DIRECTORATE OF DISTANCE & CONTINUING EDUCATION

MANONMANIAM SUNDARANAR UNIVERSITY

TIRUNELVELI- 627 012

OPEN AND DISTANCE LEARNING (ODL) PROGRAMMES

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B. Sc. Chemistry Course material

Skill Enhancement Course - I

JSCH11 Food chemistry

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Skill Enhancement Course - I

Course Code JSCH11 **SCE - I Food chemistry**

UNIT I Food Adulteration

Sources of food, types, advantages and disadvantages. Food adulteration - contamination of wheat, rice, milk, butter etc. with clay stones, water and toxic chemicals -Common adulterants, Ghee adulterants and their detection. Detection of adulterated foods by simple analytical techniques.

UNIT II Food Poison

Food poisons - natural poisons (alkaloids - nephrotoxin) - pesticides, (DDT, BHC, Malathion) -Chemical poisons - First aid for poison consumed victims.

UNIT III Food Additives

Food additives -artificial sweeteners – Saccharin - Cyclomate a n d Aspartate Food flavours -esters, aldehydes and heterocyclic compounds – Food colours – Emulsifying agents – preservatives -leavening agents. Baking powder – yeast – tastemakers – MSG - vinegar.

UNIT IV Beverages

Beverages-softdrinks-soda-fruitjuices-alcoholicbeverages-examples. Carbonation-addictionto alcohol– diseases of liver and social problems.

UNIT V Edible Oils

Fats and oils - Sources of oils - production of refined vegetable oils - preservation.Saturated and unsaturated fats - iodine value - role of MUFA and PUFA in preventing heartdiseases-determination of iodine value,RM value,saponification values and their significance.

Recommended Text

1. Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishing house,2010.
2. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand& Co.Publishers, second edition, 2006.
3. Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishning house,2010.
4. Food Chemistry, Dr. L. Rakesh Sharma, Evincepub publishing, 2022.
5. Food processing and preservation, G. Subbulakshmi, Shobha A Udipi, Pdmini S Ghugre, New age international publishers, second edition, 2021.

Recommended Books

1. H.-D. Belitz, Werner Grosch, Food Chemistry Springer Science &Business Media, 4^{th} Edition, 2009.
2. M.Swaminathan, Food Science and Experimental Foods, Ganesh andCompany,1979.
3. Hasenhuettl, Gerard. L.; Hartel, Richard. W. Food Emulsifiers and their applications Springer New York 2nd ed. 2008.
4. Food Chemistry, H.-D. Belitz, W. Grosch, P. Schieberle, Springer, fourthrevised and extended edition, 2009.
5. Principles of food chemistry, John M. deMan, John W. Finley, W. Jefferey Hurst, Chang Yong Lee, Springer, Fourth edition, 2018.

UNIT 1 – FOOD ADULTERATION

Food is a basic need for all. A food should not only be available in sufficient quantity, you would agree, it should also be nutritious, safe and wholesome. Pure food is essential for the maintenance of health. Food adulteration, therefore, not just lowers the quality of the food but also poses a serious health hazard. Consumption of poor , quality or unwholesome food by the citizens of a nation ean lead to ill-health and thus poor work efficiency. Providing good quality food is thus of considerable importance for public health and the national economy. Several laws have been enacted and implemented by the Central and State Governments to help maintain food quality at various stages fiom production through storage, processing, internal and external trade and consumption. The Prevention of Food Adulteration (PFA) Act, 1954 and the Prevention of Food Adulteration Rules, 1955 are the main statutes which protect the consumer and aim to provide him safe food: We will be learning more 'about these laws and regulations later in Unit 14 of this Course. Now, let us dwell . on why is the food adulterated, i.e. the reasons for adulteration. Particularly in the light of the ill-consequences of food adulteration, why do individuals practice food adulteration.

Reasons for adulteration

The practice of adulterating food is as old as the art of buying and selling food for cash or commodities. The question that might arise in your mind is, why do people practise adulteration of food when they know that it adversely affects the health of fellow human beings? The answer is straight forward - 'the possibility of making greater profits', which has always been the lure for people indulging in the adulteration - of food. Increasing the bulk or quantity of a food item by adding cheaper substitutes is the most common way of increasing profit margins. Adding water to milk or stones to food grains is perhaps the oldest form of adulteration. Similarly, to save money, a sweetmeat maker may place aluminium foil instead of silver foil on the sweets he makes. Apart from this, the other reasons include masking food spoilage and ignorance .of the people handling food. Let us study about these. Traders of perishable food commodities sometimes try to mask food spoilage by using various adulterants. For instance, the insect infested dry ginger may be coated with ultramarine blue to cover the holes. Poor quality fruits, vegetables and pulses are sometimes artificially coloured to give them the fresh look. Adulterants like artificial colours are also added to foods to improve their consumer appeal. Thus several prepared food items being sold in restaurants and eateries such as rice and meatpreparations, sweets etc. have added colour because the consumer prefers it.

FOODS COMMONLY ADULTERATED

If we analyze the data on adulteration collected during surveys across the country, we will notice that almost all kinds of foodstuffs have been found to be adulterated., No food is spared. However, the nature of food adulteration may vary from State to State or region to region. In one region, one type of food commodity may be more prone to adulteration, simply because sales of the commodity are high in that region. A type of adulterant may be more common in a particular area because it is cheap and readily available. Taking the example of edible oil, if for instance, groundnut oil is the most widely consumed oil in a State and then it would be obvious that the adulteration of this oil would be most common. And if cottonseed oil is the cheapest and most readily available oil in that area, then it would be used to adulterate the more expensive groundnut oil. Listed herewith are some of the foods that have been comnionly found to be adulterated. You will find that these are the ones which we consume on a daily basis. These foods include:

- grains like wheat, rice, pu!ses and their products like wheat flour, semolina (suji), gram flour (besan) etc.
- Edible oils and fats like groundnut oil, safflower oil, sunflower oil, mustard oil, yanaspati etc. ,
- spices, both whole and giound, like red chilli powder, turmeric and coriander powder, asafoetida (hing), saffron etc.
- Milk and milk products like milk powder, butter, ghee, khoa,

- sweets Coffee, tea .
- Sweetening agents like sugar, honey, gur

The adulteration of food has progressed from being a simple means of fraud to a highly sophisticated and lucrative business. Although simple forms of adulteration like addition of water to milk and coloured starch to turmeric or red chilli powder are still prevalent, newer forms and types of adulteration are emerging. Pesticide residues in vegetables, fruits, food grains, bottled water and antibiotic residues in milk and meat are now more in evidence. Use of newer adulterants like ultramarine blue in dry ginger to hide holes and other damage done by insects, urea in puffed rice to improve its texture and aluminium foil in betel nut instead of silver foil has been observed. What do we mean by the word adulterant? Any substance which is used to adulterate a particular item of food is called an adulterant. It is any substance that lessens the purity of effectiveness of a substance.

Types of adulterants detected in different food items:

Food Items	**Adulterants detected**
Milk powder	Pesticide residues, sugar, starch, fat deficiency, excessive moisture.
Ghee and vanaspati	Extraneous colours, animal body fat, hydrogenated vegetableoils, excessive moisture.
Edible oils	Castor oil, mineral oil, argemone oil, triorthocresyl phosphate, oil - soluble colours, aflatoxin, pesticide residues,

	cheaper . vegetable oils.
Milk	Antibiotic residues, formalin, boric acid, pesticide residues, neutralizers like sodium bicarbonate, urea, water, sugar, starch, foreign fat, ammonium sulphate, cellulose.
Spices	Non-permitted colours, mineral oil coating, husk, starch, foreign seedsiresins, extraneous matter, exhausted spices.
Confectionery, sweets and savouries	Non alcoholic beverages Saccharin, dulcin, brominated vegetable oils, non-permitted colours, excess permitted colour.
Coffee	Date or tamarind seeds, artificial colour.

Tea	Colour, iron filings, foreign leaves, exhausted leaves.
Pulses	Lathyrus sativus, Vicia sativa, artificial colours, talc, foreign starch, extraneous matter.
Cereals and their products like foreign maida, suji.	Fungal infestation, pesticide residues, sand, dirt, , flour starch, powdered chalk, iron filings, aflatoxins, insect damage

Milk: In milk, the most widely used adulterant is water. Not only do the milk vendors add water to the milk sold loose but there also exists a racket of removing a portion of the milk from plastic pouches of well known companies and diluting the remaining milk with water. Such addition ofiwatkr is very easily detected by measuring the specific gravity or relative density of the milk. Sometimes, to avoid detection, the vendors increase the specific grav~ty of diluted milk by adding sugar; starch or urea. Addition of preservatives like formalin, boric acid, hydrogen peroxide and neutralizers like sodium bicarbonate and caustic soda is also prevalent to increase the shelf life of the milk. This is especially done in summer months when milk spoils easily and by vendors who have to transport the milk over long distances. contaminants usually found in milk are thepesticide residues (from pesticides sprayed in cattle sheds), antibiotic residues (from medications given to the cattle) and aflatoxin (from aflatoxin contaminated feed given to the cattle).

Edible fats and oils: The most common adulterant in edible oils is'a cheaper oil, which may or may not be edible. The cheaper oils generally used to adulterate expensive cooking oils are castor oil, mineral oil, argernone oil, palmolein, cottonseed oil and rapeseed oil. Ghee is usually found to be adulterated with vanaspati or hydrogenated oils. Lard, a cheaply available animal body fat, may also be added. Contaminants which have been detected in oils are the pesticide residues (from the pesticides which had been sprayed on the oil seed crops before harvesting) and afatoxin especially in unrefined groundnut oil (from use of poor quality, - fungus infested groundnuts). The process of refining the oil destroys the aflatoxin and hence it is safer to consume refined oils.

Spices: Cheaper agricultural produce like wheat starch, jowar; rice, corn and arrowroot starch are used in a number of expensive foods like ground spices (red chilli powder, turmeric, coriander powder, garam masaIa etc.). The starch which is white in colour is usually dyed to the colour of the spice to which it is being added. Sometimes essential oils derived from expensive spices like cloves are extracted and the exhausted spice is sold as such. Cinnamon bark may be , mixed with the bark of another similar looking tree, asafoetida may be mixed with a foreign resin, seeds of black pepper may be mixed with papaya seeds and mu2tard seeds may be mixed with argemone seeds which look similar.

Miscellaneous food items; Colour seems to be an adulterant, which is added to a large variety of foods viz. non-alcoholic beverages, confectionery, sweets and savouries, to improve their appeal to the consumer. According to the PFA Act, you may recall reading inunit 7, only some artificial or synthetic colours are permitted for use in foodstuffs. Colours other than the ones prescribed by law are referred to as non-permitted colours. The most commonly used non-permitted synthetic colours reported in various studies are Orange 11, Sudan dyes, Metanil Yellow, Auramjne, Malachite Green and Rhodamine B. In addition, extraneous matter like sand, husk, sawdust, wood pieces, stones, straw etc. are also used as adultermtsespgcially in cereals and pulses to increase the bulk.\Similar looking foreign pulse grains, which are mostly toxic, may be used to adulterate populc toor or arhar dhal. Metal adulterants include iron filings (in suji) and nickel (in vanaspati) which are present mainly as a result of poor processing techniques and aluminium foils used instead of silver foils in several products like sweets. Intense or artificial sweeteners like saccharin may be added in excess to non-alcoholic beverages or to foods in which it is not permitted like confectionery and sweets. Non-permitted sweeteners like dulcin and several other chemicals like urea, acetic acid, sodium hydroxide, sodium bicarbonate are also used asadulterants.

Classification of Adulterants

Antibiotic residues - for e.g. milk and milk products, meat and meat products.

pesticide residues - like milk, grains, oil, bottled water, vegetables and fruits.

Microbial contaminants - like fungi and fungal toxins, bacteria and their toxins due to improper storage or processing of the food products.

Metallic contaminants -iron filings in tea, suji, from rollers used in processing

Harmful effects of adulterants

Aflatoxicosis (liver damage), which is caused by the consumption of foodstuffs contaminated with aflatoxins, was first reported in 1974 among tribals in Western India. An outbreak associated with the consumption of bread made from moulddamaged, wheat containing trkhothecene mycotoxins was reported m the Kashmir valley. People who consumed the contaminated wheat flour, developed symptoms of abdominal pain and vomiting. These outbreaks have already been discussed in detail earlier in the unit entitled 'Food Contaminants' i.e. Unit 6 and you can refer back to the unit for details of these outbreaks, as well as, toxic effects of other contaminants like veterinary drug residues, heavy metals, pesticide residues etc. You will recall that selling unintentionally contaminated food is also an offence under the PFA Act and such food is called adulterated. Let us learn about the harmful effects of adulterants in'different foods. Toxic adulterants in milk and their ill-effects Milk, as you would have realized, is a highly perishable food item which is prone to microbial spoilage. You might have observed that if you leave milk at room temperature in summers, it begins to sour in a matter of few hours. If this milk is heated, it curdles or splits. Bacteria naturally present in the milk or those which enter the milk due to improper handling, multiply in number on keeping the milk at room temperature. In the process, they produce acid which makes the milk sow and ultimately curdles it.

Milk vendors who have to transport milk to long distances, especially in hot weather, add chemicals like carbonates or alkalis for neutralizing developed acidity in milk. Such addition of chemicals is not permitted by law. Chemicals like sodium carbonate (washing soda) can be harmful when ingested with milk and can have deleterious effects on the intestinal lining by irritating it. Sodium hydroxide (caustic soda) is also used for neutralizing acidity in milk. It is strongly alkaline and corrosive. It rapidly destroys organic tissues. Formaldehyde is another adulterant used to increase the shelf life of milk by killing the bacteria. It is a disinfectant against bacteria, fungi and many viruses and actually used in the preparation of lotions, soaps and mouthwash.

Ingestion of formaldehyde solution causes an intense pain with inflammation, ulceration and necrosis of mucous I membranes.

