B.Sc., HOME SCIENCE

I YEAR – I SEMESTER
COURSE CODE: 7BHF1C1

CORE COURSE - I – FOOD SCIENCE

Objectives:
To enable the students to

1. Gain knowledge of food groups, food compositions and their significance
2. Study different methods of cooking foods and gain experience in food preparations

Unit - I

Introduction to foods - Concept of food, nutrients, classification of foods, food groups and uses. Methods of cooking – objectives, merits and demerits; moist heat methods – boiling, steaming, blanching, poaching, steaming, simmering, pressure cooking; dry heat methods – baking, roasting, grilling, parching; frying – sautéing, deep fat, shallow fat; microwave cooking, solar cooking

Unit - II

1. **Cereals and Millets –** Classification, nutritional composition, structure, parboiling, cereal products; cereal cookery – effect of moist and dry heat, gelatinization, factors affecting fermented foods,
2. **Pulses, Nuts and Oilseeds –** Classification, nutritional composition, structure, toxicants; processing – soaking, germination, fermentation, pulse cookery – methods, factors affecting and changes occur during cooking.
3. **Fats and sugars -** Fats and Oils: Composition, smoking temperature, rancidity
4. **Sugars:** Classification, sources, use in cookery

Unit – III

Vegetables and Fruits - Classification, nutritional composition; pigments – water soluble, and fat soluble. Properties and functions of enzymes, tannins, pectin, acids and flavones. Selection of cooking methods. Factors affecting – changes during cooking; enzymatic browning - causes, prevention and conservation of nutrients.

Unit - IV

Milk and Milk Products - Nutritional composition, kinds of milk, processing – pasteurization, Homogenization and standardization of milk; milk products – butter, ghee, cheese, dehydrated milk; milk cookery– problems encountered in cooking milk.

Unit – V

Flesh Foods and Beverages

1. **Meat:** Classification, nutritional composition, selection, postmortem changes, storage, cooking methods, effects, factors affecting, uses.
2. **Egg:** Types of eggs, Structure, composition, nutritional composition, quality of eggs, egg cookery and uses.
3. **Poultry and fish:** Types of Poultry, nutritional composition, selection, storage, cooking methods and uses.
4. **Fish:** Types of fish, selection, storage, cooking methods and uses.
5. **Beverages -** Types of Beverages and its health benefits.

Books for Reference:

1. Srilakshmi B (2003) **Food science** 3rd Edition, New Age International Pub, New Delhi.
2. Shakuntala Manay and Shadaksharaswamy (1995) **Foods, Facts and Principles,** Wiley Eastern Co., New Delhi.
3. Norman N.Potter Joseph H. Hotchkiss (1995) **Food Science,** Fifth edition, Springer.
4. Kay Yockey Mehas, Sharon Lesley Rodgers (2002) **Food Science: The Biochemistry of Food and Nutrition** Glencoe/McGraw-Hill**.**
5. Subbulakshmi Shoba A Udipi (2006) **Food Processing and Preservation** New Age International Publisher.

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CORE COURSE - I – FOOD SCIENCE

UNIT – I

INTRODUCTION AND CONCEPT OF FOODS

Food is usually of plant, animal or fungal in origin, and contains essential nutrients, such as carbohydrates, fats, proteins, vitamins, or minerals. The substance is ingested by an organism and assimilated by the organism's cells to provide energy, maintain life, or stimulate growth.

A food is something that provides nutrients. Nutrients are substances that provide: energy for activity, growth, and all functions of the body such as breathing, digesting food, and keeping warm; materials for the growth and repair of the body, and for keeping the immune system healthy.

Food is any substance normally eaten or drunk by living things. The term food also includes liquid drinks. Food is the main source of energy and of nutrition for animals, and is usually of animal or plant origin. There are 4 (four) basic food energy sources: fats, proteins, carbohydrates and alcohol.

Nutrients

Nutrients can be described as the chemical components of food and can be classified into six broad groups: carbohydrates, proteins, fats, vitamins, minerals and water. Water is not technically a nutrient, but it is essential for the utilisation of nutrients.

Protein: Found in beef, pork, chicken, game and wild meats, fish and seafood, eggs, soybeans and other legumes included in traditional Central America cuisine, protein provides the body with amino acids. Amino acids are the building blocks of proteins which are needed for growth, development, and repair and maintenance of body tissues. Protein provides structure to muscle and bone, repairs tissues when damaged and helps immune cells fight inflammation and infection.

Carbohydrates: The main role of a carbohydrate is to provide energy and fuel the body the same way gasoline fuels a car. Foods such as corn, chayote, beans, plantains, rice, tortilla, potatoes and other root vegetables such as yucca, bread and fruit deliver sugars or starches that provide carbohydrates for energy.

Energy allows the body to do daily activities as simple as walking and talking and as complex as running and moving heavy objects. Fuel is needed for growth, which makes sufficient fuel especially important for growing children and pregnant women. Even at rest, the body needs calories to perform vital functions such as maintaining body temperature, keeping the heart beating and digesting food.

Fat: Dietary fat, which is found in oils, coconut, nuts, milk, cheese, meat, poultry and fish, provides structure to cells and cushions membranes to help prevent damage. Oils and fats are also essential for absorbing fat-soluble vitamins including vitamin A, a nutrient important for healthy eyes and lungs.

Vitamins and minerals are food components that help support overall health and play important roles in cell metabolism and neurological functions.

Vitamins aid in energy production, wound healing, bone formation, immunity, and eye and skin health.

Minerals help maintain cardiovascular health and provide structure to the skeleton.

Consuming a balanced diet including fruits, vegetables, dairy, protein foods and whole or enriched grains helps ensure the body has plenty of nutrients to use. Providing a few examples of specific micronutrient functions can enhance the effectiveness of nutrition education:

- **Vitamin A** helps the eyes to see
- **Calcium and magnesium** help muscles and blood vessels relax, preventing cramps and high blood pressure
- **Vitamin C** helps wounds heal and the body's ability to fight off germs
- **Iron** helps the blood transport oxygen throughout the body and prevents anemia

CLASSIFICATION OF FOOD

Food can be classified in accordance to their chemical property, to their function, to their essentiality, to their concentration and to their nutritive value. According to their function in the body:

Energy giving foods

The carbohydrates, fats and the protein are considered as calorie nutrients, so that the body can perform the necessary functions. Rice, chapatti, bread, potato, sugar, oil, butter and ghee are examples of energy giving foods.

Body building foods

Foods such as proteins, fats and carbohydrates are also called as body-building food. They are the nutrients that form body tissues. Fish, meat, chicken, eggs, pulses, nuts and milk are some body building foods.

Protective foods

Vitamins and minerals are the nutrients that function to regulate body processes. They protect us from various diseases. Fruits and vegetables are some examples. Therefore we must eat these regularly.

FOOD GROUPS

Foods from the basic food groups provide the nutrients essential for life and growth. These foods are also known as 'everyday foods'. Each of the food groups provides a range of nutrients, and all have a role in helping the body function. In particular, vegetables, legumes and fruit protect against illness and are essential to a healthy diet.

ICMR FIVE FOOD GROUPS

Five Food Group System

Food Group	Main Nutrients
I. Cereals, Grains and Products : Rice, Wheat, Ragi, Bajra, Maize, Jowar, Barley, Rice flakes, Wheat flour.	Energy, protein, Invisible fat Vitamin – B_1, Vitamin – B_2, Folic Acid, Iron, Fibre.
II. Pulses and Legumes : Bengal gram, Black gram, Green gram, Red gram, Lentil (whole as well as dhals) Cowpea, Peas, Rajmah, Soyabeans, Beans.	Energy, Protein, Invisible fat, Vitamin – B_1, Vitamin – B_2, Folic Acid, Calcium, Iron, Fibre.
III. Milk and Meat Products : **Milk :** Milk, Curd, Skimmed milk, Cheese **Meat :** Chicken, Liver, Fish, Egg, Meat.	Protein, Fat, Vitamin – B_{12}, Calcium. Protein, Fat, Vitamin – B_2
IV. Fruits and Vegetables : **Fruits :** Mango, Guava, Tomato Ripe, Papaya, Orange. Sweet Lime, Watermelon. **Vegetables (Green Leafy)** : Amaranth, Spinach, Drumstick leaves, Coriander leaves, Mustard leaves, fenugreek leaves . **Other Vegetables** : Carrots, Brinjal, Ladies fingers, Capsicum, Beans, Onion, Drumstick, Cauliflower.	Carotenoids, Vitamin – C, Fibre. Invisible Fats, Carotenoids, Vitamin – B_2. Folic Acid, Calcium, Iron, Fibre. Carotenoids, Folic Acid, Calcium, Fibre

V. Fats and Sugars : **Fats :** Butter, Ghee, Hydrogenated oils, Cooking oils like Groundnut, Mustard, Coconut. **Sugars :** Sugar, Jaggery	 Energy, Fat, Essential Fatty Acids Energy

Objectives of Cooking

1. Cooking sterilizes food: Above 40□ C the growth of bacteria decreases rapidly. Hence food is made safe for consumption.
2. Cooking softens the connective tissues of meat and the coarse fibre of cereals, pulses and vegetables so that the digestive period is shortened and the gastro intestinal tract is less subjected to irritation.
3. Palatability and food quality is improved by cooking – Appearance, flavour, texture and taste of food are enhanced while cooking.
4. Introduces variety – Different dishes can be prepared with the same ingredients. (Eg.) Rice can be made into biriyani and kheer.
5. Increases food consumption – Cooking brings about improvement in texture and flavour thereby increasing consumption of food.
6. Increases availability of nutrients – Example in raw egg, avidin binds biotin making it unavailable to the body. By cooking, avidin gets denatured and biotin is made available.

