vegetables also prevents browning.
- Wrapping in a cling wrap tightly is also a good way to prevent browning.
- Most important, do not use a rusty knife or any other iron metals because iron will increase the rate of reaction.

Role of Fruits in Cookery

- Raw, whole or cut fruits can be served as an appetiser, as a salad or for dessert.
- Fruits can be served in the form of juices or milk shakes.
- Apples are served as stewed apples.
- Fresh fruits can be preserved as jams, marmalades, preserves and dried fruits.

3.3 Food Preservation – Principles

Food preservation is one of the methods to protect food from unwanted microbial growth. After the food is produced, we store and protect by covering the rice and curry with lids to keep away flies and other insects. By this, we are protecting it from any infection caused by them. This is a short-term condition. Food preservation, on the other hand, is done to preserve food for a longer time.

Following are the important objectives of food preservation:

- To prevent microbial contamination.
- To kill pathogens.
- To minimise food spoilage and food poisoning.

The Importance of Food Preservation

The main reason we preserve food is to keep it safe before consumption. And because we want to eat satisfying food.

Here are more reasons to preserve food:

- **Bacterial growth** – If the conditions are right – warmth, moisture and time – bacteria like Salmonella and E. coli have a field day. Preservation methods, even simple ones like refrigeration, can really reduce the likelihood of bacterial growth and food spoilage.
- **Quality** – To be appetising, the food needs to look, smell, feel and most importantly, taste good. If it doesn't, we look for food that ticks all these boxes. The odd bruise or dent is often harmless, but food must be in its best quality for us to want it.
- **Wastage** – We waste a tremendous amount of food. According to a recent study by the World Wildlife Fund and British retailer Tesco, an eye-watering 2.5 billion tons of food is wasted globally.

  With 2.3 billion people being moderately or severely food insecure, this wasted food can provide each person over 2,500 meals per year. That's seven meals a day! Preserving food extends its shelf-life and can prevent it from being wasted.
- **Save money** – Wasting food is expensive. Each time we throw away food that we didn't get a chance to eat before the use-by date, we throw our money away.
- **Saving the environment** – Food that we throw away ends up in landfills. When it decomposes, it produces methane gas. Food that is wasted in landfills accounts for about eight percent of global emissions.

3.3.1 Methods - Dehydration

Dehydrating food is a preservation method used to extend the shelf-life of your food by removing its water content.

It is also one of the oldest and most widespread food preservation techniques, outdating many other modern methods like canning and freezing.

Here are some of the most popular methods:

Sun drying

- ☑ Sun drying is one of the oldest and most simple methods used to dehydrate foods.
- ☑ It involves laying foods, such as fruits like figs or mangos, on a mesh screen or tray made with wooden dowels. Then, you cover the food with a second screen to deter pests and insects.
- ☑ Food can be dried in any sunny area with low humidity and a minimum temperature of 86° F (30° C).
- ☑ If using this method, it's also important to avoid screens made with hardware cloth, as these may oxidize and leave residue on your food.

Air drying

- ☑ Like sun drying, air drying is a dehydration method that's so simple that it doesn't require any special equipment.
- ☑ Similar to sun drying, air drying places food in the shade instead of the sun.
- ☑ This can help protect foods from the sun's powerful rays, making it a good option for leafy greens, herbal teas, and spices.

Solar drying

- ☑ Solar dehydrators are powered by the sun, which can help dehydrate your foods without using any electricity.
- ☑ Solar dehydrators often appear similar to a tabletop greenhouse. They can be purchased or made at home using materials that are readily available from your local hardware store.

Oven drying

- ☑ Your oven can be used to dry foods when you keep it temperature around 140° F (60° C).
- ☑ Though oven drying can take around 6-10 hours depending on the specific food, this method may be beneficial for people who don't want to purchase any additional appliances.
- ☑ Make sure your oven can be set to a temperature of 140° F (60° C) or less, as higher temperatures will cook food instead of drying it.
- ☑ Additionally, be sure to prop the door open while dehydrating foods, which allows extra moisture to escape during the drying process.

Electric dehydrators

- ☑ Electric dehydrators are one of the most efficient and convenient methods used for drying foods.
- ☑ These appliances are usually equipped with a timer and temperature gauge, along with fans to evenly distribute heat.
- ☑ They also typically have multiple trays, allowing you to dehydrate several types of food simultaneously.
- ☑ Electric dehydrators can range quite a bit in price. Some models start at around $50 and higher end options may cost up to $1,000.

3.3.2 Low Temperature

Storage at low temperatures prolongs the shelf life of many foods. In general, low temperatures reduce the growth rates of microorganisms and slow many of the physical and chemical reactions that occur in foods.

- ♦ **Refrigeration:** The life of many foods may be increased by storage at temperatures below 4 °C (40 °F). Commonly refrigerated foods include fresh fruits and vegetables, eggs, dairy products, and meats. Some foods, such as tropical fruits (e.g., bananas), are damaged if exposed to low temperatures. Also, refrigeration cannot improve the quality of decayed food; it can only

retard deterioration. One problem of modern mechanical refrigeration – that of dehydration of foods due to moisture condensation – has been overcome through humidity control mechanisms within the storage chamber and by appropriate packaging techniques.

- **Freezing:** Freezing and frozen storage provide an excellent means of preserving the nutritional quality of foods. At subfreezing temperatures the nutrient loss is extremely slow for the typical storage period used in commercial trade.
- **Cellar storage temperature:** It is usually used for the storage of surplus foods like root crops, potatoes, onions, apples, etc. for limited periods.

3.3.3 High Temperature

The process of heating was used centuries ago before its action was understood. Food is heated up or cooked. Heat is used to inactivate organisms or enzymes of spoilage significance in the foods. Microorganisms are killed by heat because the application of heat coagulates the food proteins and inactivates the microbial enzymes and thus results in death of microorganisms. The examples include all forms of cooked food, pasteurization, milk sterilized by UHT (ultra high temperature), canning etc. One of the most important modern applications of the heat preservation is the pasteurization of milk.