Hydrogen peroxide is another preservative which may be used to inhibit microbial growth and prevent milk spoilage. Strong solutions of this chemical produces irritating burns on the skin and mucous membranes and its continuous use even as a mouthwash ,has been known to cause damage to the papillae of the tongue. Urea, which may be added to increase the specific gravity of milk diluted with water, can cause gastrointestinal irritation.

Mineral oil (liquid paraffin), a cheap inedible oil used as an adulterant, may result in anal seepage and irritation, if consumed in excessive amounts. Prolonged ingestion may interfere with the absorption of fat-soluble vitamin like vitamins A, D, E and K. Tle admimstration of castor oil by mouth as a laxative was widely practised earlier. Such an ntake, particularly in large doses, may produce nausea, vomiting, colic pain and a severe laxative effect. Similar effects may be seen after consumption of cooking dl adulterated with castor oil. Castor oil in doses that exert a laxative effect is reported to inhibit the absorption of fat-soluble vitamins, notably vitamin A and vitamin D.

UNIT - II FOOD POISONS

Food is an integral part of existence for living organisms. It provides us with energy to carry out every day activities. It helps build our immunity system to be fit to fight against diseases. This is the reason why it becomes all the more necessary to eat the right food at the right time. Sometimes, microorganisms grow on the food which we consume. Food gets contaminated when these microorganisms multiply and release toxic substances, resulting in food poisoning.

Let us have a detailed look at the causes, symptoms and treatment of food poisoning.

Causes of Food Poisoning

Food poisoning can be caused by the following three factors:

Bacteria

Bacteria is the major cause of food poisoning. Salmonella is the major cause of food poisoning in the US. Campylobacter and Clostridium botulinum are the other two lethal causes of food poisoning.

Viruses

The viruses responsible for food poisoning include norovirus, sapovirus, rotavirus, and astrovirus. Food poisoning through viruses is less common, but proves to be fatal. Hepatitis A virus is a serious condition transmitted through food.

Parasites

Food poisoning through parasites is very rare. Toxoplasma, a common cause of food poisoning, can be found in cat litter boxes.

Food can also be contaminated during the growing, harvesting and storage steps. The harmful organisms transfer from one surface to the other and result in food contamination. The raw, ready-to-cook food products are more at risk. Since these food items are not cooked, therefore the pathogens are not destroyed resulting in food poisoning.

Symptoms Of Food Poisoning

Following are a few of the symptoms to help you check if you are diagnosed with food poisoning

- Weakness
- Headache
- Nausea
- Diarrhoea
- Vomiting
- Irritable abdominal cramps
- Mild fever
- Loss of appetite

Treatment of Food Poisoning

The following treatment should be given to a person suffering from food poisoning:

- Drink plenty of liquids to replace the lost electrolytes
- Allow ice cubes to melt in the mouth or sip small amounts of water even if vomiting persists.
- Gradually start eating blander food items such as cereals, toast, rice, banana, etc.
- Prevention of Food from Contamination
- To prevent food from contamination, it is very important to adopt proper methods for food preservation. We can preserve food by inhibiting the growth of microorganisms on food and slowing oxidation of fats.

Storage and preservation of whole food grains and cooked food are different. Microbes act on cooked food since it needs moisture to breed and whole food is usually devoid of moisture. This is the reason why bread left unused under moist conditions sees the action of microbes on it.

One of the characteristics of contaminated food apart from visible changes is that it emits a foul smell and tastes different than usual.

Listed below are a few methods of food preservation using which food can be prevented from contamination.

Chemical Method

Preservatives are used to check microbial activity in this method of preservation of food. Acid preservatives are also added to prevent food from spoilage in pickles, squashes, jams, canned food, etc. Some common preservatives:

- Salt
- Edible Oils

- Sodium benzoate
- Sodium metabisulphite

Preservation by common salt

Salt removes water from any food material as it is water absorbent. In the absence of water, microbes do not multiply. Hence salt is added to fish and meat to extract moisture content so that microbial activity is inhibited. It is also added to tamarind, raw mangoes etc. A salt solution, called brine is used in the process of pickling.

Preservation by sugar

Sugar, salt, absorbs moisture from food, making it too dry for microbes to exist. In food items like jams and jellies, sugar is added as a preservative. The process of desiccating food by dehydrating it first and then packing it with pure sugar is known as sugaring. Sugaring is used to preserve food, some fruits are preserved this way. In some cases, meat and fish are also preserved using the sugaring process.

Preservation by Oil and Vinegar

One of the most commonly used methods to preserve food is the use of edible oil. Oil and vinegar checks on spoilage in pickles. Fruits and vegetables are also oiled to preserve them from getting rotten. Vinegar has properties to stop and slow down the spoilage of food over a long period of time, it does so because acidity level or pH of vinegar does not allow any microbial activity to occur.

Heat and Cold Treatments

Boiling milk and food before storing them is one of the methods of food preservation. Pasteurization is the process of heating packaged and unpackaged foods to about 70 degrees Celsius for 15-30 seconds and stored after suddenly chilling. This way, milk can be consumed without boiling as it is free from microbes. We preserve meat and other food items under cold temperatures in the freezer to prevent attack by microbes.

Storage and Packing

Fruits, vegetables, and cooked food are stored in airtight containers, aluminium foils, cans, paper bags, and Ziploc bags to prevent them from getting contaminated

Alkaloid poison

Alkaloid poisoning is an illness associated with excess consumption of any specific type of green vegetable over an extended period of time.

An alkaloid is a type of naturally occurring compound that has a least one nitrogen atom present in its structure. These substances are commonly found in plants and animals. Here are a few examples of different alkaloids:

Examples of Different Plant Alkaloid Structures

Pesticides

Many people do not associate pesticides with food poisoning but these do contain toxins which can cause a range of health problems which include food poisoning.

What are pesticides?

Pesticides are substances, for example chemicals which are used to kill or repel pests. These pests include insects, birds, mammals, weeds, roundworms and microbes. Most people think of pesticides in conjunction with food such as those which are sprayed onto fields of crops to protect them against harm by insects, birds and other potential threats.

But pesticides can be used in a variety of other ways which include:

- Herbicides: to kill/control weeds and other harmful plants
- Rodenticides: to kill/control rodents such as mice and rats
- Fungicides: to kill/control fungi (e.g. mushrooms)
- Avicides: to kill/control birds

These are just a few of the many forms of pesticides. There are many advantages of using pesticides but unfortunately, there are several disadvantages as well. One of these is the negative effect they have on our health.

Pesticide poisoning

Pesticides are often used on foods such as fruit and vegetables but consuming these is likely to cause health problems especially for people who handle these foods. But consuming these foods is as equally as bad.

Causes of pesticide poisoning

It has been claimed that some pesticides cause several types of food poisoning bacteria to thrive and spread this illness. Certain bacteria such as e coli or salmonella respond to these pesticides by multiplying which increases the risk of food poisoning. This debate still goes on.

Symptoms of pesticide poisoning

Eating fruit or vegetables which have been sprayed with pesticides can cause the following symptoms:

- Abdominal cramps
- Vomiting
- Nausea
- Diarrhoea
- Headache
- Blurred vision
- Feeling weak and shaky
- Twitchy muscles
- Extreme tiredness

These symptoms often appear within minutes of exposure to a pesticide although in some cases they may take longer to develop.

Children and pesticide poisoning

Children often face a greater risk of pesticide poisoning which is due to the following reasons:

- ➢ They are more likely to be exposed to the pesticide, for example, playing with infected soil.
- ➢ They are more likely to be unaware of the risks of eating unwashed fruit or vegetables which have been sprayed with pesticides.
- ➢ They are more susceptible to pesticide poisoning than adults

This poisoning can occur if they drink infected water or eat infected food. These pesticides can invade their bodies through their mouths but can also gain access through their skin or respiratory systems. Babies are also at risk. Pesticides can infect even the unborn baby as they pass from the mother to the baby via the placenta. If the mother has consumed or been exposed to pesticides then she will pass these onto her unborn baby. Breastfeeding is also a problem. A newborn baby can also be at risk as these pesticides may pass from the mother through her breast milk to the new baby.

These risks are greater for babies and children in developing countries.

Treatment for pesticide poisoning

It is important to seek treatment for pesticide poisoning even if you are unsure as to whether you have been infected or not. Contact your GP or obtain urgent medical advice if you have been exposed. It is important to seek treatment for pesticide poisoning even if you are unsure as to whether you have been infected or not. Contact your GP or obtain urgent medical advice if you have been exposed.

Chemical food poisoning

There are two main types of chemical poisoning. One is caused by chemical products and the other by heavy metals.

Pesticides

Common sources of chemical contamination of foods are pesticides including insecticides, herbicides and rodenticides, and detergents, or their containers. When these chemical products find their way into food they can cause poisoning. There are also many cases of intentional chemical poisoning in Ethiopia when people drink these chemicals to commit suicide. Many people die from chemical poisoning if they do not go to healthcare facilities in time.

Heavy metals

Metals cause poisoning when foods are stored in faulty or damaged containers made of materials like tin, lead, copper and zinc. These metals can dissolve in acid foods such as fruit juices and produce fast-acting poisons in the body when ingested. Possible sources of contamination include residues migrating into foods from soldered cans, leaching from utensils, contaminated water, glazed pottery, painted glassware and paints.

Poisoning first aid

Poisoning is caused by exposure to a harmful substance. This can be due to swallowing, injecting, breathing in, or other means. Most poisonings occur by accident.

Immediate first aid is very important in a poisoning emergency. The first aid you give before getting medical help can save a person's life.

This article is for information only. DO NOT use it to treat or manage an actual poison exposure. If you or someone you are with has an exposure, call the local emergency number (such as 911), or the local poison control center can be reached directly by calling the national toll-free Poison Help hotline (1-800-222-1222) from anywhere in the United States.

Considerations

Millions of poisonings are reported to United States poison control centers every year. Many result in death.

It is important to note that just because a package does not have a warning label does not mean a substance in the package is safe. You should consider poisoning if someone suddenly becomes sick for no apparent reason. Poisoning should also be considered if the person is found near a furnace, car, fire, or in an area that is not well ventilated.

Symptoms of poisoning may take time to develop. However, if you think someone has been poisoned, DO NOT wait for symptoms to develop. Get medical help right away.

Causes

Items that can cause poisoning include:

- Carbon monoxide gas (from furnaces, gas engines, fires, space heaters)
- Certain foods
- Chemicals in the workplace
- Drugs, including over-the-counter and prescription medicines (such as an aspirin overdose) and illicit drugs such as cocaine
- Household detergents and cleaning products
- Household and outdoor plants (eating toxic plants)
- Insecticides
- Paints

Symptoms

Symptoms vary according to the poison, but may include:

- Abdominal pain
- Bluish lips (cyanosis)
- Chest pain
- Confusion
- Cough
- Diarrhea
- Difficulty breathing or shortness of breath
- Dizziness
- Double vision
- Drowsiness
- Fever
- Headache

- Heart palpitations
- Irritability
- Loss of appetite
- Loss of bladder control
- Muscle twitching
- Nausea and vomiting
- Numbness and tingling
- Seizures
- Skin rash or burns
- Stupor
- Unconsciousness (coma)
- Unusual breath odor
- Weakness

First Aid

Seek immediate medical help.

For poisoning by swallowing and some inhalations:

Check and monitor the person's airway, breathing, and pulse. If necessary, begin rescue breathing and CPR.
Try to make sure that the person has indeed been poisoned. It may be hard to tell. Some signs include chemical-smelling breath, burns around the mouth, difficulty breathing, vomiting, or unusual odors on the person. If possible, identify the poison.

1. DO NOT make a person throw up unless told to do so by poison control or a health care professional.
2. If the person vomits, clear the person's airway. Wrap a cloth around your fingers before cleaning out the mouth and throat. If the person has been sick from a plant part, save the vomit. It may help experts identify what medicine can be used to help reverse the poisoning.
3. If the person starts having convulsions, give convulsion first aid.
4. Keep the person comfortable. The person should be rolled onto the left side, and remain there while getting or waiting for medical help.
5. If the poison has spilled on the person's clothes, remove the clothing and flush the skin with water.

For inhalation poisoning:

Call for emergency help. Never attempt to rescue a person without notifying others first.

If it is safe to do so, rescue the person from the danger of the gas, fumes, or smoke. Open windows and doors to remove the fumes.

Take several deep breaths of fresh air, and then hold your breath as you go in. Hold a wet cloth over your nose and mouth.

1. DO NOT light a match or use a lighter because some gases can catch fire.
2. After rescuing the person from danger, check and monitor the person's airway, breathing, and pulse. If necessary, begin rescue breathing and CPR.
3. If necessary, perform first aid for eye injuries or convulsion first aid.

4. If the person vomits, clear the person's airway. Wrap a cloth around your fingers before cleaning out the mouth and throat.
5. Even if the person seems perfectly fine, get medical help.

Do Not

DO NOT:

- Give an unconscious person anything by mouth.
- Induce vomiting unless you are told to do so by the Poison Control Center or a doctor. A strong poison that burns on the way down the throat will also do damage on the way back up.
- Try to neutralize the poison with lemon juice or vinegar, or any other substance, unless you are told to do so by the Poison Control Center or a doctor.
- Use any "cure-all" type antidote.
- Wait for symptoms to develop if you suspect that someone has been poisoned.

When to Contact a Medical Professional

Your local poison control center can be reached directly by calling the national toll-free Poison Help hotline (1-800-222-1222) from anywhere in the United States. They will give you further instructions.
This is a free and confidential service. All local poison control centers in the United States use this national number. You should call if you have any questions about poisoning or poison prevention. It does not need to be an emergency. You can call for any reason, 24 hours a day, 7 days a week.

After doing first aid steps at home, you may need to go to the emergency room. Take the container with you to the hospital, if possible. At the hospital you will have an exam. You also may need the following tests and treatments.