METHODS OF COOKING

Heat is transferred to the food during cooking by conduction, convection, radiation or microwave energy. Cooking takes place by moist and dry heat. Moist heat involves water and steam. Air or fat are used in dry heat.

Moist Heat	Dry Heat	Combination
Boiling	Roasting	Braising
Stewing	Grilling	
Steaming	Toasting	
Pressure Cooking	Baking	
Poaching	Sauteeing	
Blanching	Frying	

MOIST HEAT METHODS

Boiling:

Boiling is a method of cooking foods by just immersing them in water at 100□ C and maintaining the water at that temperature till the food is tender. Rice, egg, dhal, meat, roots

and tubers are cooked by boiling.

Merits

1. Simple method - It does not require special skill and equipment.
2. Uniform cooking can be achieved.

Demerits

1. Continuous excessive boiling leads to damage in the structure and texture of food.
2. Loss of heat labile nutrients such as B and C vitamins if the water is discarded.
3. Time consuming – Boiling takes more time to cook food and fuel may be wasted.
4. Loss of colour – water soluble pigments may be lost.

Stewing

It refers to the simmering of food in a pan with a tight fitting lid using small quantities of liquid to cover only half the food. This is a slow method of cooking. The liquid is brought to boiling point and the heat is reduced to maintain simmering temperatures (82□C - 90□ C). The food above the liquid is cooked by the steam generated within the pan. Apple, meat along with roots, vegetables and legumes are usually stewed.

Merits

1. Loss of nutrients is avoided as water used for cooking is not discarded.
2. Flavour is retained.

Demerits

1. The process is time consuming and there is wastage of fuel.

Steaming:

It is a method of cooking food in steam generated from vigorously boiling water in a pan.

The food to be steamed is placed in a container and is not in direct contact with the water or liquid. Idli, custard and Idiyappam are made by steaming. Vegetables can also be steamed.

Merits

1. Less chance of burning and scorching.
2. Texture of food is better as it becomes light and fluffy. Eg. Idli.
3. Cooking time is less and fuel wastage is less.
4. Steamed foods like idli and idiappam contain less fat and are easily digested and are good for children, aged and for therapeutic diets.
5. Nutrient loss is minimized.

Demerits

1. Steaming equipment is required.
2. This method is limited to the preparation of selected foods.

Pressure cooking:

When steam under pressure is used the method is known as pressure cooking and the equipment used is the pressure cooker. In this method the temperature of boiling water can be raised above 100^0 C. Rice, dhal, meat, roots and tubers are usually pressure cooked.

Merits

1. Cooking time is less compared to other methods.
2. Nutrient and flavour loss is minimized.
3. Conserves fuel and time as different items can be cooked at the same time.
4. Less chance for burning and scorching.
5. Constant attention is not necessary.

Demerits

1. The initial investment may not be affordable to everybody.
2. Knowledge of the usage, care and maintenance of cooker is required to prevent accidents.
3. Careful watch on the cooking time is required to prevent over cooking.

Poaching:

This involves cooking in the minimum amount of liquid at temperatures of 80 C - 85 C that is below the boiling point. Egg and fish can be poached.

Merits

1. No special equipment is needed.
2. Quick method of cooking and therefore saves fuel.
3. Poached foods are easily digested since no fat is added.

Demerits

1. Poached foods may not appeal to everybody as they are bland in taste.
2. Food can be scorched if water evaporates due to careless monitoring.
3. Water soluble nutrients may be leached into the water.

Blanching:

In meal preparation, it is often necessary only to peel off the skin of fruits and vegetables without making them tender. This can be achieved by blanching. In this method, food is dipped in boiling water for 5 seconds to 2 minutes depending on the texture of the food. This helps to remove the skin or peel without softening food.

Blanching can also be done by pouring enough boiling water on the food to immerse it for some time or subjecting foods to boiling temperatures for short periods and then immediately immersing in cold water. The process causes the skin to become loose and can be peeled off easily.

Merits

1. Peels can easily be removed to improve digestibility.
2. Destroys enzymes that bring about spoilage.
3. Texture can be maintained while improving the colour and flavour of food.

Demerits

1. Loss of nutrients if cooking water is discarded.

DRY HEAT METHODS

Roasting:

In this method food is cooked in a heated metal or frying pan without covering it. Eg. Groundnut.

Merits

1. Quick method of cooking.
2. It improves the appearance, flavour and texture of the food.
3. Spices are easily powdered if they are first roasted.

Demerits

1. Food can be scorched due to carelessness.
2. Roasting denatures proteins reducing their availability.

Grilling:

Grilling or broiling refers to the cooking of food by exposing it to direct heat. In this method food is placed above or in between a red hot surface. Papads, corn, phulkas, chicken can be prepared by this method.

Merits

1. Enhances flavour, appearance and taste of the product.
2. It requires less time to cook.
3. Minimum fat is used.

Demerits

1. Constant attention is required to prevent charring.

Toasting:

This is a method where food is kept between two heated elements to facilitate browning on both sides. Bread slices are cooked by toasting.

Merits

1. Easy and quick method.
2. Flavour improved.

Demerits

1. Special equipment required.
2. Careful monitoring is needed to prevent charring.

Baking:

In this method, the food gets cooked in an oven or oven- like appliance by dry heat. The temperature range maintained in an oven is 120□C – 260□C.

The food is usually kept uncovered in a container greased with a fat coated paper. Bread, cake, biscuits, pastries and meat are prepared by this method.

Merits

1. Baking lends a unique baked flavour to foods.
2. Foods become light and fluffy – cakes, custards, bread.
3. Certain foods can be prepared only by this method – bread, cakes.
4. Uniform and bulk cooking can be achieved. Eg. bun, bread.
5. Flavour and texture are improved.
6. Variety of dishes can be made.

Demerits

1. Special equipment like oven is required.
2. Baking skills are necessary to obtain a product with ideal texture, flavour and colour characteristics.
3. Careful monitoring needed to prevent scorching.

Sauteing:

Sauteing is a method in which food is lightly tossed in little oil just enough to cover the base of the pan. The pan is covered with a lid and the flame or intensity of heat is reduced.

The food is allowed to cook till tender in its own steam. The food is tossed occasionally, or turned with a spatula to enable all the pieces to come in contact with the oil and get cooked evenly.

The product obtained by this method is slightly moist and tender but without any liquid or gravy. Foods cooked by sauteing are generally vegetables which are used as side dishes in a menu. Sauteing can be combined with other methods to produce variety in meals.

Merits

1. Takes less time.
2. Simple technique.
3. Minimum oil is used.

Demerits

1. Constant attention is needed as there is chance of scorching or burning.

Frying:

In this method, the food to be cooked is brought into contact with larger amount of hot fat. When food is totally immersed in hot oil, it is called deep fat frying. Samosa, chips, pakoda are examples of deep fat fried foods. In shallow fat frying, only a little fat is used and the food is turned in order that both sides are browned. Eg. Omlette, cutlets, parathas.

Merits

1. Very quick method of cooking.
2. The calorific values of food is increased since fat is used as the cooking media.
3. Frying lends a delicious flavour and attractive appearance to foods.
4. Taste and texture are improved.

Demerits

1. Careful monitoring is required as food easily gets charred when the smoking temperature is not properly maintained.
2. The food may become soggy due to too much oil absorption.
3. Fried foods are not easily digested.
4. Repeated use of heated oils will have ill effects on health.

COMBINATION OF COOKING METHODS

Braising :

Braising is a combined method of roasting and stewing in a pan with a tight fitting lid. Flavourings and seasonings are added and food is allowed to cook gently. Food preparations prepared by combination methods are :

Uppuma	-	Roasting and boiling.
Cutlet	-	Boiling and deep frying.
Vermicilli payasam	-	Roasting and simmering.

MICROWAVE COOKING

Microwaves are electromagnetic waves of radiant energy with wave lengths in the range of 250×10^6 to 7.5×10^9 Angstroms.

The most commonly used type of microwave generator is an electronic device called a magnetron which generates radiant energy of high frequency.

A simple microwave oven consists of a metal cabinet into which the magnetron is inserted. The cabinet is equipped with a metal fan that distributes the microwave throughout the cabinet. Food placed in the oven is heated by microwaves from all directions.

Moist foods and liquid foods can be rapidly heated in such ovens. Food should be kept in containers made of plastic, glass or china ware which do not contain metallic substances. These containers are used because they transmit the microwaves but do not absorb or reflect them.

Merits

1. Quick method – 10 times faster than conventional method. So loss of nutrients can be minimised.
2. Only the food gets heated and the oven does not get heated.
3. Food gets cooked uniformly.
4. Leftovers can be reheated without changing the flavour and texture of the product.
5. Microwave cooking enhances the flavour of food because it cooks quickly with little or no water.

Demerits

1. Baked products do not get a brown surface.
2. Microwave cooking cannot be used for simmering, stewing or deep frying.
3. Flavour of all ingredients do not blend well as the cooking time is too short.

SOLAR COOKING

Solar cooking is a very simple technique that makes use of sunlight or solar energy which is a non-conventional source of energy.

Solar cooker consists of a well insulated box which is painted black on the inside and covered with one or more transparent covers.