Heat treatment of food may be given in different ways:

- ☑ **Pasteurization (temperature below 100°C):** Pasteurization is a heat treatment involving temperatures below 100°C that kills a part but not all the microorganisms present in food. Milk, for example, is usually heated to 63°C for 30 min or 71°C for 15 seconds or in UHT 138°C for 2-4 seconds. Examples include milk, wine, beer, fruit juices and aerated waters which are routinely pasteurized. The mode of heating can be steam, hot water, dry heat or electric currents. The products are cooled promptly after the heat treatment. Pasteurization is usually supplemented by other methods to prolong shelf-life.
- ☑ **Boiling (temperature at 100°C):** Cooking of rice, vegetables, meat, fish etc. at home is usually done by boiling the food with water and involves a temperature around 100°C.
- ☑ **Canning (temperature above 100°C):** Canning is the process in which the foods are heated in hermetically sealed (airtight) jars or cans to a temperature that destroys microorganisms and inactivates enzymes that could be a health hazard or cause the food to spoil. The vacuum seal formed after heating and cooling in the process ensures that no microorganism can get into the product. The degree of heat and the length of time of heating vary with the type of food and the kinds of microorganisms that are likely to occur in it. High-acid foods such as fruits and tomatoes can be processed or "canned" in boiling water, while low-acid vegetables and meats must be

processed in a pressure canner at 121°C (15 psi pressure). Tin-coated steel cans are most commonly used followed by glass containers. Nowadays, containers made of aluminum and plastics in the form of pouches or rigid containers are also increasingly used. Examples of food preserved by canning are- all kinds of tinned foods, such as soup, meat, beans, cereal grains, legumes, nuts, and other various dried food products such as fruit, coffee, milk, soups, fish, meat and vegetables.

3.3.4 Preservatives

Preservatives are food additives, which are specifically added to prevent the deterioration or decomposition of a food. Chemicals are used to inhibit the factors causing spoilage. These are also used to complement other food preservation techniques.

Preservation of foods by the chemicals is effected by interfering with the cell membrane of the microorganism, their enzyme activity and genetic mechanism; and by acting as antioxidants. In food preservation, the added chemical preservatives may be grouped into two classes.

- ☑ **Class I preservatives:** The first one includes the use of sugar, salt, spices, acetic acid (vinegar) and alcohol, and is referred to as class I preservatives and is considered to be relatively safe to humans.
- ☑ **Class II preservatives:** The second group includes the use of benzoic acid, sulfur dioxide, nitrates and nitrites and a variety of neutralizers, firming agents and bleaching agents and referred to as class II preservatives and is considered to be relatively safe to humans, but within the permissible doses prescribed by the food regulatory bodies of the country because higher concentrations can be a health hazard.

MULTIPLE CHOICE QUESTIONS

1. Green leafy vegetables are excellent sources of _____. [d]
   a) protein b) vitamin c) fat d) minerals
2. The pigment present in beet root is _____. [a]
   a) betalin b) allin c) curcumin d) carotenoids
3. The enzyme responsible for browning is _____. [a]
   a) polyphenol oxidase b) thiaminase c) oxygenase d) protein
4. _____ are said to be theheart of cooking. [a]
   a) spices b) meat c) milk d) pulses
5. _____ is also known as Devil's Dung. [c]
   a) nutmeg b) mace c) asafoetida d) dill
6. ____can be defined as the process to slow or stop food spoilage [a]
   a) Food preservation b) Food Storage
   c) Food Quality d) Food Poisoning
7. Vegetables, fruits etc are preserved by ____ method [b]
   a) Salting b) Freezing c) Chemical Preservation d) Dehydration

FILL IN THE BLANKS

1. Sweet lime and oranges are examples of _____ fruits. **(Citrus)**
2. The pigment present in tomatoes is _____. **(lycopene)**
3. Guavas and amla are good sources of _____. **(Vitamin C)**
4. _____is a mixture of eight spices. **(Gram masala).**
5. _____ stem is used as antiseptic. **(Turmeric)**
6. _____ is the process of removal of water from food. **(Dehydration)**
7. _____in food preservation can be defined as the mild heat treatment. **(Pasteurization)**

UNIT-IV	ANIMAL FOODS AND FOOD ADULTERATION **Milk-** Composition, Nutritive value, fermented and non-fermented milk **Egg** - Composition, nutritive value and quality **Poultry** - Classification, composition and nutritive value **Meat** - Nutritive Value and changing during cooking **Fish** - Classification, competition and nutritive value **food Adulteration** - Intentional and Incidental

4.1 Milk- Composition

INTRODUCTION

The story of milk goes back to the beginning of civilization itself. Cattle were domesticated even in prehistoric times and milk was one of the most essential of all foods. Milk is one of the most complete single foods available in nature for health and promotion of growth.

Milk is the normal secretion of mammary gland of mammals. Its purpose in nature is to provide good nourishment to the young of the species producing it. Man has learnt the art of using milk and milk products as a food for his wellbeing and has increased the milk producing function of the animals best adapted as a source of milk for him.

The cow is the principle source of milk for human consumption in many parts of the world; Other animals as a source of milk for human beings are the buffalo, goat, sheep, camel and mare. In India, more milk is obtained from the buffalo than the cow. Some amount of goat milk is also consumed.

Definition

Milk, liquid secreted by the mammary glands of female mammals to nourish their young for a period beginning immediately after birth. The milk of domesticated animals is also an important food source for humans, either as a fresh fluid or processed into a number of dairy products such as butter and cheese.

Composition

Milk composition can vary depending on the species, breed, stage of lactation, and other factors, but generally it consists of the following main components:

- **Water:** Milk is composed of approximately 87-88% water.
- **Lactose:** Also known as milk sugar, lactose is the primary carbohydrate in milk, typically making up around 4.5-5.5% of the total composition.
- **Milk fat:** The fat content in milk can range from around 3% in low-fat milk to 5-6% in whole milk. The fatty acid profile includes saturated, monounsaturated, and polyunsaturated fats.

- **Proteins:** Milk contains a variety of proteins, with the most abundant being casein (about 80% of total milk proteins) and whey proteins (about 20% of total milk proteins). The total protein content is typically around 3-4%.
- **Minerals:** Milk is a good source of several essential minerals, including calcium, phosphorus, potassium, sodium, magnesium, and others, typically making up around 0.7-0.9% of the total composition.
- **Vitamins:** Milk contains a range of vitamins, including vitamin A, vitamin B12, riboflavin (B2), niacin (B3), and others. The vitamin content can vary depending on the cow's diet and other factors.
- **Other minor components:** Milk also contains small amounts of enzymes, hormones, and various other bioactive compounds.