- Activated charcoal
- Airway support, including oxygen, breathing tube through the mouth (intubation), and ventilator (breathing machine)
- Blood and urine tests
- Chest x-ray
- CT (computerized axial tomography) scan
- ECG (electrocardiogram, or heart tracing)
- Fluids through the vein (IV)
- Laxative
- Medicines to treat symptoms, including antidotes to reverse the effects of the poisoning if one exists

Prevention

Be aware of poisons in and around your home. Take steps to protect young children from toxic substances. Store all medicines, cleaners, cosmetics, and household chemicals out of reach of children, or in cabinets with childproof latches.

Be familiar with plants in your home, yard, and vicinity. Keep your children informed, too. Remove any poisonous plants. Never eat wild plants, mushrooms, roots, or berries unless you very familiar with them.

Teach children about the dangers of substances that contain poison. Label all poisons.

DO NOT store household chemicals in food containers, even if they are labeled. Most nonfood substances are poisonous if taken in large doses.

If you are concerned that industrial poisons might be polluting nearby land or water, report your concerns to the local health department or the state or federal Environmental Protection Agency.

Some poisons or environmental exposures do not require large doses or contact to cause symptoms and injury. Therefore, it is very important to get treatment right away to avoid serious harm. The outcome will depend on the type of poison the person came in contact with and the care received to treat the exposure.

UNIT-III FOOD ADDITIVES

Many different food additives have been developed over time to meet the needs of large-scale food processing. Additives are added to ensure processed food remains safe and in good condition throughout its journey from factories or industrial kitchens, to warehouses and shops, and finally to consumers. Additives are also used to modify the sensory properties of foods including taste, smell, texture and appearance.

Food additives can be derived from plants, animals or minerals, or they can be chemically synthesized. There are several thousand food additives used, all of which are designed to do a specific job. Food additives can be grouped into 3 broad categories based on their function.

Flavouring agents

Flavouring agents are chemicals that impart flavours or fragrances and are added to food to modify its aroma or taste. They are the most common type of additive used in foods, with hundreds of varieties used in a wide variety of foods, from confectionery and soft drinks to cereal, cake and yoghurt. Flavouring agents can be extracted from naturally occurring sources (e.g. plant or animal sources) or chemically synthesized. Flavours extracted directly from naturally occurring sources are often referred to as natural flavours. Such flavours can also be chemically synthesized and are sometimes referred to as nature made or nature identical to indicate that although the flavour molecule itself is naturally occurring it hasn't been extracted from its source, but synthesized to be identical. Artificial flavouring agents are chemicals that do not exist in nature but are synthesized to imitate natural flavours or elicit other taste sensations. Culinary ingredients, including spices, nuts and dried fruits or vegetables, can also modify aroma or taste, but are generally not considered flavouring agents.

Enzyme preparations

Enzyme preparations are a type of additive that may or may not end up in the final food product. Enzymes are naturally occurring proteins that boost biochemical reactions by breaking down larger molecules into their smaller building blocks. They can be obtained by extraction from plants or animal products or from micro-organisms such as bacteria and are used as alternatives to chemical-based technology. They are mainly used in baking (to improve the dough), for manufacturing fruit juices (to increase yields), in wine making and brewing (to improve fermentation), as well as in cheese manufacturing (to improve curd formation).

Other additives

Other food additives are used for a variety of reasons, such as preservation, colouring and sweetening. They are added when food is prepared, packaged, transported, or stored, and they eventually become a component of the food.

Preservatives can slow decomposition caused by mould, air, bacteria or yeast. In addition to maintaining the quality of the food, preservatives help control contamination that can cause foodborne illness, including life-threatening botulism.

Colouring is added to food to replace colours lost during processing or other production, or to make food appear more attractive.

Non-sugar sweeteners are often used as an alternative to sugar because they contribute fewer or no calories when added to food. WHO has issued a recommendation against the use of non-sugar sweeteners in general, based on evidence that they don't seem to benefit long term weight loss or maintenance and may increase risk of noncommunicable diseases.

Safety assessments

Food additives are assessed for potential harmful effects on human health before they are approved for use. Authoritative bodies at the national, regional and international levels are responsible for evaluating the safety of food additives. The Joint FAO/WHO Expert Committee on Food Additives (JECFA) is the international body responsible for evaluating the safety of food additives for use in foods that are traded internationally.

WHO response

Evaluating the health risk of food additives

WHO, in cooperation with the Food and Agriculture Organization of the United Nations (FAO), is responsible for assessing the risks to human health from food additives. Risk assessments of food additives are conducted by an independent, international expert scientific group – the Joint FAO/WHO Expert Committee on Food Additives (JECFA).

Only food additives that have undergone a JECFA safety assessment and are found not to present an appreciable health risk to consumers can be used internationally. This applies whether food additives come from natural sources or they are synthetic. National authorities, either based on the JECFA assessment or a national assessment, can then authorize the use of food additives at specified levels for specific foods.

JECFA evaluations are based on scientific reviews of all available biochemical, toxicological, and other relevant data on a given additive – mandatory tests in animals, research studies and observations in humans are considered. The toxicological tests required by JECFA include acute, short-term and long-term studies that determine how the food additive is absorbed, distributed and excreted, and possible harmful effects of the additive or its by-products at certain exposure levels.

The starting point for determining whether a food additive can be used without having harmful effects is to establish the acceptable daily intake (ADI). The ADI is an estimate of the amount of an additive in food or drinking water that can be safely consumed daily over a lifetime without adverse health effects.

International standards for the safe use of food additives

The safety assessments completed by JECFA are used by the joint intergovernmental food standard-setting body of FAO and WHO, the Codex Alimentarius Commission, to establish levels for maximum use of additives in food and drinks. Codex standards are the reference for national standards for consumer protection, and for the international trade in food, so that consumers everywhere can be confident that the food they eat meets the agreed standards for safety and quality, no matter where it was produced.

Once a food additive has been found to be safe for use by JECFA and maximum use levels have been established in the Codex General Standard for Food Additives, national food regulations need to be implemented permitting the actual use of a food additive.

Artificial Sweeteners

Almost everyone likes a sugary snack. But if you often have foods and drinks with lots of added sugar, the empty calories can add up. Added sugar can play a part in weight gain. It also may raise your risk of serious health problems, such as diabetes and heart disease.

You might try to stay away from table sugar by using less processed sweeteners such as honey and molasses. But these also are forms of added sugar. They add calories to your diet.

Some people use products called sugar substitutes, also known as artificial sweeteners. They taste sweet like sugar but have fewer calories. Some have no calories.

Uses for sugar substitutes

Many sugar substitutes taste sweeter than sugar. So very little is needed to sweeten foods and drinks. Other sugar substitutes called sugar alcohols are not as sweet as sugar.

Sugar substitutes are in many kinds of foods and drinks labeled sugar-free or diet. That includes soft drinks, candy and baked goods.

Some sugar substitutes also are sold on their own in packets or other containers. These can be added to foods or drinks at home.

Safety of sugar substitutes

Government health agencies oversee ingredients that product-makers add to food. These agencies check ingredients, such as sugar substitutes, before foods or drinks that contain them can go on sale. In the United States, the Food and Drug Administration (FDA) allows the following sugar substitutes to be used:

- Acesulfame potassium (Sweet One, Sunett).
- Advantame.
- Aspartame (NutraSweet, Equal).
- Neotame (Newtame).
- Saccharin (Sweet'N Low).
- Sucralose (Splenda).

- Luo han guo (Monk Fruit in the Raw).
- Purified stevia leaf extracts (Truvia, PureVia, others).

Other countries, such as those in the European Union, have more sugar substitute options than does the United States.

The FDA allows product-makers to use sugar alcohols, such as sorbitol and xylitol, too. The agency doesn't consider sugar alcohols to be food additives.

The FDA and food safety agencies in other countries also suggest how much of a sugar substitute you can safely have each day. This amount is called the acceptable daily intake (ADI). It varies by a person's weight and the type of sugar substitute used. Acceptable daily intakes aren't the same everywhere. They're different in the United States and Europe, for example.

In general, artificial sweeteners are safe in limited amounts for healthy people, including pregnant people. But limit or cut out sugar substitutes:

- If you're living with a rare genetic disease called phenylketonuria. Foods and drinks with aspartame can lead to serious health problems.
- If you have a bowel disease. Using sugar substitutes might make your symptoms flare up.

Dietary guidelines for Americans say adults shouldn't give sugar substitutes to children under 2 years old. In general, experts need to do more studies to learn what long-term health effects sugar substitutes might have on children. Most studies have looked at the effects in adults.

Health benefits linked to sugar substitutes

If you replace added sugar with sugar substitutes, it could lower your risk of getting tooth decay and cavities.

Sugar substitutes also don't raise the level of sugar in the blood.

For adults and children with overweight or obesity, sugar substitutes also might help manage weight in the short term. That's because sugar substitutes often are low in calories or have no calories. But it's not clear whether sugar substitutes can help people manage their weight over the long term.

Over time, it's most important to eat a healthy diet and get exercise.

Health concerns linked to sugar substitutes

Health agencies have clarified that sugar substitutes do not cause serious health problems.

Sugar substitutes also are not linked to a higher risk of cancer in people. Studies dating back to the 1970s linked the artificial sweetener saccharin to bladder cancer in rats. Since then, research has shown that those findings don't apply to people.

Some research on long-term, daily use of artificial sweeteners suggests a link to a higher risk of stroke, heart disease and death overall. But other things people do, or healthy habits that people don't do, may be the cause of the higher risk.

Other research is looking at long-term use of sugar substitutes and the gut. Many focus on how the gut and brain communicate. Researchers are checking to see if sugar substitutes affect cravings for sweets, the way people feel hunger and how the body manages blood sugar.

Sugar alcohols, stevia and luo han guo can cause bloating, gas and diarrhea. The amount of sugar alcohol that causes these symptoms varies from person to person.

In general, it is safest to take in small amounts of sugar substitutes. And it's best to use sugar substitutes for a short time, or just every once in a while. So try to cut back if you use them a few times a day.

The bottom line

Artificial sweeteners can be a short-term way to help some people lessen their use of sugar and lose or manage weight. In general, sugar substitutes are safe for healthy adults.

But be aware of how sugar substitutes affect your food and drink choices. These ingredients may get your tastebuds used to sweetness. And that can make drinking enough water a challenge.

Products made with sugar substitutes also may give you the wrong message about processed foods. A snack labeled low sugar or no sugar may not be the most nutritious choice. Whole foods, such as fruits and vegetables, usually have the best mix of nutrients for the body.

But artificial sweeteners can help some people enjoy sweetness without excess calories. And if used in moderation, artificial sweeteners can be part of a healthy diet.

Saccharin

Saccharin is a non-nutritive or artificial sweetener. It's made in a laboratory by oxidizing the chemicals o-toluene sulfonamide or phthalic anhydride. It looks like white, crystalline powder. Saccharin is commonly used as a sugar substitute because it doesn't contain calories or carbs. Humans can't break down saccharin, so it leaves your body unchanged. It's around 300–400 times sweeter than regular sugar, so you only need a small amount to get a sweet taste. However, it can have an unpleasant, bitter aftertaste. This is why saccharin is often mixed with other low or zero-calorie sweeteners.

For example, saccharin is sometimes combined with aspartame, another low-calorie sweetener commonly found in carbonated diet drinks.

Food manufacturers often use saccharin because it's fairly stable and has a long shelf life. It's safe to consume even after years of storage.

In addition to carbonated diet drinks, saccharin is used to sweeten low-calorie candies, jams, jellies, and cookies. It's also used in many medicines.

Saccharin can be used similarly to table sugar to sprinkle onto food, such as cereal or fruit, or used as a sugar substitute in coffee or when baking.

Food sources of saccharin

Saccharin is found in a wide variety of diet foods and drinks. It's also used as a table sweetener. It's sold under the brand names *Sweet 'N Low, Sweet Twin, and Necta Sweet*.

Saccharin is available in either granule or liquid form, with one serving providing sweetness comparable to two teaspoons of sugar.

Another common source of saccharin is artificially sweetened drinks, but the FDA restricts this amount to no more than 12 mg per fluid ounce.

Due to the ban on saccharin in the 1970s, many diet drink manufacturers switched to aspartame as a sweetener and continue to use it today.

Saccharin is often used in baked goods, jams, jelly, chewing gum, canned fruit, candy, dessert toppings, and salad dressings.

It can also be found in cosmetic products, including toothpaste and mouthwash. Additionally, it's a common ingredient in medicines, vitamins, and pharmaceuticals.

In the European Union, saccharin that has been added to food or drinks can be identified as E954 on the nutrition label.

Cyclamate

Cyclamate is an artificial sweetener. It is 30–50 times sweeter than sucrose (table sugar), making it the least potent of the commercially used artificial sweeteners. It is often used with other artificial sweeteners, especially saccharin; the mixture of 10 parts cyclamate to 1 part saccharin is common and masks the off-tastes of both sweeteners. It is less expensive than most sweeteners, including sucralose, and is stable under heating. Safety concerns led to it being banned in a few countries, though the European Union considers it safe.

Prior to 1973, Abbott Laboratories produced sodium cyclamate (Sucaryl) by a mixture of ingredients including the addition of pure sodium (flakes or rods suspended in solvent) with cyclohexylamine, chilled and filtered through a high speed centrifugal separator, dried, granulated and micro-pulverised for powder or tablet usage.