The purpose of these transparent covers is to trap heat inside the solar cooker. These covers allow the radiation from the sun to come inside the box but do not allow the heat from the hot black absorbing plate to come out of the box. Because of this, temperature upto 140 °C can be obtained which is adequate for cooking.

Merits

1. Simple technique – requires no special skill.
2. Cost effective as natural sunlight is the form of energy.
3. Original flavour of food is retained.
4. There is no danger of scorching or burning.
5. Loss of nutrients is minimum as only little amounts of water is used in cooking.

Demerits

1. Special equipment is needed.
2. Slow cooking process.
3. Cannot be used in the absence of sunlight – rainy season, late evening and night.

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UNIT – II

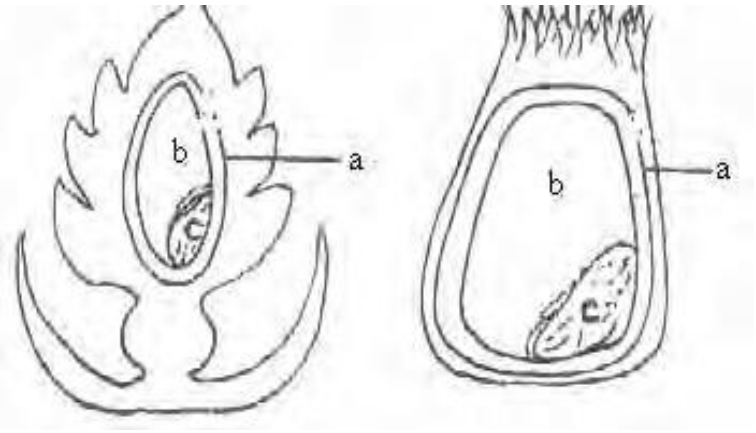
1.CEREALS AND MILLETS:

Cereals form the staple food of the human race. In India wheat, rice, maize (corn), oats, jowar, ragi and bajra are the common cereals and millets used.

STRUCTURE OF RICE AND WHEAT

The overall structure of all cereal grains is basically similar. Rice grains resemble wheat but is smaller than that of wheat. It is flattened laterally and has no ventral furrow.

Wheat cereal grains are composed of an outer bran coat, a germ and a starchy endosperm.



a. Bran b. Endosperm c. Germ

Fig. 3.1 Structural Parts of rice and wheat

Bran:

Bran is the outer layer of the kernel and constitutes 5 percent of the kernel. During milling the bran is discarded. Bran is rich in fibre and minerals. It is also a good source of thiamine and riboflavin.

Aleurone Layer:

This is located just under the bran, which is rich in protein, phosphorus and thiamin and contains moderate amounts

of fat. The aleurone layer makes up about 8 percent of the whole kernel. This layer is lost in the milling process along with bran.

Endosperm:

This is the large central part of the kernel and constitutes 84 –85 percent of the kernel. The endosperm cell consists mainly of starch and protein and little mineral matter and fibre and only half a trace of fat. The vitamin content of the endosperm is low.

Germ :

This is a small structure at the lower end of the kernel and is separated from the endosperm by the scutellum. It makes up 2 – 3 percent of the whole kernel. It is rich in protein, fat, vitamins and minerals.

The germ serves as a store of nutrients for the seed when it germinates. During milling some of the germ is lost along with the bran and aleurone layer.

NUTRITIVE VALUE OF CEREALS

Cereals are an important and economic source of energy. Hundred grams of cereals supply 340 kilo calories of energy. Cereals are also a significant source of proteins (8 – 11 percent) in the diets of people whose staple food is cereals.

However, cereal protein is incomplete as it lacks an essential amino acid, lysine. This lack is made up when cereals are eaten along with other protein foods such as dhals, pulses and milk.

Wheat flour contains glutelin and gliadin as proteins which are commonly known as gluten. The strength of the wheat flour is based on the quality of gluten used.

Whole grains chiefly furnish starch, proteins, minerals, B -Vitamins and fibre.

Refined cereals lose part of the protein, minerals, and B - Complex vitamins in milling. They contain a little more starch than whole cereals.

Whole grains contain more vitamins, minerals and fibre than refined grain and are valuable dietary sources of iron, phosphorus, thiamine and fibre.

PARBOILING AND MILLING EFFECT ON NUTRIENT CONTENT

Parboiling is a process of soaking paddy in water at 65^0 - 70^0 C for 3 – 4 hours. The water is drained and the soaked paddy is steamed in the same vessel for 5 to 10 minutes. The paddy is dried in the sun or mechanically dried.

Advantages of Parboiling:

1. Dehusking of parboiled rice is easy.
2. Grains become tougher resulting in reduced losses during milling.
3. Part of the scutellum and germ which are rich in B – Vitamins get fixed to the grain and hence loss of B – Vitamins are less. The retention of thiamine, riboflavin, niacin and folic acid in parboiled rice is greater than that of polished or hand pounded rice.
4. It improves digestibility.
5. It swells more when cooked to desired softness.

MILLETS

NUTRIENT CONTENT OF RAGI, MAIZE, AND JOWAR

Ragi :

Ragi or finger millet is widely consumed without any refining by many people in rural areas. It contains B Vitamins but is poor in thiamine. Ragi is rich in minerals especially calcium. It is also rich in fibre and is a fair source of iron.

Maize or corn :

Maize, like any other cereal is rich in calories. It is deficient in amino acid lysine. It is a good source of carotene and contains thiamine and folic acid in appreciable amounts.

Jowar :

Jowar or Sorghum is grown in Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Uttara Pradesh and parts of Tamil Nadu. It is rich in carbohydrate, and B – Complex vitamins. It is poor in vitamin – A and rich in dietary fibre. Compared to rice, jowar is richer in protein but the quality is not as good as rice protein.

PROCESSED CEREAL PRODUCTS

Whole wheat flour:

It is obtained by grinding whole wheat. It contains the finely ground bran, germ and endosperm of the whole kernel.

Maida:

It is refined wheat flour. The bran and germ are separated in making white flour or maida. Maida bakes more uniformly into a loaf of a greater volume and it is more bland in taste and more easily digested. It is used in the manufacture of macaroni products.

Semolina:

It is coarsely ground endosperm and its chemical composition is similar to that of white flour.

Macaroni Products:

- These products include macaroni, spaghetti, vermicelli and noodles.
- The starchy endosperm of wheat is coarsely ground into semolina which is made with water into a thick dough. The dough is placed in a cylinder, the lower end of which is fitted with a disc perforated with openings. As the dough is forced through the openings various shapes are formed. Macaroni is a tube form, spaghetti may be either tube or rod, vermicelli is a tiny rod and noodles are flat strips.

Malted Wheat:

- The process of malting helps in the production of malted cereal flour Malted cereal flour is inexpensive and can be made at home as well as commercially.
- Malt is used in brewing and in the preparation of malt extract for pharmaceutical purposes and in the preparation of malted milk powder.

Broken Wheat:

Broken Wheat is whole wheat coarsely ground into large particles. As the losses during milling is little, it is a very nutritious food.

Rice products:

Rice bran:

Breakage of the white rice kernel during milling results in small fragments of the endosperm becoming part of the bran fraction. Parboiled rice bran is normally finely granulated and light tan in colour. It has a bland flavour and can be used in the preparation of bread, snacks, cookies and biscuits. In addition, rice bran is a very rich source of dietary fibre. It is therefore an effective stool bulking agent.

Rice bran oil :

Rice bran oil is obtained by extracting edible grade oil from rice bran. The National Institute of Nutrition, (NIN) Hyderabad has certified that this oil is toxicologically safe for human consumption. This oil is rich in Vitamin E. In addition, it has cholesterol lowering effect than other oils.

Puffed Rice:

Puffed rice is obtained when sun ripe paddy is filled in earthen jars and is moistened with hot water. After 2-3 minutes the water is decanted and the jars are then kept in an inverted position for 8-10 hours.

The paddy is exposed to sun for a short time and then parched in hot sand at 190 -210º C for 40-45 seconds. During parching, the grains swell and burst into soft white products. The parched grains are sieved to remove sand and winnowed to separate the husk.

Rice flakes:

Rice flakes are made after soaking the paddy in hot water, parching it by roasting and then flattening it by force while it is hot to form flakes. It retains a large part of iron and B-vitamin of the aleurone layer. The roasting helps to toast the grain, resulting in partial cooking of the grain. It needs very little time to prepare and is used as a snack. It should be free from bran, broken particles, fragments of the seed coat, insects, stones, trash and bad odour.

Products of Maize Corn oil:

Corn oil is extracted from corn germ. Corn or maize oil is a highly desired vegetable oil owing to its relatively high level of linolenic fatty acid and its excellent flavour.

Popcorn:

Popcorn is prepared by heating the kernels of corn.
During heating, the water vapour within them expands, increasing the pressure until it is sufficient to make the kernels explode or "pop". It is used as a snack for children. Popping can be done with or without fat.

Corn starch:

It is made by a process of wet milling in which the hull and germ are removed. The corn is then ground and mixed with water. The semi liquid material is separated by passing it over sieves or centrifuging it. The starch settles out while most of the protein remains suspended.

The starch is then washed, dried and powdered. Corn starch is widely used because it is inexpensive, lacks characteristic flavour and cooks to a smooth and almost clear paste in water or other clear liquid and superior to wheat flour or potato starch.