Milk composition

	Water %	Dry mat (%)	Fat (%)	Proteins (%)	Lactose (%)	Minelars (%)
cow	87,5	12,5	3,7	3,3	4,7	0,8
sheep	80,7	19,3	8	5,6	4,8	0,9
goat	87	13	4	3,6	4,5	0,9
buffalo	82	18	7,9	4,5	4,8	0,8
horse	89	11	1,9	2,5	6,3	0,3
human	87,6	12,4	4	1,2	7	0,2

4.1.1 Nutritive Value

Nutritive Value of Milk

- Milk is a complex fluid containing protein, fat, carbohydrates, vitamins and minerals.
- The main protein in milk is casein and it constitutes 3.0-3.5 percent of milk.
- The fat content of milk varies from 3.5 percent in cow's milk to about 8.0 percent in buffalo's milk.
- Fat is present in the form of ¬ne globules varying in diameter from 1to 10µm(micrometers).
- Milk also contains phospholipids and cholesterol.
- Lactose is the sugar present in milk. The important minerals in milk are calcium, phosphorus, sodium and potassium.
- Milk is an excellent source of riboflavin and a good source of Vitamin A. However, milk is a poor source of iron and ascorbic acid.
- The small amount of iron present is bio available.

Components	Cow (100 mL)	Buffalo (100 mL)	Human (100 mL)
Protein (g)	3.2	6.5	1.1
Fat (g)	4.1	4.3	3.4
Lactose (g)	4.4	5.1	7.4
Calcium (mg)	120	210	28
Energy (kcal)	67	117	65

Types of processed Milk

Raw milk is processed into the following types of milk.

- **Skim Milk:** Skim milk is whole milk from which fat has been removed by a cream separator. The quantity of fat is usually 0.05 to 0.1 percent. It contains all other milk nutrients, except Vitamin A and D, but can be fortified by the addition of these vitamins.
- **Toned Milk:** Toned milk is prepared by using milk reconstituted from skim milk powder. Skimmed milk is prepared by removing fat from milk in a cream separator. The skimmed milk is then mechanically dried to give skim milk powder. It is mixed with buffalo milk containing 7 percent fat. The fat content of toned milk should be less than 3 percent.
- **Standardised Milk:** In standardised milk the fat content is maintained at 4.5 percent and soluble non-fat is 8.5 percent. It is prepared from a mixture of buffalo milk and skim milk.
- **Homogenised Milk:** Homogenisation is a mechanical process that reduces the size of fat globules by forcing milk through small apertures under pressure and velocity. When milk is homogenised, the average size of the globule will be 2 micrometers. The decrease in the size of fat globules increases their number and surface area. The newly formed fat droplets brings about stabilization of the milk emulsion and thus prevents rising of the cream. Homogenised milk has a creamier texture, bland flavour and whiter appearance.
- **Evaporated Milk:** It is made by evaporating more than half the water from milk under vacuum, at a temperature of 74° C - 77° C. It is then fortified with vitamin D, homogenised and filled into cans 56 and sterilized at a temperature of 118° C for 15 minutes and cooled. The treatment employed lends a brown colour and characteristic flavour owing to the reaction between sugar and protein.
- **Condensed Milk:** It is obtained when whole milk is concentrated to about one-third of its original volume and has about 15 percent sugar added to it. The preparation of condensed milk involves

  (i) Filtration and pasteurization of milk,

(ii) Preheating and evaporation
(iii) Addition of sterilised sugar syrup
(iv) Homogenisation.

- **Flavoured Milk:** It is the milk prepared by the addition of flavour such as rose, pista, badam, cardamom etc. to pasteurised whole milk.
- **Milk Powder:** Milk powder is prepared by dehydrating whole milk in drum driers or spray driers. In the case of drum or roller drying, the milk is filtered, pasteurized, homogenised and then fed into roller driers which are internally heated with steam. The dried milk is obtained as a thin sheet and is powdered. In spray drying, the homogenised milk is blown as a fine spray into a pre-heated vacuum chamber resulting in fine dry powder. The milk powder is collected, cooled and packed.

Physical Properties of Milk

- **Acidity:** Milk has a pH of about 6.5 to 6.7. The salts of the minerals - calcium, phosphorus, sodium and potassium help to maintain this pH level.
- **Viscosity:** The viscosity of milk is affected by temperature, amount and nature of dispersion of protein and fat, acidity and the effects of various enzymes and bacteria. Homogenization increases the viscosity of milk.
- **Freezing Point:** The freezing point of milk is -0.55° C.
- **Boiling Point:** Milk boils at 100.2° C.

4.1.2 Fermented Milk Products

- **Paneer:** Paneer is a soft cheese prepared by addition of lemon juice or citric acid to hot milk and precipitating the casein. The liquid released in this process is known as whey and the resultant curd is tied in a muslin cloth and hung for a day to squeeze any liquid present in it. The soft cheese (paneer) that is obtained is used in Indian gravies and pulavs. It is a very good source of protein.
- **Cheese:** It involves the curdling of milk with enzyme rennet under microbially controlled condition. Milk is held at about 27° C in vats and a lactic acid culture is added. When the milk gets acidic, rennet is added to it and the milk is allowed to coagulate.

The curd formed is cut and heated to about 37° C with constant stirring to remove the whey. The whey is drained. Salt is mixed with the curd and it is pressed to remove further amount of whey. The cheese formed is coated with paraffin to prevent loss of moisture.

The paraffined cheese is allowed to ripen for three to six months at temperatures between 45° to 60° C. Cheese is a concentrated source of protein.

- **Curd:** Curd is prepared by heating milk to about 50° C. A teaspoon of curd (starter) from an earlier batch of curd is added and is mixed thoroughly. The lactic acid bacteria present in the starter curdles the milk. The bacteria breaks down lactose to lactic acid thereby increasing the acidity of milk. When the pH reaches 4.6, the milk protein casein coagulates as curd.
- The optimum temperature for the formation of curd is 35° - 40° C and the time needed for curd formation is 8 - 12 hours depending on the atmospheric temperature. Curd is used as a dressing on salads made from fresh vegetables and combines well with plain cooked rice.
- **Yoghurt:** This is a coagulated milk product with curd like consistency. It is made from partially skimmed or whole milk and it has a slightly acidic flavour. In the production of yoghurt, a mixed culture of Lactobacillus bulgaricus, Streptococcus thermophilus and Lactobacillus acidophilus is added to pasteurised milk and incubated at 42° C to 46° C.