Cyclamates Sodium cyclamate is a potent sweetening agent. It has been subjected to numerous safety and carcinogenicity studies. Animal data led to warning against excessive and indiscriminate use a long time ago, causing the World Health Organization in 1967 to adopt a safety limit of 50 mg/kg. However, in 1982 a joint FAO/WHO expert committee on food additives revised this recommendation to allow for a maximum daily intake of up to 11 mg/kg of sodium or calcium cyclamate (as cyclamic acid)38. Nevertheless, since in certain climates and populations the amount of cyclamates in soft drinks and other beverages can exceed these limits, more epidemiological data are needed to evaluate, for example, a possible association with cancer of the uropoietic system and with histological and radiological abnormalities of the small intestine and malabsorption. Cyclamate is commercially available in the sodium and calcium salt forms. Both of these are colourless and odourless solids. Cyclamate in its acid form is a strong acid with pKa of 1.7141. Interestingly, the acid form of cyclamate has been demonstrated by X-ray crystallography to exist in the zwitterionic state. Cyclamates exhibit excellent solubility characteristics for use in essentially all imaginable applications. Although the acid form is sufficiently water-soluble (133 g/L), its high acidity results in preference for the very soluble sodium (200 g/L) or calcium (250g/L) salts. To illustrate the more than adequate solubility of sodium cyclamate, consider an application in which cyclamate is used in a binary blend with a sweetener such as saccharin. In such a situation, it is generally desired that cyclamate should provide half of the total sweetness desired that would typically be, allowing for sweetness synergy, sweetness equivalent to approximately 4% sucrose. Hydrolytic degradation of cyclamate salts yields cyclohexylamine and inorganic sulfate. As a consequence of the adverse biological activity of cyclohexylamine, FDA scientists conducted a comprehensive evaluation of cyclohexylamine levels in a range of food products .

Aspartame

Aspartame is a dipeptide that is used as an artificial sweetener. It is completely hydrolysed in the gastrointestinal tract to methanol, aspartic acid, and phenylalanine. Aspartame appears to be a safe sweetener, and despite numerous studies of its safety during the past three decades, the incidence of serious adverse effects has been difficult to determine in controlled studies. Since one of the metabolic products of aspartame is phenylalanine, excessive use of aspartame should be avoided by patients with phenylketonuria. Toxicity of another possible metabolic product, methanol, is unlikely, even when aspartame is used in extraordinary amounts33. Aspartame has reportedly caused angioedema and urticaria. It is sold under the brand names Equal , NutraSweet , and Natra Taste . Because it is made from amino acids, it provides 4 kcal/g. Aspartame is 200 times sweeter than sucrose and therefore very small amounts are required for sweetening foods, thus making its caloric contribution insignificant. According to the FDA, the acceptable daily intake of aspartame for humans is 50 mg/kg body weight, for both adults and children. Aspartame is used as a sweetener in many products including chewing gum, diet soda, dry drink mixtures, yogurt and pudding, and instant tea and coffee. The flavor profile of aspartame is found to be highly acceptable. In a study on the effects of artificial sweeteners on food intake and satiety, aspartame was found by participants to have a more pleasant taste compared with stevia or sucrose. Furthermore, aspartame does not elicit the same response as sugar does in the brain or the pancreas. A magnetic resonance imaging study showed a decline in activity of the hypothalamus part of the brain after ingestion of sucrose, whereas aspartame does not show similar response. It is suggested that for a hypothalamic reaction to occur there should be the combined stimuli of sweet taste and energy content, as found in sweetened caloric beverages. In the pancreas, aspartame does not stimulate an insulin response as sugar does .

Esters

Most of the hydrocarbons covered so far in this module aren't the first molecules that come to mind, in terms of edibility. The alkane and unsaturated hydrocarbon groups are commonly found in petroleum, and most alcohols oxidize to produce aldehydes, which are fatal when ingested.

However, ethanol, which we know combusts to produce CO_2, $_2O$, and heat, is used as a fuel and yet is the key ingredient in alcoholic beverages. It is not so much the ethanol that provides the flavor in such drinks, despite what an increasing proof (percent composition of ethanol) may suggest, but the family of **esters**. The process of yeast fermentation produces alcohols, which react with carboxylic acids in a condensation reaction to make esters[1].

The most common ester in wine is ethyl acetate, whose condensation reaction is shown above. This makes sense, considering ethanol is the only alcohol present in large quantities. One of the reasons why connoisseurs value aged fine wines is because over time, the concentration of esters increases through the aforementioned natural condensation reactions.[2]

Dilution of beverages obviously decreases their flavor, but this is not only because the solution is less concentration. By adding a large amount of water to a solution with esters, the condensation reaction can be undone, splitting the ester into its component alcohol and carboxylic acid. This process is called hydrolysis.

Although the ester functional group has a polar carbonyl, it contains no hydrogen atoms suitable for hydrogen bonding. Therefore esters have low boiling points relative to most molecules of similar size. In many cases, even though its molecules are almost twice as large as those of the constituent alcohol and acid, an ester is found to have a lower boiling point than either. Ethyl acetate, for example, boils at 77.1°C, lower than ethanol (78.5°C) or acetic acid (117.9°C).

While they are important flavoring agents in wines and other such drinks, esters occur naturally in many fruits and enhance their flavors. A short table is given below[3].

Table 11 *Esters and their flavors*

Ester	Flavor
Ethyl formate	Rum
N-amyl acetate	Pears, bananas
N-octyl acetate	Oranges
Methyl butrate	Apples
Ethyl butrate	Pineapples
N-amyl butrate	Apricots
Methyl salicylate	Oil of wintergreen
Linalyl acetate	Lavender, sage

It is interesting to note that while esters are fragrant and responsible for many flavors, the alcohols and carboxylic acids that comprise them, as aforementioned, are toxic to the body. For example, methyl butrate gives apples their familiar taste, but methanol is poisonous, and butyric acid has an acrid smell that gives rancid butter its odor - another example of how effective a chemical reaction can be in changing chemical properties!

Food colours

The colour of your food plays an important role by visually stimulating your appetite.

- Off colour foods are generally considered inferior in quality and so colours are added.
- Colours can also protect vitamins and flavours that may be affected by sunlight during storage.
- By using colours, we can enhance the natural colour of a dish and introduce decorative colours to other foods.
- Colour of the food can influence the perceived flavour.

Types of food colours- Natural and Synthetic Colours:

Food colourings are of two types: artificial and natural. Not surprisingly, natural colours are a better alternative as they are wholly derived from plants. Natural colouring usually appears less vibrant when compared to artificial colouring. This however, does not affect the taste of your food.

Natural colours:

Natural food colour is any dye, pigment or any other substance obtained from vegetable, animal, mineral that is capable of colouring foods or drugs. Colours come from variety of sources like seeds, fruits, vegetables, algae and insect. Grass, beet root, and turmeric are some of the natural sources from which colours are extracted.

Know your natural colours:

- **Red, blue and violet**: Derived from anthocyanins found in beetroots, raspberries and red cabbages.

- **Green**: Derived from chlorophylls, the green pigment found in all leaves and stems.

- **Yellow, Orange, Red**: Derived from carotenoids found in apricots, carrots and tomatoes.

Synthetic food colours:

They are also called artificial colours. These are manufactured by chemical reaction and are commonly used in food and pharmaceutical industries. Some of the common food colours are tartrazine, sunset yellow, amaranth, allura red, quinoline yellow, brilliant blue and indigo carmine.

Synthetic or Natural:

Due to consumer concerns around synthetic dyes, there is a tilt towards promotion of natural colours. Certified, synthetic colours are popular because they are less expensive but they are also effective in giving an intense and uniform colour. They can also blend easily to give a variety of hues. The usage of synthetic food colours is gradually coming down in India too after realising their harmful effects. Considering the relatively higher cost of natural colours, it seems that the shift from synthetic colours is going to be an extremely slow process.

Regulation

Whether it is natural or synthetic, the key thing is to meet the desired specifications of the product as stipulated by regulation. There are a set of regulations according to FSSAI-the Indian regulatory body for the use of food colors in different foods. Even if there is a tilt towards natural products, if the desired specifications are not met, then this serves no purpose.

Emulsifying Agents

Emulsifiers are food additives used to help mix two substances that typically separate when they are combined (e.g., oil and water).[1,2] Emulsifiers have one water-loving (hydrophilic) and one oil-loving (hydrophobic) end. When they are added to an unmixable liquid, the emulsifier molecules position themselves along the so-called interfacial layer where the oil separates from the water. Here, the emulsifier is positioned in such a way that their hydrophilic end faces towards the water phase and their hydrophobic end faces the oil phase, making it possible for the water and oil to become finely dispersed in each other. In the end, the emulsifier creates a stable, homogenous, and smooth emulsion.

Emulsifiers play an important role in the manufacture of food products, enhancing their appearance, taste, texture, and shelf life.[1,2] Nowadays, many of the foods we consume, such as margarine, mayonnaise, creamy sauces, candy, packaged processed foods, confections, and a range of bakery products, will not have the same properties without the addition of an emulsifier.

What are different types of emulsifiers?

Emulsifiers currently used in food production are either purified natural products (either from plant or animal origins) or synthetic chemicals that have very similar structures to the natural products.[2] For example, the emulsifier lecithin (E322), which is widely used in chocolate products, can be sourced from soybeans (oil), eggs, liver, peanuts, and wheat germ.[3] Pectin (E440), also a widely used emulsifier, can also be naturally found in fruits such as apples and pears.[4]

Currently, around 60 additives in the category 'emulsifiers, stabilisers, gelling agents, and thickeners' are permitted in the EU.[5-18]

E-numbers	Substance/class	Some foodstuff in which they are commonly used
E322	Lecithin	Chocolate produts
E407	Carrageenan	Flavoured milk, iced coffee, dairy-based ice cream and frozen desserts, chilled desserts, cream
E412	Guar gum	Dairy-based products, soy-based products, water-based frozen desserts, sandwich fillers and spreads, salad products
E415	Xanthan gum	Mayonnaise, sandwich fillers and spreads, salad products, dressing and vinegar, table sauces
E432-436	Polysorbates	Fine bakery wares, milk and cream analogues, ice cream, desserts, sugar confectionery
E460-469	Celluloses, including carboxymethylcellulose	Vitamin & dietary supplements, artificial sweeteners, meal replacements & other drinks, water-based ice lollies, pops & sorbets, meat substitutes
E471	Mono- and diglycerides of fatty acids	Dairy-based ice cream and frozen yoghurt, margarine, cakes, pastries, frozen desserts, sandwiches and wraps
E473-474	Sucrose esters and sucroglycerides	Gum, plant-based ice cream & frozen yoghurt, pastilles, gums, jellies & chews, plant-based drinks, snack/cereal/energy bars
E475	Polyglycerol esters of fatty acids	Cakes, pastries & sweet goods, sweet biscuits/cookies, baking ingredients & mixes, frozen desserts

E476	Polyglycerol polyricinoleate	Chocolate products, dairy-based frozen products, margarine & other blends
E481-482	Stearoyl lactylates	Fine bakery wares, breakfast cereals, desserts, bread
E491-495	Sorbitan esters	Cakes, pastries & sweet goods, baking ingredients & mixes, chocolate products

What are common applications of emulsifiers in food?

Bread

It is possible to make bread without emulsifiers but the result is often dry, low in volume and easily stales.[2] As little as 0.5% emulsifier added to the dough is enough to achieve an enhanced volume, a softer crumb structure and a longer shelf-life. There are two types of emulsifiers used in bread: dough strengtheners (e.g., diacetyl tartaric acid esters (E472e) and sodium or calcium stearoyl-2-lactylate (E481, E482)) and dough softeners (e.g., mono- and di-glycerides of fatty acids (E471)). Dough-strengthening agents make the dough stronger and result in bread with an improved texture and volume. Dough-softening agents allow obtaining a softer crumb structure and increased shelf-life.

Chocolate

All chocolate products contain 0.5% of lecithin (E322) or ammonium phosphatide (E442). These emulsifiers are added to provide the right consistency of the chocolate.[1] As a result, the chocolate can be moulded into plates of chocolate, chocolate bars etc. If the chocolate has been stored at too high temperatures, its surface may appear dull or white. This is called 'bloom' which makes the product less attractive to the customer. Sorbitan tristearate (E492) can delay the development of bloom.[1]

Ice-cream

Ice-cream is one of the most complex foods we encounter, containing ice crystals, air, fat particles, and an unfrozen aqueous mix.2 Emulsifiers are added during the freezing process, to promote a smoother texture and ensure the ice-cream does not melt rapidly after serving. They also improve freeze-thaw stability. Mono and diglycerides of fatty acids (E471), lecithin (E322) and polysorbates (E432, E436) are commonly used in ice-cream production. All this applies to other desserts such as sorbet, milkshake, frozen mousse and frozen yogurt as well.

Margarine

Emulsifiers give margarine the required stability, texture and taste.[2] To ensure that the water droplets are finely dispersed in the oil phase, mono and diglycerides of fatty acids (E471) and lecithin (E322) are widely used. Citric acid esters of mono and diglycerides:

- (E472c) prevent the margarine from splattering while polyglycerol esters

- (E477) and lactic acid esters make up for the good quality of margarine used to bake cakes, for example.

Processed meat

Sausages dominate Europe's processed meat industry. The main components of sausages are meat proteins, fat and water, which are bound together in a stable emulsion.[2] Emulsifiers stabilise this emulsion and distribute the fat finely throughout the product. And in low-fat meat products, food additives are responsible for making them as pleasant as their full-fat counterparts. The food industry uses mono and diglycerides of fatty acids (E471) and citric acid esters (E472c) for manufacturing processed meat.

Legislation

Just like any other food additive, emulsifiers are subject to stringent EU legislation governing their safety assessment, authorisation, use and labelling.18 These legislations require all added emulsifiers, as all food additives, to be specified on the labels of products where they are used, either by their name or their corresponding E-number. Additionally, they must be preceded by the technological function (e.g., emulsifier: E466 or emulsifier: carboxymethylcellulose).

FOOD PRESERVATIVES

Preservation techniques have been used as far back as the 14th century when man first used salt (salting) and smoke (curing) to stop meat and fish from going bad. Nowadays, the use of food additive preservatives has become an indispensable part of the food we eat. Despite a number of misgivings about their safety, our increasing demand for greater choice, ease and convenience of foods, and our high standard of food safety, makes them a vital component in our food systems. Let's explore the varying ways preservatives keep our foods fresh, safe, and shelf stable.

What are preservatives and how do they work?