ROLE OF CEREALS IN COOKERY

- Cereals form the staple diet and contribute to most of the calorie requirement and half of the protein requirement. Cereals improve the quality of pulse protein. They are excellent source of starch and B vitamins. Cereals also contribute to satiety and are used to prepare the main dish. No meal can be made without cereals.
- Cereals are used as thickening agent, e.g. corn flour in custards, corn flour in white sauce, macaroni in soups.
- Cereals are used as coating agent, e.g., maida paste in cutlets or bread crumbs in cutlets.
- Cereals are used in sweet preparations, e.g., rice, payasam, wheat halwa.
- Malted cereals are used in the preparation of beverages and weaning foods.
- Cereals products like corn flakes and rice flakes are used as ready to use foods.
- Fermented foods made from cereals are used as breakfast foods or snacks, e.g., idli, dhokla.

Fermentation:

The term fermentation refers to the breakdown of carbohydrate like matter under either aerobic or anaerobic conditions. The organisms involved may be bacteria or moulds. During fermentation microorganisms produce gas and help in leavening the batter or dough. They also produce flavouring substances.

Advantages of Fermentation:

1. Flavour and texture of the product is improved.
2. Vitamin B and C content is increased.
3. The product is easily digestible.
4. Acid by-products formed during fermentation inhibits the growth of harmful microorganisms.
5. Variety in the diet:- Traditional Indian recipes like idli, dosa, appam, dhokla and rice vadam are cereal based fermented products.

1. PULSES,NUTS AND OIL SEEDS

Pulses are the edible fruits or seeds of pod-bearing leguminous plants. The term pulse in India is used for edible legumes and dhal is used for decuticled split legumes.

Bengal gram, red gram, black gram, green gram, lentil, horse gram, peas and kesari dhal are some of the major pulse crops in India. Soyabean is also grown.

NUTRIENT CONTENT OF PULSES

- Pulses give 340 calories per 100 gm which is almost similar to cereal calorie. They are a rich source of protein containing about 18 – 25 percent protein. Soyabean is an exception containing about 35 to 40 percent protein.
- All pulses contain sufficient amount lysine which is deficient in cereals and therefore they can supplement cereal protein. A mixture of cereals and pulses is superior to that of either one. Hence a combination of cereals and pulses is ideal for human consumption.
- Pulses contain 55 – 60 percent of carbohydrate including starch soluble sugar and fibre.
- They contain 1.5 percent lipids. Pulses also contain calcium, magnesium, zinc, iron, potassium and phosphorus.
- They are a poor source of carotene and vitamin C but fairly rich in niacin. Germination increases the vitamin C content of pulses. The thiamine content of pulses is equal to or exceeds that of cereals. Being rich in B - Vitamins, they contribute significantly to B – Vitamin intake.

TOXIC SUBSTANCES IN PULSES

- Some toxic substances are naturally present in some pulses. These include trypsin inhibitors and haemagglutinins. Trypsin inhibitor, as the name indicates, interferes with digestion of proteins by inhibiting the action of the enzyme trypsin. Haemagglutinins combine with haeme and thus destroy haemoglobin. Fortunately, both of these toxic substances are destroyed by heat, which is used in the normal cooking process.
- Broad beans contain some toxic substances. When these beans are consumed raw a disease called favism occurs. This disease is characterized by haemolytic anemia. Since human beings usually do not consume broad beans raw, they are not likely to suffer from favism.
- Kesari dhal also contains a toxic substance. This dhal is grown in Madya Pradesh(M.P) It was observed that during the drought conditions, only this dhal is grown and used as a staple food. When this dhal is consumed over a long time paralysis of lower limbs occurs in males. This is known as lathyrism.
- It is reported that when the intake of kesari dhal is restricted to 30 per cent of the total calorie intake, no adverse effects are observed. Therefore it is important to ensure that the intake of this dhal must be restricted to a maximum of 30 percent of the total calorie intake.

GERMINATION – NUTRIENT ENHANCEMENT

- Germination is a process that involves the soaking of pulses overnight. The water is then drained and the seeds are tied in a loosely woven cotton bag and hung.
- Water is sprinkled twice or thrice a day and sprouts usually appear within 6 – 8 hours.

Advantages of germination :

- Vitamin C is synthesised during germination. The increase in vitamin C is around 7 – 20 mg per 100 gm of pulses.
- Riboflavin, niacin, choline and biotin are increased.
- Starch is converted into sugars.
- It reduces the anti-nutritional and toxic factor in pulses.
- Increased variety in the diet as sprouted pulses can be added to salads.
- Dormant enzymes get activated and digestibility and availability of nutrients is improved.
- Minerals like calcium, zinc and iron are released from bound form.
- Sprouted pulses can be eaten raw, since germination improves taste and texture.

FACTORS AFFECTING PULSE COOKERY

- Soaking in water hastens the cooking of dried pulses.
- Soaking in boiling water reduces cooking time as the enzyme phytase present in the legume is inactivated.

- Hard water prolongs the cooking time of dried pulses. This may be due to the reaction of calcium and magnesium ions in hard water with the pectic constituents of dried beans.
- Addition of cooking soda (Sodium bicarbonate) will hasten cooking. However this causes loss of thiamine. Excess soda also makes cooked legumes dark and mushy.
- Addition of acidic component such as tomato juice tamarind juice prolong the time required to make pulses tender.
- Cooking time is considerably reduced when pulses are cooked by the use of steam under pressure.

ROLE OF PULSES IN COOKERY

- Pulses are rich in protein and B vitamins and improve the quality of cereal protein.
- Pulses give satiety due to high protein and fibre content.
- Pulses improve flavour and consistency of dhal sambar and rasam.
- They contribute to fermentation in preparation of idli and dosa.
- They are used in snacks like sundal, bajji, panipuri and bhelpuri.
- They are used in salads, e.g., sprouted gram.
- They are used in desserts like paruppu payasam and sweets like mysore pak and laddu.
- They are used as thickening agent e.g., Bengal gram flour in gravies.
- Roasted pulses are used in making chutneys and chutney powders.
- Roasted pulses are used in making chutneys and chutney powders.
- They are used as part of seasonings in curries.

2.NUTS AND OILSEEDS

NUTRITIVE VALUE OF NUTS

- Nuts are a rich source of protein and fat and a good source of B – Vitamin and antioxidant vitamin E. They are a concentrated source of energy.
- Groundnuts are a very rich source of protein and fat. They are exceptionally rich in niacin. Groundnuts are boiled or roasted and consumed.
- It is also used in the preparation of groundnut butter. The chief product is the oil which can be used for cooking. The cake left after the oil is extracted is purified and used in supplementary mixes.
- Cashewnuts are also a rich source of protein and fat and contain appreciable amount of iron. It is widely used in the preparation of sweets and confectionery.
- It can be roasted and eaten. Cashewnuts are also used to garnish dishes such as pulavs and payasam.
- The white flesh of coconut is rich in calories though not a very good source of protein. It is extensively used in cookery in Tamil Nadu and Kerala in the preparation of curries, chutneys, sweets and puddings.
- The white flesh when dried is called copra and has a high content of oil.
- Almonds are expensive and are used in the preparation of badam milk and sweets. It

is a rich source of protein that are not of high biological value.

- Almonds are an excellent source of vitamin E, an antioxidant.

OIL SEEDS

Groundnut :

- Groundnut oil which is obtained from groundnut is a clear amber coloured liquid which is extensively used in cooking. It is used in the preparation of margarine, vanaspathi and preservation of sardine fish.
- The residue left after the oil extraction of groundnut is the groundnut cake, which is used in the preparation of groundnut flour and cattle feed for farm animals.

Coconut :

- Coconut oil is extracted from dried coconut. It can also be used in the preparation of vanaspathi and margarine. Coconut cake obtained after oil extraction is a valuable feed for cattle.

Soyabean :

- Soyabean yields substantial amount of oil. The whole dry beans contain 40 percent protein and 20 percent fat. In India, soyabean oil finds its application in the manufacture of vanaspathi.
- The meal after oil extraction is being used widely as a poultry feed. The protein isolated from soyabean meal after oil extraction is being successfully incorporated in weaning and supplementary foods.

Sesame seeds :

- Gingelly oil is extracted from sesame seed and it is a traditional oil that has been used in India. The roasted seeds are mixed with jaggery syrup and made into balls and eaten.
- Decorticated seeds contain 25 percent oil and are used for oil extraction. Sesame seeds are a fair source of protein and calcium.

ROLE OF NUTS IN COOKERY

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

- Nuts are used in fresh, raw, roasted, boiled or salted forms and also fried forms.
- Nuts are used as thickening agents. Coconut 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 can be made from nuts, e.g., cashewnut and coconut burfi.
- Powders made out of nuts like groundnut and coconut are used as chutneys and salad dressing.
- Nuts are used to garnish ice-creams and cakes

- Nuts are used in beverages, e.g, badam kheer.
- Peanut butter is used as a topping on bread or as side dish along with chapathis.

3.FATS AND OILS

- Fats are an important component of the diet and is present naturally in many foods. Fats are solid at room temperature while oils are liquid. Fats in the diet can be of two kinds viz., the visible and the invisible fat.
- Invisible fats are those present inherently in foods. Example of food containing appreciable quantities of invisible fat include meat, poultry, fish, dairy products, eggs, nuts and seeds.
- Visible fats are those fats that are made from these products. They are cooking oils, salad oils, butter, ghee and margarine.

NUTRITIONAL SIGNIFICANCE

- They are a concentrated source of energy. One gram of fat contributes 9 kilocalories as against 4 kilocalories contributed by carbohydrates and protein.
- They are a good source of vitamin A,D,E and K.
- They provide essential fatty acids which are components of membranes of living cells.
- They impart special flavour and texture to our foods, thus increasing palatability.
- They are also used by the body to make prostoglandins involved in a large variety of vital physiological functions.