Role of Milk & Milk Products in Cookery

1. It contributes to the nutritive value of the diet, eg. milkshakes, plain milk, flavoured milk, cheese toast.
2. Milk adds taste and flavour to the product eg. payasam,tea, coffee.
3. It acts as a thickening agent along with starch eg. whitesauce or cream soups.
4. Milk is also used in desserts, eg. icecream, puddings
5. Curd or buttermilk is used as a leavening agent and to improve texture, eg. dhokla.
6. Curd is used as a marinating agent, eg. marinating chicken and meat.
7. Curd is used as a souring agent, eg. ravadosa, dry curdchillies.
8. Khoa is used as a binding agent, eg. carrot halwa.
9. Cheese is used as garnishing agent.
10. Salted butter milk is used for quenching thirst.

4.1.3 Non-Fermented Milk Products

- **Khoa:** Khoa is prepared by evaporating whole milk in an open cast iron pan with continuous stirring until it is semi-solid. It is used extensively in the preparation of Indian sweets.
- **Cream:** Cream is the fat of milk and is used in the preparation of sweets. It is made by simmering large quantities of milk until a thick layer of milk fat and coagulated protein form on the surface. It can be consumed with or without the addition of sugar.
- **Butter:** Butter is obtained from cream by churning. When cream is churned, the fat globules are destabilised and coalesce until the milk separates into two phases - viz., the butter and the aqueous phase. Butter is removed and

washed. Butter is used as a cooking medium in many Indian recipes. It is one of the main ingredients in cakes, biscuits, icing and bread.

- **Ghee:** Ghee is butter oil. It is prepared by melting butter and separating the moisture from butter by heating. It is used in preparing Indian sweets, savouries, curries and variety rice like pulav and biriyani.

4.2 Egg

Definition

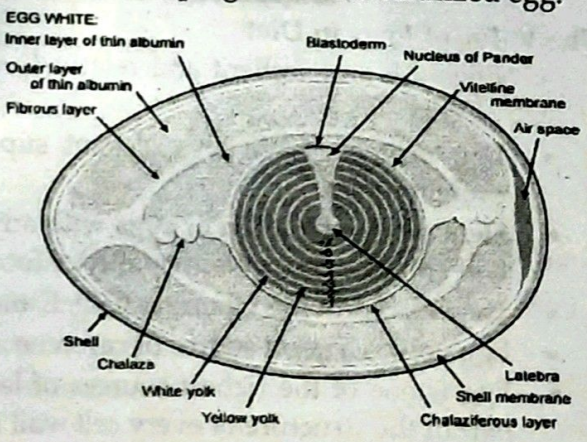
Egg, the content of the hard-shelled reproductive body produced by a bird, considered as food.

While the primary role of the egg obviously is to reproduce the species, most eggs laid by domestic fowl, except those specifically set aside for hatching, are not fertilized but are sold mainly for human consumption. Eggs produced in quantity come from chickens, ducks, geese, turkeys, guinea fowl, pigeons, pheasants, and quail.

The chicken eggs, which represent the bulk of egg production in the United States and Europe. Duck eggs are consumed as food in parts of Europe and Asia, and goose eggs are a food in many European countries. Commercial production of turkey and pigeon eggs is almost entirely confined to those used for producing turkey poults and young pigeons (squabs). Pheasant and quail eggs provide birds for hobby or sport use.

Structure of Egg

- An egg is designed to give protection and food for a developing chick. It is therefore a very nutritious food. There are three main parts: the shell, the white and the yolk.
- The shell consists of two parts
  1. An outer shell composed mainly of calcium carbonate
  2. Two thin inner membranes composed mainly of phosphates
- The outer shell protects the egg, or the developing chick in a fertilized egg.
- The shell is porous and contains numerous tiny holes, which enable a chick to breathe.
- The colour of the shell varies from white to deep brown depending on the breed of the hen.
- The two inner membranes lining the shell act as



chemical filters to obstruct bacteria which may enter through the porous shell.

- The two membranes separate to form a small air pocket between them at the rounded end.
- The egg white has two distinctly visible layers.
- The egg white immediately surrounding the yolk is thick and viscous.
- This is surrounded by a thinner more transparent white.
- The egg yolk is anchored to the membranes inside the egg shell by two rope like structures known as the chalazae.
- These hold the yolk centrally in position.
- The yolk is separated from the white by a membrane known as the vitelline membrane.

4.2.1 Composition of Eggs

- The white of the egg (albumin) consists of largely water with no fat or carbohydrate but contains 8-12 percent protein.
- Different types of proteins are present in egg white like ovalbumin, conalbumin, ovamucoid, ovomucin and avidin.
- The protein ovomucin is responsible for the jelly-like character of egg white and thickness of the albumin.
- Avidin binds with biotin and makes the vitamin unavailable.
- But avidin is denatured by heat and thus cooked egg does not affect the availability of biotin.
- Egg yolk comprises mostly 25-33 percent of fat and 15-17 percent protein and the remaining water.
- The major proteins in egg yolk are lipoproteins which include lipovitellins and lipovitellinin.
- These lipoproteins are responsible for the excellent emulsifying properties of egg yolk, when it is used in products such as mayonnaise.

4.2.2 Nutritive Value of an Egg

The Value of Eggs in Diet

- Eggs are an excellent and relatively cheap source of high biological value protein.
- Egg proteins have an excellent supplementary value to all other plant protein foods.
- Hence a combination of eggs with any of the cereal or cereal pulse mixture will enhance the protein quality of food.
- They also provide vitamins A, D, E and riboflavin.
- Egg yolk is a good source of carotene and iron.
- Egg is one of the richest sources of lecithin- a phospholipid which forms a part of the structure of every cell wall in the body.

- Egg also provides essential fatty acids like linoleic acid and arachidonic acid.