Preservatives are food additives that play an important role in making foods last longer or taste better. Specifically, preservatives help to control and prevent the deterioration of food, providing protection against spoilage from micro-organisms (e.g., bacteria, yeast, moulds), life-threatening botulism and other organisms that can cause food poisoning (antimicrobial function).[1] High-risk foods such as meat, seafood, dairy, and cheese serve as a breeding ground for potentially dangerous micro-organisms, therefore, the addition of a preservative is usually required to ensure food safety.[2] Next to spoilage caused by micro-organisms, it can also be brought about by chemical (e.g., oxidation) or physical (e.g., temperature, light) factors.[1] Preservatives are also used to prevent these types of spoiling reactions in order to prevent any alterations in foodstuff's taste or, in some cases, their appearance (antioxidant function). Without the addition of a preservative, certain foods may turn rancid or change in colour. Ultimately, preservatives protect the quality of foods and beverages, reduce food cost, improve convenience, lengthen shelf-life, and reduce food waste.

Besides the use of food additive preservatives, foods can also be preserved by different processing methods like canning, dehydration (drying), smoking, salting, freezing, and the use of packaging.[4] Some practical examples include the canning of jams and tomato sauce, drying fresh fruits to make dried fruit, and adding salt to cabbage to make sauerkraut. In this article, however, we will focus on food additive preservatives only.

What are different types of preservatives?

Preservatives currently used in food production are either extracted from natural sources or synthetically produced.[1] For example, the preservative natamycin (E235), which is widely used in the surface treatment of cheese and sausages, can be naturally sourced from bacteria commonly present in soil.[3] Natural preservatives can also be sourced from plants, animals, fungi, and algae.[1] Furthermore, common kitchen staples like salt and sugar can also be used to naturally preserve food in certain cases, for example when making pickles or sauerkraut.[4]

Preservatives can be broadly categorized into so-called antimicrobial preservatives and antioxidant preservatives. However, many of the preservatives, like the sulphites used in wine and nitrates used in meat, serve both functions.[1] Antimicrobial preservatives like sulphur compounds such as the sulphites (E220-228) are used to inhibit the growth of bacteria e.g., in wine, dried fruits, vegetables in vinegar or brine.[5] Sorbic acid (E200) can be used for many different purposes, including the preservation of potato products, cheese and jam.[6] Benzoic acid and its calcium, sodium or potassium salts (E210-213) are used as antibacterials and antifungals in foods such as pickled cucumbers, low sugar jams and jellies, dressings, condiments.[7] Antioxidant preservatives are often used in minimally processed vegetable products such as ready-to-use salads, freshly cut fruit, and fresh juices, where browning is a significant concern.[1] Ascorbic acid (E300) and citric acid (E330) can be used to prevent browning because it inhibits a certain enzyme that in the presence of oxygen creates brown pigments.

Examples of widely used preservatives in the EU:[1,3,5-14]

Type of preservative	**E-number**	**Substance/class**	**Some foodstuff in which they are commonly used**
Antimicrobials	E-200-203	Sorbic acid and sorbate compounds	Processed cheese, processed fruit and vegetables, bread and rolls, fine bakery wares, sauces, potato products
	E-210-2013	Benzoic acid and benzoate	Flavoured fermented milk products, fruit and vegetables, confectionery, processed fish and fishery products
	E235	Natamycin	Surface treatment of cheese and sausage
	E-280-283	Propionic acid and	Vinegar, cheese products, milk products, shellfish,

		proprionates	coffee
Antioxidants	E-300-302	Ascorbic acid (i.e., vitamin C) and ascorbates	Fine bakery wares, fruit juices, flavoured drinks, unprocessed fruits and vegetables
	E-306-309	Tocopherol	Meat products, food supplements, fine bakery wares, fats and oils, flavoured drinks
	E-320-321	Butylated hydroxyanisole (BHA) & butylated hydroxytoluene (BHT)	Oils, margarines, fat-containing products
	E-330	Citris acid	Non-alcoholic drinks, jams and jellies, sauces, cheese, canned vegetables
Antimicrobials & antioxidants	E-220-228	Suphur dioxide and suphite compounds	Dried fruits, fruit preservatives, processed potato products, wine
	E-249-252	Nitrite and nitrate compounds	Meat products, pizza, poultry products, sandwiches/wraps

Are preservatives bad for you and should you avoid them?

There has been much public concern that some food additives cause adverse reactions, although careful investigations show that it is mostly based on misconception rather than on identifiable adverse reactions. Preservatives have rarely been shown to cause true allergic (immunological) reactions. Among the food additives reported to cause adverse reactions are some preservatives from the group of sulphiting agents, which include several inorganic suplhite additive (E220-228), and benzoic acid and its derivatives (E210-213), may trigger asthma characterised by breathing difficulties, shortness of breath, wheezing and coughing in sensitive (e.g. asthmatic)

individuals.[5,7] However, in general, due to stringent EU legislation governing the safety assessment of additives, preservatives can be generally regarded as safe for most consumers.
The European Parliament together with the European Council has laid down a detailed labelling system for food additives to enable consumers to make informed choices with regard to foods containing preservatives.[15] Legislation also stipulates that additives are labelled on the packaging of food products by their category (preservative, colour, antioxidant, etc) with either their name or E-number.

LEAVENING AGENTS

Leavening agent, substance causing expansion of doughs and batters by the release of gases within such mixtures, producing baked products with porous structure. Such agents include air, steam, yeast, baking powder, and baking soda.

Air and steam

Leavening of baked foods with air is achieved by vigorous mixing that incorporates air bubbles, producing foam. Egg white is well suited to this purpose because it produces voluminous and strong foams that retain their expanded structure when dried by the baking process. Egg white is used in such baked products as angel food cake, chiffon cakes, and sponge cakes. Gluten, the elastic protein of flour, may also be whipped to produce a foam, as in beaten biscuits.

Puff pastes, which are used for light flaky pastries, are expanded by water vapour (steam) pressure. During baking, as the interior of the product nears the boiling point, the vapour exerts pressure within bubbles that have been incorporated earlier by other means, producing swelling.

Fermentation

Leavening also may be achieved by the process of fermentation, which releases carbon dioxide gas. Bakers' yeast, composed of living cells of the yeast strain *Saccharomyces cerevisiae*, is available as a pressed cake and in a powdered form. When added to doughs, yeast initiates fermentation by acting upon certain sugars contributed by other dough ingredients, releasing both carbon dioxide and substances that affect the flavour and aroma of the baked product. Yeast-leavened products include most types of breads and rolls and such sweet dough products as coffee cakes, raised doughnuts, and Danish pastries.

The sourdough method, used for rye breads, employs a small portion of dough, or sponge, in which sugar-fermenting bacteria have been allowed to develop. When added to a fresh dough mixture, the sponge produces fermentation. Commercial sour cultures are sometimes used as substitutes for naturally fermented sourdoughs.

Chemical leavening agents

Chemical leavening agents also produce expansion by the release of carbon dioxide. Modern baking powders are combinations of baking soda (sodium bicarbonate) and dry acids or acid salts, usually with starch added for stability in storage. Single-acting baking powders, containing tartaric acid or cream of tartar, release carbon dioxide at room temperature, and mixtures in which they are used must be baked immediately to avoid loss of most of the gas. Slow-acting baking powders, containing phosphates, release part of their gas at room temperature and part when heated. Double-acting baking powder, the most widely used type, contains sodium aluminum sulfate and calcium acid phosphate and releases a small amount of gas when mixed and the balance when heated.

Baking soda is added to doughs and batters in which acid is provided by other ingredients, such as honey, sour cream, molasses, or cocoa. If used without acid ingredients, baking soda may produce yellowing and undesirable odours and flavours in the finished product. Mixtures leavened with baking soda require quick handling to avoid release of most of the gas before baking.

BAKING POWDER

Baking powder, leavening agent used in making baked goods. Commercial bakeries and domestic bakers frequently use baking powder, which consists of a mixture of a base (carbonate or bicarbonate) and a weak acid in appropriate amounts. Baking powder also contains added diluents, such as starch, which act as a buffer between the base and acid. The end products of the baking-powder reaction are carbon dioxide and some blandly flavoured harmless salts.

All baking powders meeting basic standards have virtually identical amounts of available carbon dioxide, differing only in reaction time. Most commercial baking powders are of the double-acting type, giving off a small amount of available carbon dioxide during the mixing and makeup stages, then remaining relatively inert until baking raises the batter temperature. This type of action eliminates excessive loss of leavening gas, which may occur in batter left in an unbaked condition for long periods. By comparison, single-acting baking powders, containing tartaric acid or cream of tartar, release carbon dioxide at room temperature, and mixtures in which they are used must be baked immediately to avoid loss of most of the gas.

Scone, quick bread of British origin and worldwide fame, made with leavened barley flour or oatmeal that is rolled into a round shape and cut into quarters before baking, traditionally on a griddle. The first scones were baked in cast iron pans hung in the kitchen fires of rural England and Wales. With the advent of Eastern trade, scones became an integral part of the fashionable ritual of "taking tea," with which they are still served daily, hot and buttered, throughout Britain and many regions of its former empire.

Scones may be enriched by the addition of clotted cream and eggs to the usual mixture of flour, baking soda, sugar, and salt. The dough is kneaded briefly, then rolled and cut to shape, usually triangular, and brushed with the reserved egg white prior to baking. Some recipes call for mashed potatoes. Scones made of baking powder dough sometimes contain currants. These are cut into various rounded, wedge, and diamond shapes and baked in an oven.

YEAST

Nutritional yeast, inactive dried yeast used as a condiment and food product. It is most often made from the *Saccharomyces cerevisiae* yeast strain, and it is commonly sold packaged as flakes or powder. The golden yellow flakes are often used in vegan and dairy-free cooking. Nutritional yeast was considered a specialty food product and mainly reserved for vegan cooking when it was first introduced, but it has grown in popularity in the 21st century and is now readily available in grocery stores in most major cities in North America and Europe.

History and common uses

Baking company Red Star Yeast was the first to manufacture nutritional yeast flakes in the United States in 1950. This commercialization followed the discovery by chemists in the early 1900s that leftover brewer's yeast had a high nutritional value. Brewer's yeast is a waste product of the brewing process, and chemists realized it could be recycled into a health supplement. One of the earliest attempts to create a food product that capitalized on this was Marmite, the fortified English savoury spread. Marmite is made from yeast extract and is considered both a food and a supplement. Brewer's yeast as it naturally occurs is fairly bitter. Nutritional yeast differs from brewer's yeast in that it was developed specifically to be a more-palatable and less-bitter food product.

Nutritional yeast grew rapidly in popularity in the 21st century, going from an ingredient discussed mostly in vegan cookbooks to an ingredient featured on menus at well-known restaurants in the United States. The rise in the product's popularity accompanied increased interest in plant-based diets. Both professional chefs and home cooks have found ways to incorporate nutritional yeast into many savoury recipes: it can be used as a topping, especially on popcorn, as a seasoning on vegetables, or as an ingredient in soups and sauces. Nutritional yeast is a good pantry item, as it stores well, with a shelf life of up to two years in properly sealed containers.

Production, nutritional content, and health benefits

Nutritional yeast is often made commercially by cultivating brewer's yeast (*Saccharomyces cerevisiae*) in beet or sugarcane molasses. In the weeks-long process of making nutritional yeast, once the fermentation is complete, the yeast is washed, pasteurized, and heat-dried. The final pasteurization and drying steps deactivate the yeast, so it retains no power as a leavening agent. Once the yeast is deactivated, the cells die and release amino acids, including glutamic acid. The glutamic acid left behind by the dehydration process imparts a rich, umami flavour (a foundational flavour that conveys a savoury or meaty taste) to the yeast that is reminiscent of cheese. The drying process also toasts the yeast, which deepens its nutty flavour. Food components known to impart umami are mainly glutamic acid and its sodium-rich counterpart, flavour enhancer monosodium glutamate (MSG). Unlike MSG, however, nutritional yeast contains no sodium.

Nutritional yeast may have health benefits, especially for vegans and vegetarians. It has a relatively high protein content, and it is free of sodium, fat, sugar, soy, and gluten. Many nutritional yeast brands are fortified with vitamin B_{12}, which is naturally found in meat, seafood, eggs, and traditional animal-derived dairy products. Vitamin B_{12} is an important component in the human body that is involved in making DNA, and it plays a role in keeping blood and nerve cells healthy. In Bragg's fortified nutritional yeast, one of the most popular brands, 1 tablespoon (15 millilitres) nearly meets or exceeds the recommended daily intake of several B vitaminsfor adults. Nutritional yeast is also a source of all nine amino acids, making it a complete protein. Dietary moderation is recommended, as it does have 2 grams of fibre per tablespoon, a relatively high fibre content that could cause intestinal distress if too much is introduced to a diet too quickly.

MSG

Monosodium glutamate (MSG) is a flavor enhancer often added to restaurant foods, canned vegetables, soups, deli meats and other foods. The U.S. Food and Drug Administration (FDA) has classified MSG as a food ingredient that's generally recognized as safe. But its use is still debated. For this reason, when MSG is added to food, the FDA requires it to be listed on the label.

MSG has been used as a food additive for many years. During this time, the FDA has received many reports of concerning reactions that people have attributed to foods that had MSG in them. These reactions — called MSG symptom complex — include:

- Headache
- Flushing
- Sweating

- Face pressure or tightness
- Lack of feeling (numbness), tingling or burning in the face, neck and other areas
- Quick, fluttering heartbeats
- Chest pain
- Feeling sick (nausea)
- Weakness

But researchers have found no clear proof of a link between MSG and these symptoms. Researchers admit, though, that a small number of people may have short-term reactions to MSG. Symptoms are often mild and don't need to be treated. The only way to prevent a reaction is to not eat foods that have MSG in them.

VINEGAR

Vinegar, sour liquid that is made by the fermentation of any of numerous dilute alcoholic liquids into a liquid containing acetic acid. Vinegar may be produced from a variety of materials: apples or grapes (wine or cider vinegar); malted barley or oats (malt vinegar); and industrial alcohol (distilled white vinegar). There are also vinegars made from beer, sugars, rice, and other substances. As a commercial product, however, vinegar was probably first made from wine (French *vin*, “wine”; *aigre*, “sour”).