REFINED OILS

Oils and fats do not occur free in nature. They occur in animal tissues and in seeds and fruits from which they are isolated. The extracted oils are crude and contain many constituents like free fatty acids, unsaponifiable matter, gums, waxes, mucilaginous matter, variety of colouring matter, metallic contaminants and undesirable odour producing constituents.

In refining these constituents are removed by the following steps:

- Suspended particles are removed by filtration or centrifugation.
- Free fatty acids are removed by alkali treatment.
- Any remaining free fatty acids are removed by neutralisation.
- Pigments are removed by bleaching using adsorbents like activated earth or carbon and sometimes chemical bleaching agents.
- The oil is finally deodorized by injecting steam through the heated fat under reduced pressure to obtain refined oil.

HYDROGENATION – VANASPATHI AND MARGARINE

- Plant oils contain a large percentage of unsaturated fatty acids and hence have a tendency to become rancid. These unsaturated glycerides in oil can be converted to more saturated glycerides by the addition of hydrogen. This process is known as hydrogenation.

- Hydrogenated fat is manufactured from vegetable oils by the addition of molecular hydrogen to the double bonds in the unsaturated fatty acids in the presence of nickel.
- The double bonds take up hydrogen and saturated fatty acids are obtained. By this process, liquid fats can be converted to semi solid and solid fats for use as shortening in the preparation of biscuits, cakes and butter substitutes.
- Hydrogenation is of great economic importance because it allows oils to be converted into fats, which have better keeping quality.
- As hydrogenated fats are prepared from refined deodourised oils, the resulting fats are odourless and colourless and blend well in several food preparations.

Vanaspathi:

- Hydrogenated oil in India is known as vanaspathi. It is manufactured by hydrogenating refined groundnut oil or a mixture of groundnut oil with other edible vegetable oils.
- According to vanaspathi control order, the melting point of vanaspathi should be between 31^0C and 37^0 C and it should contain 5 percent sesame oil and should be fortified with vitamin A.

Margarine :

- Margarine is often used as a substitute for butter. It is made from vegetable oils or a mixture of vegetable and animal fat by hydrogenation.
- It is then blended with cultured skim milk and salt. The fats most commonly used in the manufacture of margarine are cotton seed oil, soyabean oil, corn oil, groundnut oil, coconut oil and meat fat.
- Additional additives may include diacetyl for butter flavour, sodium benzoate for preservation, mono and diglycerides or lecithin for emulsification, yellow colouring matter and vitamin A and D.

RANCIDITY

- Fats and oils undergo certain undesirable changes during storage which result in spoilage. The major spoilage of fats and oils is rancidity.
- Rancidity refers to the development of disagreeable odour and flavour in fats and oils owing to specified chemical reaction such as oxidation and hydrolysis.
- Hydrolysis is the decomposition of fats into free fatty acid and glycerol by enzymes in the presence of moisture. These free fatty acids released are responsible for the unpleasant flavour and odour.
- During oxidation, oxygen is added to the unsaturated linkage and this results in the formation of peroxides. These peroxides decompose to yield aldehyde and ketones which are responsible for the pronounced off flavour. Rancidity may also be caused by the absorption of odour and action of micro organism and enzymes.

Prevention of Rancidity :

- Storage in coloured glass containers prevent oxidation of fats by rays of light.
- Vacuum packaging retards rancidity by excluding oxygen.
- Naturally occurring antioxidants like vitamin C, □ carotene and vitamin E protect against rancidity.
- Synthetic antioxidants like butylated hydroxy anisole (BHA), butylated hydroxy toluene (BHT) and propylgallate can also be added to prevent rancidity.

SMOKING POINT

- When fats and oils are heated to a high temperature, decomposition of fat occur and finally a point is reached at which visible fumes are given off. This is called smoking point and the temperature is called smoking temperatures of fat.
- Smoking temperature is defined as the lowest temperature at which visible fumes consisting of volatile gaseous products of decomposition are evolved.

Factors affecting smoking temperature of fats and oils :

- The amount of free fatty acids present.
- The surface of oil exposed while heating.
- The presence of mono and diglycerides and foreign particles such as flour particles.
- Smoking temperature is important for fats used for frying. Fats with low smoke point are not suitable for frying because of the odour and irritating effect of the fumes.
- The decomposition products may also give an unpleasant flavour to the food. Hence it is preferable to use fats with relatively high smoking temperatures for frying.

Smoking points of some fats and oils

Oil or fat	Smoking temperature (□ C)
Soyabean oil	230
Hydrogenated fat	221
Butter fat	208
Groundnut oil	162
Coconut oil	138

ROLE OF FAT / OIL IN COOKERY

- Fat is used as a medium of cooking in shallow and deep fat frying.
- Fat improves the texture of food. e.g., cake, biscuit, cookies.
- Fats help in leavening – in making cake, leavening occurs by incorporating air into the fat during the leavening process.
- Fat increases smoothness of the product e.g., Halwas, crystalline candies.

- Fats are shortening agents- one of the most important function of fat is to shorten baked products which otherwise are solid masses firmly held together by strands of gluten.
- Fat improves palatability – fat gives taste and flavour to the food.

4.SUGARS

- Sugar, honey and jaggery are sweetening agents. They are added to beverages and foods to increase palatability. Sugar is made up of glucose and fructose.
- It is a source of energy providing 4 kilocalories per gram. Jaggery is made from sugar cane juice after processing it. Jaggery is a fair source of iron. Palmyra palm, date palm or coconut palm is used for it.
- Honey is the golden coloured syrup made by bees from the nectar of flowers. It is a mixture of glucose and fructose.

The nutritive value of sugar, honey and jaggery are given below:

Item	Energy (k cal)	Carbohydrate (g)	Calcium (mg)	Iron (mg)
Sugar	398	99.4	12	0.15
Jaggery	383	95.0	80	2.65
Honey	313	79.5	5	0.69

- Two types of confectionery can be prepared when sugar is boiled viz., crystalline candies and amorphous candies.
- Crystalline candies can be made by boiling sugar and water sufficiently to concentrate sugar to the point where a firm crystalline structure will form on cooling.

CLASSIFICATION OF SUGAR

ARTIFICIAL SWEETENERS

Artificial sweeteners are those substances used as substitutes for sugar.

Characteristics of an ideal sweetener :

- sweet or sweeter than sucrose.
- pleasant taste with no after taste.
- colourless
- odourless
- readily soluble
- stable
- economical
- non toxic
- does not promote dental caries.

Low calorie sweeteners :

Polyols :

- Polyols occur in nature and are also synthesised from easily accessible carbohydrates such as starch, sucrose, glucose, invert sugar, xylose and lactose.
- Sugar alcohols (xylitol, sorbitol, mannitol, lactitol and isomalt) are polyols. They are white crystalline, water soluble powders. Sorbitol is used in chocolates and diabetic foods. Mannitol is used in sugar free chewing gum and xylitol is used in pastries, jam, ice cream. The average calorific value is 2.4 k cal / g.

Non-caloric Sweeteners :

Cyclamate :

It is 30 times sweeter than sucrose. It was banned as studies revealed its role in the development of tumors.

Acelsulfame – K :

It can be used in cooked or baked products. It is a synthetic derivative of acetoacetic acid.

Alitame:

It is a dipeptide based amide. It is 2000 times sweeter than sucrose.

Aspartame :

It is made by combining two amino acids – aspartic acid and phenyl alanine. Methyl alcohol is then added to form a methyl ester. It is a white, crystalline powder that has a sugar like taste. It is used in soft drinks, instant tea and coffee.

Saccharin:

It is sodium orthobenzene sulphonamide or its calcium salt. It is 300 times sweeter than sucrose. According to the WHO recommendation only 0 – 2.5 mg / kg body weight is permitted daily.

Natural Non-Caloric Sweeteners :

Neohespiridine dihydrochalcone – It is isolated from citrus peel.
Glycyrrhizin – It is obtained from roots of leguminous plant Glycyrrhiza glabra.
Thaumatin – It is obtained from a West African fruit plant.

ROLE OF SUGAR IN COOKERY

- It is used as a sweetening agent.
- Used in the preparation of sugar syrup for sweets like gulab jamuns, fruit squashes.
- It is a preservative in jams and jellies. High concentration of sugar prevents the growth of micro- organisms.
- Sugar contributes to the flavour and colour of the product when it is caramelised.
- It helps to improve texture of cake and confectionary.
- It can be used to prepare sweets and candies.

B.Sc., HOME SCIENCE

I YEAR – I SEMESTER
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CORE COURSE - I – FOOD SCIENCE

UNIT – III

VEGETABLES AND FRUITS

- India with its diverse, but favourable agroclimatic conditions produces a wide range of tropical and temperate fruits and vegetables. The annual production of these crops is about 53 million tonnes.
- Vegetables are plants or parts of plants served with the main course of a meal.
- Apart from the nutritive value, vegetables probably do more than any other group of foods to add appetising colour, texture and flavour to our daily food.
- With the wide choice of colour of vegetables, it is possible to select a vegetable with a desired colour to highten the appearance of a meal.
- The texture of a vegetable varies depending upon whether it is served raw are cooked. The texture and appearance of meals can then be varied by the way the vegetable is served.
- Vegetables contain a wide range of characteristic flavours. By a proper choice of vegetables, the desired flavour of a meal can be obtained.
- A fruit is the edible and juicy product of a tree or plant and consists of the matured ovary including its seeds and adjacent parts. Usually fruits are sweet, with a wide range of flavours, colours and textures.