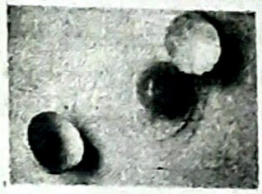
Nutrient (unit)	Whole Egg
Weight	60g
Water (percentage)	65-68.5
Calories (kcal)	70
Protein (g)	6.3
Carbohydrate (g)	0.36
Total fat (g)	4.8
Polyunsaturated fat (g)	1
Monounsaturated fat (g)	1.8
Saturated fat (g)	1.6
Cholesterol (mg)	185
Choline (mg)	126
Vitamin A (IU)	270
Vitamin D (IU)	41
Vitamin E (mg)	0.5

4.2.3 Evalution of Egg Quality

Egg is an excellent food and hence its quality is of very great importance. Fresh eggs have the best quality. Quality of eggs can be determined by candling where the egg is held against a source of strong light. Candling will reveal

a) A crack in the shell.
b) The size of the air cell.
c) The firmness of the white.
d) The position of the yolk.
e) The presence of foreign substances.

In a good quality egg, the white is thick and stands high. Yolk is firm, round and high. In a poor quality egg, the yolk is somewhat ¬flattened and enlarged. The white appears watery.


Fresh egg


Older or rotten egg

Use of Egg in Cookery

- Eggs can be used in many ways in cookery.
- Eggs when used alone or in combination with other foods they become the major protein source of a meal. Eggs can be used as boiled, scrambled, fried (omelettes) or poached for table use.
- Eggs are used as

1. **Thickening Agent:** Egg proteins coagulate on heating. Therefore, eggs can be used as thickening agents for making stirred and baked custards, soups and puddings.
2. **Binding Agent:** Egg proteins coagulate between 65 and 70°C and help to hold shape of the products in which it is used. They can be used for making cutlets, French toast or Bombay toast and banana fritters.
3. **Leavening Agent:** Eggs when beaten, form elastic ¬films wluich can trap air. This air expands during baking and gives a fluffy spongy product. Thus they can be used in cakes, foamy omelette, soufflés and meringue.
4. **An Emulsifying Agent:** Besides protein, egg contains phospholipids such as lecithin which are known for their emulsifying quality. Hence egg can be used an excellent emulsifying agent in products such as mayonnaise as it is able to stabilise the oil in water dispersion.
5. **As a Flavouring and Colouring Agent:** Egg is used in food mixtures to contribute flavour and colour to products such as cakes and puddings.
6. **As a Clarifying Agent:** Egg helps in the preparation of clear soups. When a small amount of egg white is added to the liquid soup and heated, the egg albumin coagulates and carries along with it suspended particles. On allowing it to settle, a clear soup is obtained.
7. **As a Garnishing Agent:** Hard boiled eggs are diced and are used to garnish dishes like biryani.
8. **As an Enriching Agent:** Eggs are used to enhance the nutritive value of various preparations.

4.3 Poultry

Introduction

The word "poultry" comes from Middle English pultry or pultrie, itself derived from Old French/Norman word pouletrie. The term for an immature poultry, pullet, like its doublet poult, comes from Middle English pulet and Old French polet, both from the Latin word pullus, meaning a young fowl or young animal. The word "fowl" is of Germanic origin (cf. Old English Fugol, German Vogel, Danish Fugl).

Definition

The term poultry is applied to all domesticated birds used as food and includes chicken, ducks, geese, turkeys and pigeons. Of these, chicken and turkey are most commonly used for their meat.

4.3.1 Classification of Poultry

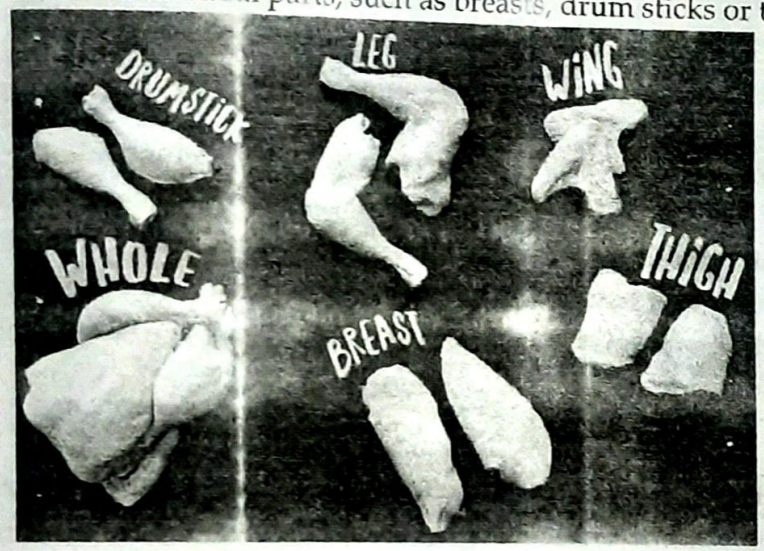
Poultry is classified based on age. Age influences tenderness and fat content of the poultry. According to Indian standards, the classification is as follows:

- **Broiler or fryer:** Chicken of 8 to 10 weeks of age either sex, having tender meat with soft, pliable smooth textured skin and flexible breastbone cartilage.
- **Roaster:** A young chicken, usually 3 to 5 month of age, of either sex, having tender meat with soft pliable smooth textured skin and breastbone cartilage that may be somewhat less flexible that of the broiler or fryer.
- **Stag:** A male chicken usually under 10 months of age with coarse skin, somewhat toughened and darkened flesh and a considerable hardening of the breastbone cartilage.
- **Stewing chicken or fowl:** A mature chicken, usually more than 10 months of age, with meat less tender than that of a roaster and inflexible breastbone tip.
- **Cock:** A mature male chicken, usually over 10 months of age, with coarse skin, toughened and darkened meat and hardened breastbone tip.

Processing

Poultry is marketed in ready to cook form as dressed chicken after removing the head, feet and entrails. After the birds are killed, they are scalded, that is, dipped in hot water briefly. The temperature of the scald water may be 60 0 C and the bird is kept in it for about 45 seconds or more. Scalding loosens the feathers on the chicken and thus helps defeathering.

After defeathering, evisceration of the bird takes place. The eviscerated birds are thoroughly washed and chilled. Chicken can be purchased whole, cut into parts or in packs of similar individual parts, such as breasts, drum sticks or thighs.