Vinegar can be made from any liquid that is capable of being converted into alcohol in a two-step process. The fruit juice or other liquid contains sugar, which is converted into alcohol and carbon dioxide gas by the actions of yeast enzymes. The alcohol thus formed combines with atmospheric oxygen by the action of *Acetobacter* bacteria, forming acetic acid and water. Organic acids and esters derived from the fruit or other source material are also present and are responsible for the flavour and aroma variations of vinegar. Table vinegar contains approximately 4 percent acetic acid.

In 1864 the French chemist and bacteriologist Louis Pasteur showed that it is *Acetobacter* bacteria that cause the conversion of alcohol to acetic acid. These bacteria work together symbiotically, producing enough acetic acid to prevent invasion by other organisms.

Despite its ancient origin, the technology of vinegar production advanced slowly, improvements consisting principally of better methods of aeration. The Orleans process, best-known of the old methods, used a barrel of about 50 gallons (200 l) capacity. A mash consisting of wine or other alcoholic liquid was poured into the barrel, and a small amount of vinegar containing a mass of vinegar bacteria, called mother of vinegar, was added to start the reaction. One or two small air holes drilled above the liquid level exposed the surface to aeration. The finished vinegar was drawn off through a wooden spigot near the bottom. Care was taken in refilling the barrel with the new charge of raw ingredients to avoid breaking up the surface film of bacteria.

Early in the 18th century, a Dutch technologist, Hermann Boerhaave, found that the rate of acid production in the vinegar process was directly proportional to the amount of surface exposed to air. Thus, subsequent methods attempted to introduce more air into the casks. In the 20th century, continuous aeration—air bubbles pumped through the mash—was developed.

Vinegar’s principal uses are the flavouring of foods and the preservation, or pickling, of meat products, fish, fruit, and vegetables. For use as a condiment, vinegar is often flavoured with garlic, onions, tarragon, or other herbs and spices. Mixed with oil and seasonings it becomes a classic cold sauce—vinaigrette—used as a dressing on vegetable salads and served as a sauce with cold cooked vegetables, meats, and fish. Vinegar is also a common ingredient in marinades and is widely used in the pickling of cucumbers and other vegetables.

UNIT-IV BEVERAGES

Definition of Beverage

Beverages are an integral part of human diet, starting from new born. The cycle starts with the infant formulas- highly complex drink, rich in many key nutrients. As human age and their nutritional requirements change, product designer keeps pace by developing new and innovative beverages to meet these needs.

Beverages can be defined as � **any fluid which is consumed by drinking�** . It consists of diverse group of food products, usually liquids that include the most essential drink � water� to wide range of commercially available fluids like fruit beverage, synthetic drinks, alcoholic beverage, milk, dairy beverages, tea, coffee, chocolate drinks etc. Despite differences in their properties one common feature that exists in all beverages is their ability to act as thirst quencher. In simple words beverages can be defined as � liquid which is essentially designed or developed for human consumption� . The beverages are rarely consumed for its food value but it is vital for life. Although their prime role is to fulfill the human need but these are part of our culture.

However there are important pre-requisite for beverages:-

- � All are made from food ingredients
- � All are subject to pure food law
- � Consumed in enormous quantities � sometimes safer than potable supply

24.2 Health Importance of Beverages

Beverages are essential for growth, development as well for carrying out various physiological processes that are critical for living a healthy life.

- � In adult individuals 70 percent of body weight, 73 percent of lean muscle, 25 percent of adipose tissues, 22 percent of bone and 80 percent of blood consists of water. Consumption of beverages help in maintaining the water content in body and prevent dehydration
- � The water assists in digestion, assimilation and excretion of foods. It also helps in removing the toxic substances produced in body as a result of metabolisms such as urea, uric acid, ammonia etc. through kidney.
- � Water in beverages help in regulating the temperature of body through the process of sweating.
- � Beverages specially the fruit and vegetable based ones are source of micronutrients (vitamins and minerals) and anti-oxidants (carotenoids, flavonoids).

- � Certain beverages like tea and coffee contain alkaloids which stimulate the central nervous system.
- � Consumption of alcoholic beverages specially wine is recommended for its heart healthy image due to the presence of flavonoids.
- � Fermented dairy beverages are consumed because of the beneficial microflora present in them which assist in restoration and improvement of gastro-intestinal health.

Classification of Beverages

Beverages may be classified on various ways. The classification criteria may depends on various factors as mentioned below:

- � Natural and Synthetic (Ingredients used in manufacture)
- � Carbonated and Non-carbonated (Degree of mechanical carbonation)
- � Alcoholic and Non-alcoholic (presence or absence of alcohol)
- � Hot and Cold (Temperature of serving)
- � Stimulating and Non-stimulating (Based on physiological effect)

Natural and synthetic beverages

The natural beverages are prepared from the naturally derived ingredients including fruit juices or milk or malt, sugar, acid, flavouring and colouring materials. The examples of this group are fruit based beverages, malt beverages and dairy beverages.

Synthetic beverages are analogue of natural beverages and may contain ingredients which are prepared synthetically like flavouring and colouring materials. These are primarily developed to offer pleasure to consumers at affordable cost. The major group of synthetic beverages is soft drinks which contain flavoured sugar syrup as base material that may or may not be carbonated. The high potency sweetener based beverages also belong to the category of synthetic beverages as they contain artificial sweeteners mainly to reduce the calorific value.

Carbonated and non-carbonated beverages

Carbonated beverages are the one where carbon dioxide is dissolved in syrup or water. The presence of carbon dioxide creates bubbles upon release of pressure and fizzing in the beverage. The carbonated beverages are commonly referred as � Soft Drink� . Cola or lemonade beverages are typical examples of carbonated beverages. The process of fermentation also produces carbon dioxide in certain beverages like beer. Carbonation is done for various reasons. Consumers find the fizzy sensation pleasant, and like the slightly different taste that dissolved carbonic acid provides. Soda water is another popular type of carbonated beverage which may also be flavoured.

Majority of fruit and dairy based beverages falls into the category of non-carbonated beverages. The category also includes hot beverages and alcoholic beverages that do not contain carbon dioxide.

Alcoholic and non-alcoholic beverages

Alcoholic beverages contain ethyl alcohol which can be consumed for its intoxicating and mind-altering effects. Alcoholic beverages are produced by the process of natural or controlled fermentation. On the basis of raw material used and process technology used in their manufacture alcoholic beverages may be classified into three major groups:

a) Beer

It is the world� s third most consumed beverage. Beer is prepared by fermenting the � wort� (soluble liquid of barley malt digest) with appropriate yeast to attain an alcohol level in the range of 4-8 percent. Apart from alcohol, beer is also characterized by the � effervescence� i.e. foam which is produced by carbon dioxide and bitterness. The bitterness and aroma in beer is contributed by the hops (*Humulus lupulus*) solids as α-iso-acids and other polyphenols. There are many variants of beer but two are more popular. These are called as � Lager� beer which is fermented by bottom yeast i.e. *Saccharomyces pastorianus* at lower temperature (7-12� C) for longer period, while the � Ale� is manufactured by using top fermenting yeast i.e. *Saccharomyces cerevisiae* at relatively higher temperature (18-25� C) (Fig. 24.1).

b) Wine

Wines are made from variety of fruits. Such as grapes, peach, plum or apricots. However, the most commonly used one is grapes, both green as well as red grapes. The grapes are macerated to release juice which is fermented naturally by wide range of yeasts including *Saccharomyces spp., Pichia spp., Stellata spp*. and certain lactic acid bacteria. The duration of fermentation is also longer as compared to beer and mostly fermented wine is aged (months to year) to develop desirable sensory characteristics (Figure 24.1). There are two major type of wines i.e. white wine (made from green grapes) and red wine (from red or blue grapes). The red wine contain anthocyanin (as colouring pigment) and subjected to secondary fermentation termed as **� Malolactic fermentation�** to mellow the flavour of wine. The alcohol content in wine ranges from 9-16% (v/v). Sparkling wines are characterized by � effervescence� produced by carbon dioxide and clarity, example: Champagne.

c) Spirit

Spirit is a class of alcoholic beverages which are unsweetened and produced by distillation of fermented base. The fermented base may be molasses (by-product of sugar industry), fruit juices, cereal extract or sometime a combination of many fermentable substrates. Spirits are characterized by relatively higher alcohol content which may be as high as 20 percent. The process of distillation increases the concentration of alcohol but reduced the level of congeners. Some of the alcoholic beverages belonging to the category of spirit are listed in Table 24.1.

Table Alcoholic beverages belonging to the category of spirit

Alcoholic Beverage	Base Material	Alcohol Content (by volume)	Remark
Brandy	Fruit Juices mainly grapes	35-60%	Normally consumed after-dinner, preferred for medicinal purpose. Aged in oak barrels
Rum	Molasses or sugarcane juice	40-55%	Dark Coloured and quite popular in Caribbean nations. Aged for not less than three years
Gin	Wheat & rye may contain herbs	37.5-50	Flavoured and not aged. Mostly consumed with citrus juices
Whisky	Cereal (Barley, Rye, corn malt)	40-55%	Most famous one is � Scotch Whisky�
Vodka	Malted cereals, potatoes etc.	38-40%	Popular in Russian federation countries, two variants white and flavoured Vodka
Cider	Apple juice and other temperate fruits	2-7%	Characterized by acidic-alcoholic taste

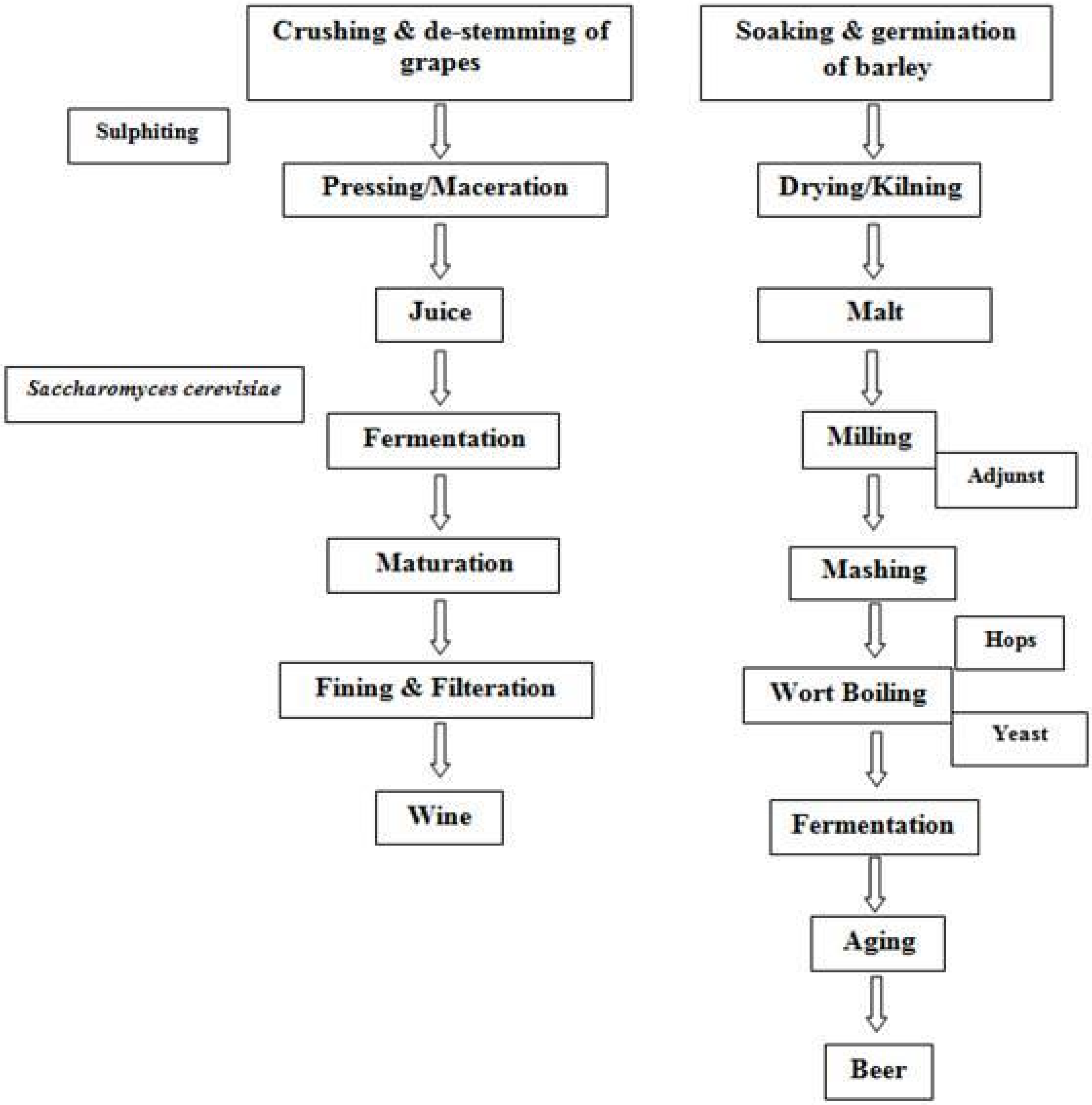

Fig. Manufacture technology for beer and wine

Hot and cold beverages

Another criterion for classifying beverages is the temperature of serving. Certain beverages are consumed only hot i.e. temperature above 65-70� C which are termed as � Hot beverage� while those served at chilled temperature are called as � cold beverages� . The examples of hot beverages are tea, coffee, chocolate and milk. However, iced tea and cold coffee are served chilled. Most of the fruit beverages, dairy drinks, alcoholic drinks and soft drinks are example of cold drinks. Term � cold drink� is synonymous to � carbonated drinks� as well.

Stimulating and non-stimulating beverages

Consumption of some beverage stimulates the body systems mainly to nervous system and circulatory system. It is mainly due to the presence of certain chemical compounds like caffeine in coffee and tea, many phenolic compounds in herbal drinks and ethyl alcohol in alcoholic beverages. The chemical constituents present in these beverages influence the physiological processes as follows:-

- Increase in basic metabolic rate (BMR)
- Increase in blood circulation and heart beat
- Stimulation of central nervous system (CNS) and release of neuro transmitter
- Diuretic (increase in frequency of urination)

- Enhancement in secretion of gastric juice

Other beverages

There are many other categories of beverages and it includes nomenclature like herbal drinks, mood drinks, energy drinks and sports drinks.