CLASSIFICATION OF VEGETABLES

Vegetables can be classified into three groups according to their nutritive value.

1. Green leafy vegetables Eg. Agathi, amaranth,
2. Roots and tubers Eg. Potato,
3. Other vegetables Eg. Brinjal, drumstick leaves

NUTRIENT CONTENT OF VEGETABLES AND FRUITS

VEGETABLES

i. Green Leafy Vegetables :

They are an inexpensive rich source of many nutrients such as þ – carotene, ascorbic acid, folic acid, calcium, iron and fibre. They are a poor source of protein.

ii. Roots and Tubers :

Roots and tubers are rich in carbohydrates and are a source of energy in the diet. Carrot and yellow varieties of yam are rich in carotene and potato contains Vitamin

C. Tapioca and yam are rich in calcium. Roots and tubers are a poor source of iron, protein and a fair source of B – Vitamins.

iii. Other Vegetables :

These are a good source of dietary fibre and add variety to the diet. They are a fairly good source of vitamins and minerals. (Eg.) brinjal, ladies finger, cauliflower, cucumber, gourd varieties.

FRUITS

A fruit is a mature ovary of a flower. The fleshy portion of the pericarp makes up the chief edible portion of the fruit.

Fruits can be classified as follows :

Berries - Gooseberry, grapes, strawberry.
Citrus - Lemon, lime, orange, sweet lime. Drupes - Peach, plums, apricot.
Melons - Water melon, musk melon Pomes - Apple, pear.

BERRIES :

- Berries are fruits with layers of pericarp(fruit coat) which are often homogenous, except for the skin on the outside. The pericarp layers are pulpous and juicy, and contain seeds embedded in the pulp mass. The fruits have fragile cell structure that is damaged by rough handling or freezing.

CITRUS FRUITS:

- These fruits belong to the genus *Citrus* which contains about 16 species of evergreen aromatic shrubs and trees mostly with thorny branches distributed throughout the tropical and subtropical regions of the world. The common citrus fruits are orange, lemon and lime. The bright colour, pleasing flavour and sweetness make them a favourite fruit. They are served as juice and can be eaten raw.

DRUPES:

- Drupes are edible fruits with a thin skin, and juicy flesh enclosing a single seed (Stone). Apricots, cherries, peaches and plums belong to this group.

MELONS:

- Melons belong to the same family as cucumbers (Cucurbitaceae). Melons are commonly eaten raw. Their flesh consists of about 94% water and only 5% sugars. The seeds stripped of their hard coats may be eaten and also yield an edible oil.

POMES

- Pomes are fruits of apple and pear trees. The receptacle, surrounds the ovaries in the flower, enlarges to become edible and juicy, and encloses the cells containing the seeds.
- Fruits particularly citrus varieties and guava are a good source of vitamin C. Yellow fruits like mango and papaya contain þ– carotene. Banana is a good source of carbohydrate and hence energy. Fruits are a poor source of protein and fat with the exception of avacado.
- Fruits also contain fibre and minerals such as sodium, potassium and magnesium. They are not a good source of calcium. Dry fruits, seethaphal and watermelon contribute appreciable amounts of iron.

PIGMENTS AND FLAVOUR COMPOUNDS

Chlorophyll :

- Chlorophyll is the green pigment of leafy vegetables and other green coloured vegetables.

Carotenoids:

- Carotenoids are the yellow, orange, red fat soluble pigments distributed in nature. They are divided into three groups viz. carotenes present in carrot, green leafy vegetables and other fruits, lycopenes present in tomatoes and xanthophylls present in yellow fruits.
- Pigments that contain the phenolic group include anthocyanin, anthoxanthin, leucoanthoxanthin, catechin, quinones and betalins. The first four groups are collectively known as "Flavanoids".

Anthocyanin :

- They are a group of reddish water-soluble pigments occurring in many fruits and vegetables. Cherries, red apples, pomegranates have their colour appeal due to anthocyanins.

Anthoxanthins :

- They are colourless white to yellow pigments that give colour to cauliflower, onions, spinach or other leafy vegetables. In green leafy vegetables the colour is masked by chlorophyll.

Leucoanthoxanthins :

- They are colourless and contribute to the puckeriness or astringency of some foods, such as apple and olives. They also play an important role in the

enzymatic browning of fruits.

Catechins :

- They are pigments that are involved in enzymatic browning.

Betalins :

- They are the red water soluble pigments found in beetroot and berries.

Quinone :

- The yellow pigment juglone is a quinone present in walnut.

Mangiferin :

- This is the yellow pigment belonging to the xanthone group. It is found in mangoes.

Tannins :

- They are complex mixtures of polymeric polyphenols. The appearance of tannins ranges from colourless to yellow or brown. Tannins contribute to the astringency of foods and also to enzymatic browning.

Flavour Compounds :

- The flavour of fruits and vegetables are extremely important to their acceptance in the diet.
- The overall flavour impression is the result of the tastes perceived by the taste buds in the mouth and the aromatic compounds detected by the epithelium in the olfactory organ in the nose.
- In fruits and vegetables, this means that sugars, acids, salts and bitter quinine-like compounds are tasted while the food is chewed in the mouth.
- Sweetness may result from the presence of glucose, galactose, fructose, ribose, arabinose and xylose.
- All fruits and vegetables contain a small amount of salt, which is detected in the overall taste impressions contributing to flavour.
- The natural flavours of vegetables are due to mixtures of aldehydes, alcohol, ketones, organic acids and sulphur compounds. Some fruits and vegetables have an astringent taste attributed to phenolic compounds or tannins.
- Two types of vegetables viz., vegetables belonging to the Allium and Cruciferae families have strong flavours resulting from the presence of various sulphur containing compounds. Allium is the genus that includes onions and

garlic. Members of the family cruciferae, which include broccoli, cabbage, turnips and cauliflower also contain prominent sulphur compounds. They are described as strong flavoured vegetables.

- Vegetables of the onion family are usually strong flavoured in the raw state and tend to lose some of the strong flavours when cooked in water.
- Onions contain sulphur compounds that are acted upon by enzymes in the tissues when the vegetable is peeled or cut to eventually produce the volatile sulphur compounds that irritate the eyes and give biting and burning sensations on the tongue.
- Vegetables of the cabbage family (cauliflower, cabbage, knolkhol) are relatively mild when raw but develop strong flavours when overcooked or improperly cooked.
- An amino acid s-methyl l-cysteine sulphoxide is also present in raw cabbage and appears to be a precursor of cooked cabbage flavour.

The role of pectin in gel formation

- The formation of a firm jelly takes place only when pectin, acid and sugar and water are in definite proportions.
- When sugar is added to the pectin solution, it acts as a dehydrating agent and destabilizes the pectin-water equilibrium and the pectin conglomerates forming a network of insoluble fibres. Large amounts of sugar solution can be held in this mesh- like structure.
- The strength of the jelly depends on the structure of fibres, their continuity and rigidity. The continuity of the network depends upon the amount of pectin present in the system and the firmness depends on sugar concentration and acidity.
- A soft jelly can be obtained by decreasing the amount of sugar. However, the rate of setting is modified by acidity. The fibrils of pectin become tough in the presence of an acid and thus able to hold the sugar solution in the interfibrillar spaces. If the amount of acid is large, the fibrils lose their elasticity and as a result jelly becomes syrupy.

ENZYMATIC BROWNING

- When fruits and vegetables such as apple, banana, potato and brinjal are cut, there is a development of brown colour on the surface due to action of enzymes.
- This is known as enzymatic browning. When the tissue is injured or cut and the cut surface is exposed to air, phenol oxidise enzymes are released at the surface.
- These act with the polyphenols present in the fruits and oxidises them to orthoquinones, which gives the brown colour to cut tissues.

Browning can be prevented by the following methods :

- Inactivation of polyphenol oxidise by applying heat.
- Elimination of oxygen by vacuum packing.

- Change of pH to prevent enzyme action.
- Dipping of fruits and vegetables in brine and sugar solutions.
- Use of antioxidants such as ascorbic acid to retard oxidation.

PREVENTION AND CONSERVATION OF NUTRIENTS IN PREPARATION AND COOKING OF VEGETABLES

Loss of nutrients in vegetables begin from preparation onward and is greater during the cooking process.

- When fruits and vegetables are peeled the vitamins present under the skin may be lost.
- Nutrients are also lost when the edible leaves of carrot beetroot and outer layer of cabbage are discarded.
- Vitamin B complex and Vitamin C are water soluble and are lost when the water in which vegetables are cooked is discarded. Sodium, potassium and chlorine are also lost when cooking water is discarded.
- Vitamin C is lost by oxidation due to exposure of air.
- During dehydration ascorbic acid and carotene are lost.
- Addition of soda results in heavy loss of B – Vitamins during cooking.

Guidelines to minimize nutrient losses during preparation:

- Wash vegetables before cutting. Soaking or washing time should be reduced to minimize nutrient loss.
- Cut vegetables into big pieces so that exposure of vitamins to water is less while cooking and washing.
- Use a vegetable peeler to remove skin as it helps remove only a very thin layer of skin.
- Use minimum water for cooking. Bring the water to boil and add the vegetables to cook.
- Cook vegetables by steaming and pressure-cooking to conserve nutrients.
- Cover the vessel with a lid while cooking as it hastens cooking.
- Do not use soda while cooking vegetables as it destroys valuable vitamins.
- Vegetables salads should be prepared just before serving to conserve nutrients.
- Use acids such as lime juice or vinegar to salads as it prevents loss of Vitamin C since Vitamin C is stable in acid.