4.3.2 Composition and Nutritive Value

Poultry meat has high protein content (about 25%) and is comparable in quality and nutritive value to other meats. It contains all the essential amino acids required for building body tissues. There is a little fat on the meat of young birds, but the fat content is influenced by age and species of poultry.

Chicken fat is more unsaturated than the fat of red meat and this has nutritional advantage. Because of its high protein to fat ratio, poultry meat is advantageous to persons who must restrict the intake of fats. Like other animal tissues, poultry flesh is a good source of B Vitamins and minerals.

Nutrition facts: Calories and macronutrients of chickens

Per 100g raw	Chicken Breast (meat only)	Chicken Breast (with skin)	Chicken Thigh (meat only)	Chicken Thigh (with skin)
Calories	110 kcal	172 kcal	119 kcal	211 kcal
Carbohydrate	0 g	0 g	0 g	0 g
Fiber	0 g	0 g	0 g	0 g
Sugars	0 g	0 g	0 g	0 g
Fat	1.2 g	9.2 g	3.9 g	15.3 g
Saturated	0.3 g	2.7 g	1.0 g	4.4 g
Monounsaturated	0.3 g	3.8 g	1.2 g	6.5 g
Polyunsaturated	0.3 g	2.0 g	1.0 g	3.4 g
Omega-3	40 mg	120 mg	100 mg	206 mg
Omega-6	170 mg	1740 mg	750 mg	3091 mg
Protein	23.1 g	20.8 g	19.7 g	17.3 g

Selection of Poultry

When purchasing fresh poultry, look for ¬firm birds with plump flesh the skin should not look wrinkled. If buying frozen chicken, check that the package is well sealed.

4.4 Meat

Introduction

Meat is valued as a complete protein food containing all the amino acids necessary for the human body. The fat of meat, which varies widely with the species, quality, and cut, is a valuable source of energy and also influences the flavour, juiciness, and tenderness of the lean. Parts such as livers, kidneys, hearts, and other portions are excellent sources of vitamins and of essential minerals, easily assimilated by the human system.

Definition

Meat refers to muscle of warm-blooded four-legged animals. Meat is defined as skeletal muscle with naturally attached tissue. Red meat consists of mutton, pork, and beef and rabbit meat. The flesh of birds (poultry), fish, crustaceans, flesh of salmon and lobsters are light coloured and are referred to as white meat.

Classes of Meat & Related Products

1. **Veal:** It is the meat from cattle slaughtered 3 to 4 weeks after birth.
2. **Beef:** Meat of cattle over 1 year old.

3. **Mutton:** Flesh of young ovine animals of both sexes whose age is 12 months or under.
4. **Yearling Mutton:** Carcasses of young sheep usually from 12 to about 20 months old are termed yearling mutton.
5. **Mature mutton:** Flesh of both the male and female of ovine species that are 20 months in age at the time of slaughter.
6. **Pork:** It is the meat of swine. Good quality pork is obtained from animals between the age of 3-12 months before the amount of fat becomes excessive.
7. **Organ meats:** Liver, kidney, heart, thymus, pancreas and brain.
8. **Sausages:** Made of ground or minced meat and are enclosed in casings.

Structure of Meat

Animal flesh consists of muscle tissue or fibres, connective tissue and fatty (adipose) tissue. Lean meat is the muscle tissue of animals. Meat muscle is made up of bundles of muscle fibres held together by creamy white connective tissues. Tendons join muscles (made up of bundles of muscle fibres, surrounded by connective tissue) to the bones of animals.

Fat: Fat is distributed throughout meat in small particles or in large masses. The pattern formed by the uniform distribution of fat in small "lakes" throughout the muscle or lean flesh is called marbling and is considered an important factor in contributing tenderness and flavour to muscle tissue.

The Colour of Meat

The colour of meat is due to the red pigment called myoglobin.

1. **OFFALS (ORGAN MEAT):** Offal also called as organ meats, refers to the internal organs and entrails of a butchered animal. The name offal means "off fall", in other words, the bits which fall from an animal when it is butchered. The term offals generally covers organs such as the heart, liver and lungs (collectively known as the pluck) and other organs like the kidneys, brains, head, feet, tongue, intestines and tails.

2. Offal from birds is generally referred to as giblets. Offals are a highly nutritious food and an excellent source of protein. The liver, kidney and heart are a good source of iron and vitamins A, and D.

4.4.1 Composition and Nutritive value of meat

- ☑ Meat has an outstanding nutritive value, contributing substantial amount of high quality proteins and essential minerals and vitamins to the diet.
- ☑ Meat contains 15- 20 percent protein of high biological value.
- ☑ The proteins of meat are well utilized by the body, thus ensuring a supply of essential amino acids necessary for growth and maintenance.
- ☑ Meat contains enough iron, phosphorus, zinc and copper to rate as an important source of these minerals.
- ☑ As far as vitamins are concerned, vitamin A, thiamine and riboflavin are present in liver, kidneys, heart and sweetbreads (the pancreas or the thymus).
- ☑ All lean meats contain thiamine, riboflavin and niacin.
- ☑ Meat is also relatively high in energy value. Meat fats are rich in saturated fatty acids.

How meats compare nutritionally
(Information based on 3.5 oz. serving)

Meat	Calories	Protein (gms)	Fat (gms)	Cholesterol (gms)
Ground Beef	289	24.1	20.7	90.0
Lean Ground	272	24.7	18.5	87.7
Chicken, dk	205	27.4	9.7	93.8
Lamb Chop	216	30.0	9.7	95.8
Pork Loin	190	28.6	9.8	79.6
Pork Chops	202	30.2	8.1	82.7
Lamb Leg	191	28.3	7.7	89.7
Pot Roast	210	33.0	7.6	101.0
Venison	207	33.5	6.4	4.0
Turkey	170	29.3	5.0	76.6
Top Round	180	31.7	4.9	84.6
Chicken, Wht	173	30.9	4.5	85.7
Longhorn	140	25.5	3.7	61.5

Source: Longhorn data: "Nutrient Density of Beef From TexasLonghorn Cattle, Texas A&M, 1987. Other data: USDA, USA Today, 11/29/91. Pope Lab, Inc., Dallas, TX

Post Mortem Changes in Meat

The changes taking place in meat after slaughter may be grouped under two heads:

- ☑ **Onset of rigor mortis:** After slaughtering, the lean tissues undergo a series of complex physical and chemical changes. As a result, muscles lose their soft pliable nature and become rigid, stiff and inflexible. This is termed as "rigor mortis". Stiff muscle starts to soften and becomes tender when it is held in a cold room temperature between 0°C to 20°C for 1–4 weeks. This is known as "ripening" or "ageing". During ageing the humidity of the room is to be controlled.
- ☑ **Development of tenderness:** Meat can be made tender by using mechanical methods like pounding, cutting and grinding which break muscle ¬fibre. Addition of salt, vinegar, lime juice and enzymes like papain (raw papaya), bromelin. (pineapple) and fi¬cin (¬figs) also help in tenderizing meat.