Energy drinks are those beverages which boost energy and mainly contain sugar and caffeine. In recent past there has been rapid growth in the demand of energy drinks. These drinks may also contain variety of stimulants and vitamins.

Herbal drinks are prepared by using the infusion of herbs in water. A wide variety of herbs may be used in preparation of such drinks. Many herbs like aloe vera, ginseng, *shatavari*, *Arjuna*, lemongrass, thyme etc. may be used for as base material for herbal drinks.

Sports beverages are also called as � electrolyte drinks� are basically designed to replenish the loss of fluid & electrolytes and provide quick energy during the exercise and sports activity. The mono saccharides such as dextrose, glucose syrup are added so that they can be transported easily into the muscle cells and produce energy apart from sucrose and maltodextrin. The carbohydrate content of sports beverage varied in the range of 4-8 percent. Electrolytes are many essential minerals such as chloride, calcium, phosphate, magnesium, sodium, and potassium. Electrolytes control osmosis of water between body compartments and help maintain the acid-base balance required for normal cellular activities.

There are three types of sports drinks all of which contain various levels of fluid, electrolytes, and carbohydrate.

- Isotonic drinks have fluid, electrolytes and 6-8% carbohydrate. Isotonic drinks quickly replace fluids lost by sweating and supply a boost of carbohydrate. This kind of drink is the choice for� most athletes especially middle and long distance running or team sports.
- Hypotonic drinks have fluids, electrolytes and a low level of carbohydrates. Hypotonic drinks quickly replace flids lost by sweating. This kind of drink is suitable for athletes who need fluid without the boost of carbohydrates such as gymnasts.
- Hypertonic drinks have high levels of carbohydrates. Hypertonic drinks can be used to supplement daily carbohydrate intake normally after exercise to top up muscle glycogen stores. In long distance events high levels of energy are required and hypertonic drinks can be taken during exercise to meet the energy requirements. If used during exercise, hypertonic drinks need to be used in conjunction with isotonic drinks to replace fluids.

Present Status of National and Global Beverage Market

In India, traditional cuisine includes drinks, which were primarily developed to provide aesthetic appeal, but they also contained certain components having nutritional and therapeutic values as well. However, with course of time these traditional health drinks diminished. According to an estimate Indian consumers drink 120 billion litre of marketed beverages out of which only 4 percent is ready-to-drink packaged once. The carbonated soft drink industry in India consists of more than 100 plants spread throughout the country. The current value of Indian beverage industry is around 1,049 million US$. In fact the soft drinks form the third-largest packaged food sector after packaged tea and packaged biscuits. However, the penetration of soft drinks in Indian market is still low. For a long period the Indian beverage industry was dominated by aerated synthetic drinks. However, the situation has changed dramatically, the aerated soft drinks, which had registered a whopping 20% growth during late 90's, could manage its present share in market against possible slide. In contrary to this last few years have witnessed a significant development in fruit based beverages newly introduced fruit beverages fall into the category of functional foods or nutraceuticals. Energy drinks, isotonic (sport) beverages herbal and green teas, fortified waters, caffeinated drinks, recreational soft drinks are some of the functional beverages which have gained popularity in recent years. The market size for the bottled water in India had an estimated value of

US$ 570 million in 2008. With annual growth rate of 14.5 percent, the market of bottled water is expected to increase rapidly in coming years.
Fruit juice market is growing at the rate of 15 percent annually and expected to reach 796 million liters by 2013 from the current volume of 624 million liters. The market of packaged fruit juice is in the range of Rs. 500-600 crores, which is quite smaller as compared to fruit drink market which is around Rs. 1300 crore. The major sale of these beverages occurs in summer months which are quite extended in India. The sale volume of beer is highest among alcoholic beverages followed by spirits. Drinking milk products constitute the largest segments among the dairy products and are growing at the annual rate of 6.8 percent. Future of Indian beverage market is quite promising and sectors that may attract processors and consumers alike include the functional dairy drinks, fruit beverages and wine. Advancement in processing and packaging technology in the form of UHT/Aseptic processes and tetrapak packaging offers newer opportunity to deliver nutritious beverages in log-life version.

SOFT DRINKS

Soft drink, any of a class of nonalcoholic beverages, usually but not necessarily carbonated, normally containing a natural or artificial sweetening agent, edible acids, natural or artificial flavours, and sometimes juice. Natural flavours are derived from fruits, nuts, berries, roots, herbs, and other plant sources. Coffee, tea, milk, cocoa, and undiluted fruit and vegetable juices are not considered soft drinks.
The term *soft drink* was originated to distinguish the flavoured drinks from hard liquor, or distilled spirits. Soft drinks were recommended as a substitute in the effort to change the hard-drinking habits of early Americans. Indeed, health concerns of modern consumers led to new categories of soft drinks emphasizing low calorie count, low sodium content, no caffeine, and “all natural” ingredients.
There are many specialty soft drinks. Mineral waters are very popular in Europe and Latin America. Kava, made from roots of a bushy shrub, *Piper methysticum*, is consumed by the people of Fiji and other Pacific islands. In Cuba people enjoy a carbonated cane juice; its flavour comes from unrefined syrup. In tropical areas, where diets frequently lack sufficient protein, soft drinks containing soybean flour have been marketed. In Egypt carob (locust bean) extract is used. In Brazil a soft drink is made using maté as a base. The whey obtained from making buffalo cheese is carbonated and consumed as a soft drink in North Africa. Some eastern Europeans enjoy a drink prepared from fermented stale bread. Honey and orange juice go into a popular drink of Israel.

History of soft drinks

The first marketed soft drinks appeared in the 17th century as a mixture of water and lemon juice sweetened with honey. In 1676 the Compagnie de Limonadiers was formed in Paris and granted a monopoly for the sale of its products. Vendors carried tanks on their backs from which they dispensed cups of lemonade.
Carbonated beverages and waters were developed from European attempts in the 17th century to imitate the popular and naturally effervescent waters of famous springs, with primary interest in their reputed therapeutic values. The effervescent feature of the waters was recognized early as most important. Flemish scientist Jan Baptista van Helmont first used the term *gas* in his reference to the carbon dioxide content. French physician Gabriel Venel referred to aerated water, confusing the gas with ordinary air. British scientist Joseph Black named the gaseous constituent *fixed air*.
Robert Boyle, an Anglo-Irish philosopher and scientist who helped found modern chemistry, published his *Short Memoirs for the Natural Experimental History of Mineral Waters* in 1685. It included sections on examining mineral springs, on the properties of the water, on its effects upon the human body, and, lastly, “of the imitation of natural medicinal waters by chymical and other artificial wayes.”

Numerous reports of experiments and investigations were included in the *Philosophical Transactions* of the Royal Society of London in the late 1700s, including the studies of Stephen Hales, Joseph Black, David Macbride, William Brownrigg, Henry Cavendish, and Thomas Lane.

English clergyman and scientist Joseph Priestley is nicknamed "the father of the soft drinks industry" for his experiments on gas obtained from the fermenting vats of a brewery. In 1772 he demonstrated a small carbonating apparatus to the College of Physicians in London, suggesting that, with the aid of a pump, water might be more highly impregnated with fixed air. French chemist Antoine-Laurent Lavoisier made the same suggestion in 1773.

To Thomas Henry, an apothecary in Manchester, England, is attributed the first production of carbonated water, which he made in 12-gallon barrels using an apparatus based on Priestley's design. Swiss jeweler Jacob Schweppe read the papers of Priestley and Lavoisier and determined to make a similar device. By 1794 he was selling his highly carbonated artificial mineral waters to his friends in Geneva; later he started a business in London.

At first, bottled waters were used medicinally, as evidenced in a letter written by English industrialist Matthew Boulton to philosopher Erasmus Darwin in 1794:

By about 1820, improvements in manufacturing processes allowed a much greater output, and bottled water became popular. Mineral salts and flavours were added—ginger about 1820, lemon in the 1830s, tonic in 1858. In 1886 John Pemberton, a pharmacist in Atlanta, Georgia, invented Coca-Cola, the first cola drink.

Production

All ingredients used in soft drinks must be of high purity and food grade to obtain a quality beverage. These include the water, carbon dioxide, sugar, acids, juices, and flavours.

Water

Although water is most often taken from a safe municipal supply, it usually is processed further to ensure uniformity of the finished product; the amount of impurities in the municipal supply may vary from time to time. In some bottling plants the water-treatment equipment may simply consist of a sand filter to remove minute solid matter and activated carbon purifier to remove colour, chlorine, and other tastes or odours. In most plants, however, water is treated by a process known as superchlorination and coagulation. There the water is exposed for two hours to a high concentration of chlorine and to a flocculant, which removes organisms such as algae and bacteria; it then passes through a sand filter and activated carbon.

Carbon dioxide and carbonation

Carbon dioxide gas gives the beverage its sparkle and tangy taste and prevents spoilage. It is supplied to the soft drink manufacturer in either solid form (dry ice) or liquid form maintained under approximately 1,200 pounds per square inch (84 kilograms per square centimetre) pressure in heavy steel containers. Lightweight steel containers are used when the liquid carbon dioxide is held under refrigeration. In that case, the internal pressure is about 325 pounds per square inch.

Carbonation (of either the water or the finished beverage mixture) is effected by chilling the liquid and cascading it in thin layers over a series of plates in an enclosure containing carbon dioxide gas under pressure. The amount of gas the water will absorb increases as the pressure is increased and the temperature is decreased.

Flavouring syrup

Flavouring syrup is normally a concentrated solution of a sweetener (sugar or artificial), an acidulant for tartness, flavouring, and a preservative when necessary. The flavouring syrup is made in two steps. First, a "simple syrup" is prepared by making a solution of water and sugar. This simple sugar solution can be treated with carbon and filtered if the sugar quality is poor. All of the other ingredients are then added in a precise order to make up what is called a "finished syrup."

Finishing

There are two methods for producing a finished product from the flavouring syrup. In the first, the syrup is diluted with water and the product then cooled, carbonated, and bottled. In the second, the maker measures a precise amount of syrup into each bottle, then fills it with carbonated water. In either case, the sugar content (51–60 percent in the syrup) is reduced to 8–13 percent in the finished beverage. Thus, a 12-ounce soft drink may contain more than 40 grams of sugar.

The blending of syrups and mixing with plain or carbonated water, the container washing, and container filling are all done almost entirely by automatic machinery. Returnable bottles are washed in hot alkali solutions for a minimum of five minutes, then rinsed thoroughly. Single-service or "one-trip" containers are generally air-rinsed or rinsed with potable water before filling. Automatic fillers can service hundreds of containers per minute.

Pasteurizing noncarbonated beverages

Noncarbonated beverages require ingredients and techniques similar to those for carbonated beverages. However, since they lack the protection against spoilage afforded by carbonation, these are usually pasteurized, either in bulk, by continuous flash pasteurization prior to filling, or in the bottle.

Powdered soft drinks

These are made by blending the flavouring material with dry acids, gums, artificial colour, etc. If the sweetener has been included, the consumer need only add the proper amount of plain or carbonated water.

Iced soft drinks

The first iced soft drink consisted of a cup of ice covered with a flavoured syrup. Sophisticated dispensing machines now blend measured quantities of syrup with carbonated or plain water to make the finished beverage. To obtain the soft ice, or slush, the machine reduces the beverage temperature to between −5 and −2 °C (22 and 28 °F).

Packaging and vending

Soft drinks are packaged in glass or plastic bottles, tin-free steel, aluminum, or plastic cans, treated cardboard cartons, foil pouches, or in large stainless steel containers.

Vending of soft drinks had its modest beginning with the use of ice coolers in the early 20th century. Nowadays, most drinks are cooled by electric refrigeration for consumption on the premises. Vending machines dispense soft drinks in cups, cans, or bottles, and restaurants, bars, and hotels use dispensing guns to handle large volume. There are two methods of vending soft drinks in cups. In the "pre-mix" system, the finished beverage is prepared by the soft drink manufacturer and filled into five- or 10-gallon stainless steel tanks. The tanks of beverage are attached to the vending machine where the beverage is cooled and dispensed. In the "post-mix" system the vending machine has its own water and carbon dioxide supply. The water is carbonated as required and is mixed with flavoured syrup as it is dispensed into the cup.

Health and regulatory issues

The regular consumption of soft drinks has been associated with multiple chronic health conditions. These increased risks are largely due to the added ingredients in soft drinks, especially sugar. Indeed, some sugar-sweetened soft drinks contain 40 grams of sugar or more per 12-ounce serving, which exceeds the recommended daily sugar intake for adults. According to the American Heart Association, women should consume no more than 25 grams of added sugar per day and men 38 grams per day. The consumption of just one to two servings of sugar-sweetened soft drinks daily significantly increases the risk of metabolic syndrome and type 2 diabetes. In addition, both men and women who drink sugar-sweetened beverages are at increased risk of coronary heart disease and premature death; for each sugary beverage a person consumes, the risk of death from cardiovascular disease increases by about 10 percent. Diet soft drinks can also be problematic for health: daily consumption of two or more diet soft drinks, specifically those that are artificially sweetened, increases the risk of heart disease and stroke in women.

In children and adults, long-term consumption of soft drinks is linked to weight gain, obesity, and tooth decay. Sugar-free soft drinks also have been associated with dental erosion. The detrimental effects to teeth are related to soft drink acidity, sugar content, and the presence of certain chemicals, such as chelators, which demineralize teeth.

Concerns about the negative health effects of soft drinks have given rise to debate about legally restricting their consumption through soda bans, increased soda taxes, and other regulatory measures. In January 2014 Mexico became one of the first countries to impose a nationwide revenue-raising tax on soft drinks containing added sugar. Later that year Berkeley, California, became the first city in the United States in which voters unanimously approved a tax on sugary drinks. In 2015 a ban on the sale of caffeinated soft drinks to children went into effect in the Vologda region of Russia. That same year authorities in San Francisco approved a measure that would require soft drink manufacturers to add health warnings to soft drink labels, similar to the health warnings displayed on labels for alcohol and tobacco products.