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CORE COURSE - I – FOOD SCIENCE

UNIT – IV

MILK AND MILK PRODUCTS

- 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 for the young of the particular species producing it. Man has learnt the art of using milk and milk products as a food for his well being 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 part of the world; Other animals as 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.

NUTRITIVE VALUE OF MILK

- Milk is a complex fluid containing protein, fat, carbohydrate, vitamins and minrals. 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 fine globules varying in diameter from 1 to 10 □m (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.

TYPES OF MILK/ KINDS OF MILK

Raw milk is processed into the following types of milk.

1. **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.
2. **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.

3. **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.
4. **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 stabilisation of the milk emulsion and thus prevents rising of the cream. Homogenised milk has a creamier texture, bland flavour and whiter appearance.
5. **Evaporated Milk:**

   It is made by evaporating more than half the water from milk under vacuum, at a temperature of 74^0 C - 77^0 C. It is then fortified with vitamin D, homogenised and filled into cans and sterilized at a temperature of 118^0 C for 15 minutes and cooled. The treatment employed lends a brown colour and characteristic flavour owing to the reaction between sugar and protein.
6. **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.

7. **Flavoured Milk :**

It is the milk prepared by the addition of flavour such as rose, pista, badam, cardamom etc. to pasteurised whole milk.

8. **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.

PASTEURISATION OF MILK

Milk is a favourable medium for bacterial growth. Pasteurisation destroys all pathogenic bacteria, including those causing typhoid, tuberculosis, diphtheria as well as yeasts and moulds.

Pasteurization is a process which consists of heating milk to a certain temperature for a definite time to ensure destruction of harmful bacteria. There are three methods of pasteurisation.

a) Holding method or Batch process :

In this method, milk is held at 62.8^0 C for 30 minutes and then rapidly cooled to

prevent multiplication of surviving bacteria.

b) High temperature short time (HTST) method or continuous process :
Milk is heated to 71.7^0 C for not less than 15 seconds.

c) Ultra High temperature method : Milk is heated to a temperature of 93.4^0 C for 3 seconds.

Advantages of Pasteurization

- During pasteurization the nutritive value of milk is not altered to a great extent because the temperature employed is not high and cooking time is short. However, there is a slight decrease in heat labile vitamin such as thiamine and ascorbic acid. Proteins are denatured only slightly and minerals are not appreciably precipitated.
- It does not produce an unpleasant cooked flavour.
- Shelf life of milk is increased due to a marked decrease in the total bacterial count.
- Harmful pathogens especially TB bacteria are destroyed.
- It inactivates enzymes such as phosphatase and lipase in milk which adversely affect the quality of milk.

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.

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 27^0 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 37^0 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 45^0 to 60^0 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 AND MILK PRODUCTS IN COOKERY

- It contributes to the nutritive value of the diet, e.g., milk shakes, plain milk, flavoured milk, cheese toast.
- Milk adds taste and flavour to the product e.g., payasam, tea, coffee.
- It acts as a thickening agent along with starch e.g., white sauce or cream soups.

- Milk is also used in desserts, e.g., ice-cream, puddings
- Curd or buttermilk is used as a leavening agent and to improve the texture, e.g., dhokla.
- Curd is used as a marinating agent, e.g., marinating chicken and meat.
- Curd is used as a souring agent, e.g., rava dosa, dry curd chillies.
- Khoa is used as a binding agent, e.g., carrot halwa.
- Cheese is used as garnishing agent.
- Salted butter milk is used for quenching thirst.

B.Sc., HOME SCIENCE

I YEAR – I SEMESTER
COURSE CODE: 7BHF1C1

CORE COURSE - I – FOOD SCIENCE

UNIT – V

FLESH FOODS AND BEVERAGES

1.MEAT

- Meat refers to the flesh of warm blooded, four legged animals chiefly cattle, sheep and pigs. Meat of sheep which is under 12 months age is sold as lamb. After the age of 12months, it is called mutton.
- Pork is the meat of swine (pig) slaughtered between the age 5 and 12 months. Veal is the meat of cattle that is slaughtered 3 to 14 weeks after birth.
- If slaughtered between 14 to 52 weeks the meat is called calf. Meat obtained from cattle slaughtered one year after birth is called beef.
- Meat is a very good source of protein. The average protein content of meat varies from 16 – 25 percent. The amino acid pattern of meat protein is of outstanding nutritive value. The fat content of meat varies from 5 – 40 percent.
- Depending on the type, breed and age of the animal, fat is distributed throughout meat in small particles of large masses. Fat deposited uniformly in small sheets in the connective tissue within the muscle is called "marbling". This contributes tenderness and flavour to the meat.
- Meat fats are rich in saturated fatty acids. The cholesterol content of meat is 75 mg / 100 gm. Carbohydrate is found in small quantities and present in the form of glycogen and glucose.
- Meat is a good source of iron, zinc and phosphorpus. It also contains sodium and potassium. It is an excellent source of B-complex vitamin particularly B_{12} which is absent in plant foods. Liver is an excellent source of iron and vitamin-A.

Changes in Meat :

- After slaughtering, the lean tissues undergo a series of complex physical and chemical changes. As a result muscles loose 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 0^0C to 20^0C for 1 – 4 weeks. This is known as "ripening" or "ageing".

- During ageing the humidity of the room is to be controlled. Tenderness of meat can also be obtained by the use of mechanical methods such as pounding, cutting and grinding which break muscle fibre. Addition of salt, vinegar, lime juice and enzymes viz., papain, bromelin and ficin also help in tenderising meat.

SELECTION OF MEAT:

- Veal or the meat of calf is pale pink and firm. The meat is soft and flabby and the cut surface is moist. The bone is pinkish white with a small quantity of blood. Fat is not seen.
- In the case of lamb, flesh of young animals below 12 months of age, the meat is pinkish red, fine grained and velvetty. The bones are porous and reddish. Good quality mutton is deep red in colour with a smooth covering of fat. The bone is hard and white.
- Poor quality meats have darker flesh and the grain is coarse and fibrous. Fat layers are heavy and have a strong flavour.

Changes that occur during cooking:

- On heating, the red pigment turns brown due to the denaturation of protein pigment.
- Heat treatment also brings about inactivation of enzymes and denaturation of proteins, which makes meat tougher. Hence, adopting correct cooking methods, time and temperature will result in a well- cooked product.
- Heating results in release of volatile compounds from both fat and lean meat which contributes to the flavour and taste of cooked meat.
- Heating melts meat fat which increases palatability of meat when eaten warm.
- There is loss of water on heating which does not change the nutritive value but may affect juiciness and bring about shrinkage in volume and weight.
- Minerals like calcium may be lost in meat dripping due to the dissolution of calcium from bones. There is loss of B-vitamins also.

Egg :

The term egg mainly refers to the egg of hen and duck. An average egg weighs 50 gms. approximately and is composed of the shell, egg white and yolk. The weight is distributed in the different parts as follows:

Percentage composition of egg

Part	Weight%
Shell	8 – 11
White	55 – 61
Yolk	27 - 32

Egg is a rich source of protein and lipids. Egg protein is of high quality as compared to any dietary protein and therefore is used as a standard for evaluating the protein quality of other foods. The nutrient composition of egg white and yolk differ considerably and is represented in the following table.

Percentage nutrient composition of egg white and yolk

Nutrient	Egg white	Egg yolk
Water	88.0 %	48.0 %
Protein	11.0 %	17.5 %
Fat	0.2 %	22.5 %
Mineral	0.8 %	2.0 %

Vitamin and minerals in Egg:

- Egg yolk is rich in vitamin-A. Thiamin and riboflavin are present in appreciable amounts. Calcium is present in the yolk in small amounts.
- Phosphorus is abundant in the yolk. Eggs are an important source of bioavailable iron and a fair source of sodium, magnesium chlorine, potassium and sulphur.

Selection of Egg:

- The shell should be clean and should not be broken.
- Fresh eggs have a small air cell. This can be detected by holding the egg against light.
- Yolk should be in the centre without any dark spots when observed against light.
- Good quality egg will sink when immersed in water. Poor quality eggs will float due to the enlarged air cell and loss of moisture.

Poultry:

- The term poultry refers to domestic fowls reared for their flesh and egg. It includes chicken, duck, geese, turkey, pigeon etc.
- Poultry meat has a high protein content varying from 18 to 25 percent. It contains all the essential amino acids required for body building.
- Fat content of poultry is influenced by age and species of the bird. Young birds have little fat content. Chicken fat is unsaturated and is therefore better than the fat of red meat. Poultry flesh is a good source of B-vitamin and minerals.

Selection of Poultry :

- Young birds (below 9 months of age) have a tender flesh and are more suitable for cooking.

Signs of a young bird :

- The feathers especially the quills on the wings should be easy to pull.
- No long hair on the body.

- Skin should be white or clean and smooth.
- Feet should be supple with smooth even over-lapping scales.

Signs which show that a bird is fresh :

- Feathers – light and fluffy.
- Eyes – prominent and clean
- No unpleasant smell
- Feet moist and not stiff and dry.
- Skin – clear with no dark or greenish tinge.