4.4.2 Changes During Cooking

- On cooking, the red pigment of meat turns brown due to the denaturation of protein pigment.
- Cooking (heat treatment) also brings about inactivation of enzymes and denaturation of proteins, which makes the meat tougher.
- When meat is cooked volatile compounds from both fat and lean meat are released which contributes to the flavour and taste of cooked meat.
- Cooking melts the meat fat which increases palatability of meat when eaten warm.
- There is loss of water on cooking meat which does not change the nutritive value but may affect the juiciness and bring about shrinkage in volume and weight.

Meat Cookery

In the process of cooking, many chemical changes occur affecting the appearance, taste and texture of meat & Cooking meat.

- Develops or improve flavour, colour, aroma
- Makes it delicious and appetizing to eat.
- Makes it more tender. Makes it easier to digest.
- Makes it safe to eat - kill any harmful bacteria it may have picked up during handling.

4.5 Fish

Introduction

India has a coast line of 5,100 km. Over 200 edible fish varieties are known to be commercially important. Marine types of fish are sardines, mackerel, tuna, catfish, brown duck, ribbon fish, prawns and cuttle. Fresh water fish are carps, catla, rohu, murrels and hilsa. Fish contains complete proteins and can be an alternative for meat in the diet, but unfortunately ¬fish consumption per capita is far lower than that of meat.

4.5.1 Classification of Fish

Edible fish are categorized as either fin fish of shell fish. The term fin fish refers to the fishes that have bony skeleton. Shell fish is used to designate both mollusks and crustaceans. Shell fish are highly perishable. Crustacea have legs with partly joined outer shells. They include crabs, lobsters, prawns and shrimps. Molluscs have harder outer shells and no legs. They have hinged shells like oysters, scallops and mussels.

Fish can be classified into several major groups based on their physical characteristics and evolutionary relationships. Here are the main classifications of fish:

Jawless Fish (Agnatha):

- Hagfishes and Lampreys
- Lack true jaws, have a circular, suctorial mouth
- Considered the most primitive group of vertebrates

-Cartilaginous Fish (Chondrichthyes):

- Sharks, Rays, and Skates
- Have skeletons made of cartilage rather than bone
- Most have placoid scales (denticles) and multiple gill slits

Bony Fish (Osteichthyes):

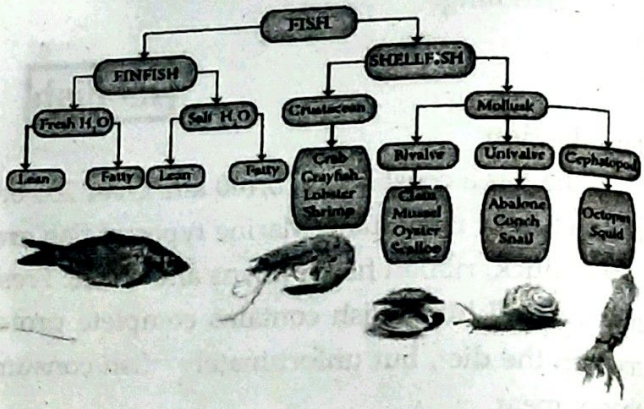
- Ray-finned Fish (Actinopterygii):
  - Includes the majority of fish species, such as Teleosts (e.g., tuna, salmon, trout)

Have bony skeletons and fins supported by rays

- Lobe-finned Fish (Sarcopterygii):
  - Include the coelacanths and lungfishes
  - Have fleshy, lobed fins and are more closely related to tetrapods (four-limbed vertebrates)

Within these major groups, fish can be further classified into various orders, families, genera, and species based on characteristics such as:

- Body shape and size
- Fin structure and placement
- Gill structure and number of gill slits
- Dental and jaw structure
- Scalation patterns
- Reproductive strategies
- Habitat preferences
- Feeding mechanisms



4.5.2 Composition & Nutritive Value

Commonly consumed fish are carp, rohu, sardine, mackerel pomfrets, seer fish, prawns, ribbons fish, sole, Bombay duck, catfish and crab. The composition of fish varies. Fish are not good source of energy because they are not good sources of carbohydrate and fat.

- ☑ **Carbohydrate:** The shell fish has less fat and more carbohydrate than fin fish. Like meat, fish contain some glycogen in muscle tissues. In the live fish, glycogen is the source of stored energy. Oysters are notable for their high content of glycogen.
- ☑ **Protein:** Fish is an excellent source of protein due to its quality and quantity. They contain around 20percent protein. The biological value of fish protein

is 80. Fish is rich in lysine and methionine hence it has supplementary value with cereals and pulses.

- ☑ **Fat:** Fish contains less amount of fat compared to meat and poultry. Fresh water fish contains eicosapentaenoic acid and docosahexaenoic acid which are ω-3 polyunsaturated fatty acids.
- ☑ **Minerals:** Fish is rich in calcium particularly small fish when eaten with bones. Marine fish are good sources of iodine, selenium and fluoride. Selenium is a powerful antioxidant. Oysters are good source of copper and iron. Sodium content of freshwater fish is slightly less than meat. Shellfish such as oysters are nature's richest source of zinc. The bioavailability of iron and zinc is higher in fish than plant foods.
- ☑ **Vitamins:** Sea foods contain significant amounts of vitamin B12 especially shell fishes. Fish liver oils are excellent source of fat-soluble vitamins. Shark liver oil contains 10,000-24,000 IU of vitamin A per gram of oil. Rohu contains vitamin C. Fish are good source of niacin and vitamin D. Sea foods contain significant amounts of vitamin B12 especially shell fishes.