Fish:

- Fishes are classified as shell fish and fin fish. The nutrient composition of fish of a given species varies depending on the season of year and maturity. However most fish contain 15 – 24 percent protein, 0.1 – 22 percent fat and 0.8 – 2 percent minerals.
- Fish proteins are easily digestable and are of high biological value. The fat content is influenced by the species, feeding habits and maturity of fish. Glycogen is present in fish but is in lesser quantities than meat.
- Fish oils are an excellent source of vitamin A and D. They are a good source of thiamin, riboflavin and niacin. Small fishes that can be eaten with bones contribute a significant amount of calcium.
- Ocean fish are a rich source of iodine. Oysters are an excellent source of copper. Fishes contain omega – 3 polyunsaturated fatty acids. These acids are found to prevent the degeneration diseases of the heart.

Selection of Fish:

The following points should be borne in mind while selecting fish :

i) Eyes should be bright and not sunken.
ii) Gills should be red.
i) The tail should be stiff and scales firmly attached to the skin.
ii) The flesh should be firm and not flabby.
iii) There should be no unpleasant odour.
iv) To test a cut piece, press down with a finger and if an impression is left then the fish is stale.
v) Any tendency for the raw flesh to come away from the bone is a dangerous sign.

USE OF EGG IN COOKERY As a Thickening Agent :

- Egg proteins coagulate on heating. The coagulation of protein is accompanied by binding of moisture and increase in viscosity. Therefore eggs can be used as thickening agents.

As a Binding Agent :

- Egg protein coagulate between 65 and 70□ C and help to hold shape of the products such as cutlets in which it is used.

As a Leavening Agent :

- Eggs when beaten, form elastic films which can trap air. This air expands during baking and gives a fluffy spongy product.

As a Emulsifying Agent :

- Besides protein, egg contains phospholids 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.

As a Flavouring and Colouring Agent :

- Egg is used in food mixtures to contribute flavour and colour to products such as cakes and pudding

As a Clarifying Agent:

- Egg helps in the preparation of clear soups. When a small amount of egg white is added to the liquid and heated, the egg albumin coagulates and carries along with it suspended particles. On allowing it to settle, a clear soup is obtained.

As a Garnishing Agent :

- Hard boiled eggs are diced and are used to garnish dishes like biryani.

As an Enriching Agent :

- Eggs are used to enhance the nutritive value of various preparations.

5. BEVERAGES

- Beverages are drinks used for the purpose of relieving thirst and including fluid in the days diet. They contain nutrients and are also stimulants.
- Appetizers are those liquids that improve the appetite of an individual. Eg. Soups.
- Intake of appetizers before a meal tends to increase the quantity of food consumed and also stimulates a desire for food consumption.

NON ALCOHOLIC BEVERAGES :

Tea :

- Tea is obtained from the leaves and flowers of tea bush. The kind of tea obtained is determined by the manufacturing process and treatment.

- Tea is a stimulating and refreshing drink.
- The principle flavour components of tea are caffeine, tannin yielding compounds and small amounts of essential oils. Caffeine provides the stimulating effect, tannin the colour, body and taste to the extract and the essential oils contribute the characteristic aroma.
- Tea can be prepared by introducing tea leaves into boiling water in a kettle or by pouring boiling water over tea leaves in a preheated tea pot and letting it steep.
- The time of steeping depends on the strength of the beverage desired and quantity of tea leaves used. To prepare good tea one teaspoonful of tea leaves for 1 cup is ideal.
- The tea should be brewed only for five minutes and strained. If it is kept for more than five minutes it will give a bitter taste. Milk and sugar should be added to individual taste.

Coffee:

- Coffee is prepared from the beans of the coffee plant. Caffeine and flavouring substances such as tannins determine the quality of the end products.
- Coffee can be prepared by filtration and percolation.

Filtration:

- This is a very common method used in the preparation of coffee. A coffee filter is used for this purpose. Coffee powder is placed in the top part of the filter and covered with a disc, which is perforated.
- Boiling water is poured over the coffee powder and it drift through it and extracts the flavour and aroma.

Instant coffee :

- Instant coffee is prepared by pouring boiling water over instant coffee powder in a dry cup.

Cocoa And Chocolate:

- Cocoa and chocolate are made from grinding the seeds of cocoa bean pods. Chocolate and cocoa unlike coffee and tea have a higher nutritive value.
- Cocoa should always be mixed with a small amount of cold liquid before being combined with other ingredients. This prevents the formation of lumps.
- It is then heated to boiling and held at that temperature to extract the flavour and reduce the amount of sediment that settles at the bottom.

Fruit Beverages :

- Fruit beverages are obtained by extracting the juice from fruits such as orange, grape, pineapple, lemon, tomato etc.
- These juices are an excellent source of vitamins, minerals and energy depending on

the fruit used. Fruit juices are not only refreshing, they are nutritious, and increase fluid intake.

- Fruit squashes are prepared by combining sugar syrup and fruit juice. They have a long shelf life and can be readily mixed with water to obtain an instant refreshing drink.

HEALTH BENEFITS OF BEVERAGES

1. **Refreshment :**
    - Beverages such as plain or carbonated water, lime juice, ginger ale and other bottled beverages, fruit juices and iced tea or coffee are refreshing drinks and are used to relieve thirst.
2. **Nourishment :**
    - Pasteurized milk, butter milk, chocolate and cocoa drinks, eggnog made with rum, fruit juices, glucose water, lemonade provide nutrients and help in nourishing the body.
3. **Stimulant :**
    - Tea, coffee, cocoa and chocolate beverages help in stimulating the system.
4. **Soothing Agent:**
    - Warm milk and hot tea have a soothing effect and are used for this purpose.
5. **Appetizers :**
    - Soups, fruit juice and alcoholic drinks in limited quantities increase an individuals appetite and thereby food consumption.
    - Fruit pulp can be combined with milk and sugar to form milk shakes e.g. apple, mango, sapota etc.

Milk Beverages :

- Milk beverages are prepared by the addition of different flavours viz. strawberry, pista, cardamom and chocolate to milk.
- They enhance the flavour of milk and thereby increase its consumption particularly by young children. Milk beverages are a good source of protein, calcium and vitamin A and B.
- Milk shakes are prepared by mixing fruit pulp with milk and sugar. Milk can be mixed with egg to prepare egg nog which is a nourishing drink with a creamy consistency.

CARBONATED NON-ALCOHOLIC BEVERAGES

- Carbonated non-alcoholic beverages are those beverages that are generally sweetened, flavoured, acidified and coloured.
- The chief ingredient is water and this may be to the extent of 92 percent. The beverage contains 8 to 14 percent of sugar which contributes to the sweetness, calorie and body of the drink.

- Artificial sweeteners such as saccharin is also used. Carbon dioxide is added to produce the tingling effect, sparkle and effervescence of carbonated beverages.
- Nutritionally, it is an empty food since it provides only calories and no other nutrients. A bottle of an aerated beverage (180 ml) gives 70 kilo calories of energy.
- Phosphoric acid, citric acid, fumaric acid and tartaric acid which are added to enhance the flavour, makes the drink acidic. It is therefore not recommended for patients suffering from acidity and ulcers. Saccharin which is a suspected carcinogen is also present in aerated drinks. Children should not be encouraged to consume carbonated beverages since they have no food value and depress the appetite.

MALTED BEVERAGES

- Malted beverages are also known as Amylase Rich Foods (ARF). This is prepared by steeping whole grain like ragi or wheat in 2 – 3 times its volume of water.
- The excess water is drained and the moist seed is germinated for 24 – 48 hours till sprouts appear. The grains are sun-dried and roasted to remove moisture. Sprouts are removed and the grains are milled and powdered.
- The malt is cooked with water or milk to prepare a nutritious beverage.
- ARF is rich in enzyme amylase. The germination process activates the enzymes of the resting grain and facilitates the conversion of cereal starch to fermentable sugars. Hydrolysis of cereal proteins also takes place.

TRADITIONAL BEVERAGES

Nera :

- Nera is a sweet drink from the fresh sap of palm.

Tender Coconut Water :

- This is a refreshing drink obtained from coconut. Potassium, ascorbic acid and many vitamins of the B group are present in coconut water. Apart from this, the water also contains traces of calcium, phosphorus and iron.

Sugarcane juice :

- Sugarcane juice extracted from sugarcane contains 12 – 15 percent sugar. The cane juice is acidic and in addition to sugar contain minerals and vitamins such as the B – group.

Panakam :

- Panakam is a traditional drink prepared using jaggery, ginger and cardamom.

ALCOHOLIC BEVERAGES

- Beer, ale, toddy, wine, whisky, gin and brandy are some of the commonly used alcoholic beverages. Alcoholic beverages are obtained by the enzymatic fermentation of yeast which converts glucose to alcohol.

Beer :

- Beer is made by fermenting barley malt extract with yeast while ale is the same product with more stimulation.

Whisky :

- It is an alcoholic distillate from a fermented mash of grains.

Gin :

- It is an artificial drink from diluted pure ethyl alcohol.

Brandy :

- This is made by fermenting fruit juices like grapes and apples.
- Alcohol is a narcotic, a drug and sedative. It is very rapidly absorbed in the body. Excessive consumption of alcohol causes damage to the liver, stomach and blood vessels.
- It also leads to diabetes mellitus, cardiovascular diseases, cirrhosis of the liver and gastric ulcers.

SOUPS

- Soups are prepared with vegetables, pulses, poultry and meat. The food which is to be used for making soup is cooked thoroughly in plenty of water. Clear soups are prepared using only the water in which the food is cooked while cream soups are prepared by adding milk and white sauce to the water.
- Soups provide us with a variety of nutrients depending on the ingredients used. Soups also enhance appetite and add colour to the meal. It is usually served at the beginning of a meal.