Table 4.3 Nutritive value of Fish (per 100 g)

Food item	Energy (Kcal)	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)
Pomfret -black (Vavalu)	111	20.3	2.6	286	2.3
Prawn (Yera)	89	19.1	1.0	323	5.3
Sardine (Mathi)	101	21.0	1.9	90	2.5
Seer (Vanjaram)	126	22.5	4.0	71	5.4

Fish & Health

Eskimos living in Greenland and the shing community in Japan, enjoy complete freedom from cardiovascular diseases. Their daily consumption of fish is 250-400 g. The beneficial effect of dietary fish is attributed to the fatty acid composition of the fish.

Selection of Fish

Fish that are fresh can be easily identified by the following qualities:

- ☑ **Prawns:** Fresh and firm, strong colour, no unpleasant smells.
- ☑ **Scallops;** Pinkish white or pale yellow, feel firm, give-off clear liquid.
- ☑ **Clams, oysters and mussels:** Tightly closed and heavy for their size, shells should not be cracked.

4.6 Food Adulteration

Adulteration is a legal offence and when the food fails to meet the legal standards set by the government, it is said to have been adulterated. Food adulteration takes place when intentionally or unintentionally substances that

degrade the quality of food are added to it. Thus, food adulteration can be defined as the contamination or adulteration of food or food materials by adding harmful substances to it.

When is Food Considered Adulterated

There are some conditions that are required to conclude whether a food is adulterated or not. These points are summarised below.

- ☑ A substance that degrades the quality of food or turns it hazardous is added to it.
- ☑ Cheaper or low-quality substances are used as a substitute for whole or a few ingredients.
- ☑ A constituent of food is partly or wholly taken out, reducing the quality of food.
- ☑ It's made presentable with harmful substances. or its colour is changed to make it look better.
- ☑ Anything that depreciates the quality of food is added to or abstracted from it.

Intentional Adulteration

Intentional adulteration, a concerning issue in food safety, refers to the deliberate contamination or tampering of food products with harmful substances for malicious purposes. This infamous act poses significant risks to public health, economic stability, and consumer trust in the food supply chain.

Understanding the types of intentional adulteration is crucial in combating this threat effectively. Delve into the intricacies of intentional adulteration, explore its various forms, and examine the strategies and technologies utilised for its detection and mitigation.

Causes of Intentional Adulteration

A confluence of social, governmental, and economic elements leads to food adulteration. Let's examine some typical causes for this troubling behaviour.

- ☑ **Maximising Profits:** A major driver of food adulteration is the desire for increased financial gain. By adding cheap and subpar materials to food goods, scammers can boost their volume and sell more at a reduced cost of manufacture.
- ☑ For instance, utilising inferior ingredients in spices or diluting milk can significantly increase revenues.
- ☑ **Scarcity and the Supply-Demand Divide:** A particular food item may occasionally be shortages due to unanticipated occurrences, low harvests, or natural disasters. In an attempt to quickly meet the enormous demand, dishonest suppliers turn to adulteration.

- ☑ **Enforcement Vulnerabilities:** Adulteration thrives in environments where regulations are weak, and food safety regulations are not strictly enforced. The appearance of lax penalties encourages dishonest individuals to participate in this fraudulent activity.
- ☑ **Customer Ignorance:** Many customers may need to be more familiar with the telltale signs of tampered food or need help to tell the difference between tampered food and real goods. This ignorance allows tainted goods to enter the market.
- ☑ **Technological Developments:** This has led to increasingly complex adulteration techniques, making identifying these dishonest business activities harder. Such advanced technical developments provide more options for deceivers to tamper with food products.

The Food Sector's Globalisation, It has led to the development of complex and wide-ranging supply chains. Because of its intricacy, it is quite challenging to trace the provenance and authenticity of items, which makes adulteration easier to go unnoticed.

Incidental Adulteration

Incidental adulteration is usually due to ignorance, negligence of proper facilities.

Contamination of foods with harmful micro organisms

Some raw foods like meat, fish, milk and vegetables grown on sewage are likely to be contaminated with harmful microorganisms. These are generally destroyed during cooking or processing of food. Some of the micro organisms may survive due to inadequate heat processing. Some foods though they contain low moisture, if they are stored in humid atmosphere, they will get infected with pathogenic fungal which can cause serious illness.

- ☑ **Metallic contamination:** Contamination of food with lead can cause toxic symptoms. Lead brings about pathological changes in the kidney, liver, and arteries. The common signs of lead poisoning are nausea, abdominal pain, anemia, insomnia, mascular paralysis and brain damage. Fish caught from water contaminated with mercury salt contains large amount of mercury. The other elements which are toxic in small doses are cadmium, arsenic, antimony and cobalt.
- ☑ **Packaging hazards:** Polyethylene, polyvinyl chloride and other allied compounds are used to produce flexible packaging material. While this method of packaging is very convenient, it must not contain any noxious thermal breakdown products which could be injurious to health. Further , temperatures used for heat cealing or sterilization should not result in formation of toxic residues. It is essential that only food grade plastic packaging materials be used for packaging foods.

MULTIPLE CHOICE QUESTIONS

1. _____ is prepared by evaporating whole milk in an open cast iron pan with continuous stirring until it is semi-solid. [a]

   a) Khoa b) Paneer c) Cheese d) Ghee

2. Egg yolk proteins are good agents [b]

   a) Oxidizing b) Emulsifying c) Colouring d) Flouring

3. Organ meats are called as [a]

   a) Offals b) Beef c) Poultry d) Chicken

4. _____is the meat from cattle slaughtered 3 to 4 weeks after birth [b]

   a) Beef b) Veal c) Poultry d) Chicken

5. _____ protect against cardiovascular disease [a]

   a) ω-3 fatty acids b) Saturated fatty acids

   c) Trans fatty acids d) UnSaturated fatty acids

FILL IN THE BLANKS

1. _____like meat, poultry, pork and fish provide the body with essential nutrients, minerals and vitamins for it to remain healthy. **(Flesh foods)**
2. A large amount of the _____ found in meat is in the liver. **(Iron)**
3. Poor quality eggs float due to _____ of the air cell and due to loss of moisture. **(Increase in size)**
4. Curd is used as a _____ in ravadosa. **(Souring agent)**
5. Fish liver oils are excellent source of _____ vitamins. **(Fat soluble)**