Despite the known health risks of soft drink consumption, many regulatory measures failed. In 2013 in New York City, for example, a proposal to ban the sale of oversize soft drinks (larger than 16 ounces) was defeated in court. The American Beverage Association, which led the challenge against the plan, claimed that the city's health board overstepped the boundaries of its control over public health when it approved the proposal.

ALCOHOLIC BEVERAGES

Alcoholic beverage, any fermented liquor, such as wine, beer, or distilled spirits, that contains ethyl alcohol, or ethanol (CH_3CH_2OH), as an intoxicating agent. A brief treatment of alcoholic beverages follows. For full treatment, *see* alcohol consumption.

Alcoholic beverages are fermented from the sugars in fruits, berries, grains, and such other ingredients as plant saps, tubers, honey, and milk and may be distilled to reduce the original watery liquid to a liquid of much greater alcoholic strength. Beer is the best-known member of the malt family of alcoholic beverages, which also includes ale, stout, porter, and malt liquor. It is made from malt, corn, rice, and hops. Beers range in alcoholic content from about 2 percent to about 8 percent. Wine is made by fermenting the juices of grapes or other fruits such as apples (cider), cherries, berries, or plums. Winemaking begins with the harvest of the fruit, the juice of which is fermented in large vats under rigorous temperature control. When fermentation is complete, the mixture is filtered, aged, and bottled. Natural, or unfortified, grape wines generally contain from 8 to 14 percent alcohol; these include such wines as Bordeaux, Burgundy, Chianti, and Sauterne. Fortified wines, to which alcohol or brandy has been added, contain 18 to 21 percent alcohol; such wines include sherry, port, and muscatel.

The making of distilled spirits begins with the mashes of grains, fruits, or other ingredients. The resultant fermented liquid is heated until the alcohol and flavourings vaporize and can be drawn off, cooled, and condensed back into a liquid. Water remains behind and is discarded. The concentrated liquid, called a distilled beverage, includes such liquors as whiskey, gin, vodka, rum, brandy, and liqueurs, or cordials. They range in alcoholic content usually from 40 to 50 percent, though higher or lower concentrations are found.

In the ingestion of an alcoholic beverage, the alcohol is rapidly absorbed in the gastrointestinal tract (stomach and intestines) because it does not undergo any digestive processes; thus, alcohol rises to high levels in the blood in a relatively short time. From the blood the alcohol is distributed to all parts of the body and has an especially pronounced effect on the brain, on which it exerts a depressant action. Under the influence of alcohol the functions of the brain are depressed in a characteristic pattern. The most complex actions of the brain—judgment, self-criticism, the inhibitions learned from earliest childhood—are depressed first, and the loss of this control results in a feeling of excitement in the early stages. For this reason, alcohol is sometimes thought of, erroneously, as a stimulant. Under the influence of increasing amounts of alcohol, the drinker gradually becomes less alert, awareness of his environment becomes dim and hazy, muscular coordination deteriorates, and sleep is facilitated. *See also* alcoholism.

CARBONATION

Carbonation, addition of carbon dioxide gas to a beverage, imparting sparkle and a tangy taste and preventing spoilage. The liquid is chilled and cascaded down in an enclosure containing carbon dioxide (either as dry ice or a liquid) under pressure. Increasing pressure and lowering temperature maximize gas absorption. Carbonated beverages do not require pasteurization.

Examples of carbonated beverages include soft drinks, sparkling water (seltzer water), and carbonated wine, which has many characteristics of fermented sparkling wine but is less expensive to produce. Carbonated beverages and waters were developed from European attempts in the 17th century to imitate the popular and naturally effervescent waters of famous springs, with primary interest in their reputed therapeutic values.

ALCOHOLIC LIVER DISEASE

Liver disease due to alcohol; Cirrhosis or hepatitis - alcoholic; Laennec's cirrhosis

Alcoholic liver disease is damage to the liver and its function due to alcohol abuse.

Causes

Alcoholic liver disease most often occurs after years of heavy drinking. Over time, scarring and cirrhosis can occur. Cirrhosis is the final phase of alcoholic liver disease.

Alcoholic liver disease does not occur in all heavy drinkers. The chances of getting liver disease go up the longer you have been drinking and more alcohol you consume. You do not have to get drunk for the disease to happen.

The disease is most common in people between 40 and 50 years of age. Men are more likely to have this problem. However, women may develop the disease after less exposure to alcohol than men. Some people may have an inherited risk for the disease.

Long-term alcohol abuse can lead to dangerous damage called alcoholic liver disease. Let's talk today about alcoholic liver disease. Alcoholic liver disease usually occurs after years of drinking too much. The longer you've abused alcohol, and the more alcohol you've consumed, the greater likelihood you will develop liver disease. Alcohol may cause swelling and inflammation in your liver, or something called hepatitis. Over time, this can lead to scarring and cirrhosis of the liver, which is the final phase of alcoholic liver disease. The damage caused by cirrhosis is unfortunately irreversible. To determine if you have alcoholic liver disease your doctor will probably test your blood, take a biopsy of the liver, and do a liver function test. You should also have other tests to rule out other diseases that could be causing your symptoms. Your symptoms may vary depending upon the severity of your disease. Usually, symptoms are worse after a recent period of heavy drinking. In fact, you may not even have symptoms until the disease is pretty advanced. Generally, symptoms of alcoholic liver disease include abdominal pain and tenderness, dry mouth and increased thirst, fatigue, jaundice (which is yellowing of the skin), loss of appetite, and nausea. Your skin may look abnormally dark or light. Your feet or hands may look red. You may notice small, red, spider-like blood vessels on your skin. You may have abnormal bleeding. Your stools might be dark, bloody, black, or tarry. You may have frequent nosebleeds or bleeding gums. You may vomit blood or material that looks like coffee grounds. Alcoholic liver disease also can affect your brain and nervous system. Symptoms include agitation, changing mood, confusion, and pain, numbness, or a tingling sensation in your arms or legs. The most important part of treatment is to stop drinking alcohol completely. If you don't have liver cirrhosis yet, your liver can actually heal itself, that is, if you stop drinking alcohol. You may need an alcohol rehabilitation program or counseling to break free from alcohol. Vitamins, especially B-complex vitamins and folic acid, can help reverse malnutrition. If cirrhosis develops, you will need to manage the problems it can cause. It may even lead to needing a liver transplant.

Symptoms

There may be no symptoms, or symptoms may come on slowly. This depends on how well the liver is working. Symptoms tend to be worse after a period of heavy drinking.

Early symptoms include:

- Loss of energy
- Poor appetite and weight loss
- Nausea
- Belly pain
- Small, red spider-like blood vessels on the skin

As liver function worsens, symptoms may include:

- Fluid buildup of the legs (edema) and in the abdomen (ascites)
- Yellow color in the skin, mucous membranes, or eyes (jaundice)
- Redness on the palms of the hands
- In men, impotence, shrinking of the testicles, and breast swelling
- Easy bruising and abnormal bleeding
- Confusion or problems thinking
- Pale or clay-colored stools
- Bleeding in the gastrointestinal tract

Exams and Tests

Your health care provider will do a physical exam to look for:

- An enlarged liver or spleen
- Excess breast tissue in men
- Swollen abdomen, as a result of too much fluid
- Reddened palms
- Red spider-like blood vessels on the skin
- Small testicles
- Widened veins in the wall of the abdomen
- Yellow eyes or skin (jaundice)

Tests you may have include:

- Complete blood count (CBC)
- Liver function tests
- Coagulation studies
- Liver biopsy

Tests to rule out other diseases include:

- Abdominal CT scan
- Blood tests for other causes of liver disease
- Ultrasound of the abdomen
- Ultrasound elastography

Treatment

LIFESTYLE CHANGES

Some things you can do to help take care of your liver disease are:

- Stop drinking alcohol.
- Eat a healthy diet that is low in salt.
- Get vaccinated for diseases such as influenza, hepatitis A and hepatitis B, and pneumococcal pneumonia.
- Talk to your provider about all medicines you take, including herbs and supplements and over-the-counter medicines.

MEDICINES FROM YOUR DOCTOR

- "Water pills" (diuretics) to get rid of fluid buildup
- Vitamin K or blood products to prevent excess bleeding
- Medicines for mental confusion
- Antibiotics for infections

OTHER TREATMENTS

- Endoscopic treatments for enlarged veins in the esophagus (esophageal varices)
- Removal of fluid from the abdomen (paracentesis)
- Placement of a transjugular intrahepatic portosystemic shunt (TIPS) to repair blood flow in the liver

When cirrhosis progresses to end-stage liver disease, a liver transplant may be needed. Liver transplantation for alcoholic liver disease is only considered in people who have completely avoided alcohol for 6 months.

Support Groups

More information and support for people with alcoholic liver disease and their families can be found by joining support groups for alcoholism or liver disease.

Outlook (Prognosis)

Alcoholic liver disease is treatable if it is caught before it causes severe damage. However, continued excessive drinking can shorten your lifespan.

Cirrhosis further worsens the condition and can lead to serious complications. In case of severe damage, the liver cannot heal or return to normal function.

Possible Complications

Complications may include:

- Bleeding disorders (coagulopathy)
- Buildup of fluid in the abdomen (ascites) and infection of the fluid (spontaneous bacterial peritonitis - SBP)
- Enlarged veins in the esophagus, stomach, or intestines that bleed easily (esophageal varices)
- Increased pressure in the blood vessels of the liver (portal hypertension)
- Kidney failure (hepatorenal syndrome)
- Liver cancer (hepatocellular carcinoma)
- Mental confusion, change in the level of consciousness, or coma (hepatic encephalopathy)

UNIT-V EDITABLE OILS

What are 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.

What are 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 Table

To make you understand how **Oils and fats** are different from each other, here are some major **differences between oils and fats:**

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

One difference between fats and oils is that at room temperature fats are solid whereas oils are liquid. Fats and oils are both made of one part called glycerol attached to three other parts called fatty acids. Glycerol is a thick liquid with many industrial uses. The fatty acids can vary and this makes the different kinds of fats and oils.

- Fats and oils are lipids. They are important energy stores in animals and plants.
- Fats are solid at room temperature whereas oils are liquids.
- Hibernating animals survive by using up their stores of body fat. Some plant seeds survive because they contain a store of oil.
- Fats and oils do not mix with water.

Fats and oils have many domestic and industrial uses. Soap for example can be made from tallow or coconut oil and a substance called a strong alkali, such as sodium hydroxide. Soap molecules have water loving heads and water repelling tails. In dirty water the tails gather around dirt particles and in this way the direction dissolve into the water and be carried away with it.

SOURCES OF OILS

Around the world, it must be noticed that about 140 million tons of vegetal oils were produced in 2009/2010 and that about 70% of that production are accounted for four vegetal species:

1 – **Soya oil**, about 26% of the world production, in USA, Argentina, Brasil and China. The world production of soybean oil was 56.7 million tonnes in 2019-20.
Soybeans (*Glycine soja*) stem from China (mentioned at the time of the Emperor Chennung, 2800 B.C.). They were brought in Europe by missionaries (1740) and first grew in the Paris botanical garden. They were first taken to the United States as inexpensive ballast in 1804. A century later, G.W. Carver laid the foundation of new ideas about soybeans.

Today, soyabean is the world's leading source of oil as well as by-products and protein-rich seed meal. The highest domestic consumption is in Asia where soybean is a basic food since ancient times.
Besides the oil content of about 20%, the high protein content (about 35%) is of special importance as a protein source in the world. Crude soybean oil contains about 88% neutral lipids, 10% phospholipids and 2% glycolipids. Refining of soybean oil affords valuable by-products including lecithin during the degumming stage as the most available source of phospholipids and mixed tocopherols as a product of deodorisation.

The composition in triacylglycerol species is characterized by the presence of LLL (19%), OLL (15%), LLLn (10%), LOP (9%), OLO (6%), and OLLn (6%) (*Holcapek M et al., J Chromatogr A 2003, 1010, 195*). About 50% of soybeans come from the USA, 20% fro Brazil, 11% from Argentina, 9% from China, and 4% from India. More than 55 million hectares are used in the world for its cultivation.

Soybeans are the vegetable oilseed grown in largest amount : the world soybean production amounted to about 156 million tons in 1999-2000 and the yield is reported to be in the range 2300-4000 kg/ha. That production represents about 52% of total global oilseed production. About 21% of soybean oil are produced in the United States, 17% in Brazil, 26% in China, 16% in Argentina, 5% in European Union, and 4% in India. The major usages of soybean oil are for food industry (77%), biofuels (17%), and oleochemicals (4%).
Recent world statistics on oilseed production in U.S. and in the world are found in the web site of the American Soybean Association

Refined soybean oil, before or after hydrogenation, is used in numerous edible products (more in North America than in Europe) : spreads, butter, margarine, frying and salad oils, mayonnaise, and as essential components of most baked goods. Soybean oil is also an important component of inks used for newsprint. Soybean's many uses can be viewed on the web site of the American Soybean Association. Soybean oil has been proposed for the synthesis of polyurethane suitable for wide range of potential biomedical applications (*Miao S et al., Eur J Lipid Sci Technol 2012, 114, 1165*).

Pictures relating to soybean production, transportation and marketing may be found on the web site of the American Soybean Association. Information on soybean may be found on the web sites SOJAXA and American Soybean Association.

FATTY ACID COMPOSITION

2 – **Palm oil**, about 18% of the world production, in Malaysia, Indonesia and Africa. In 2000/01 the production was 24.3 million tonnes and in 2011/12 51.9 million tonnes, I.E. a 113 % increase in 11 years. The total production was 73.5 Mt in 2018-19. The annual worldwide production of palm oil is the highest of any edible oil. In 2011, the major usages of palm oil are for food industry (77 %), biofuels (10 %), and oleochemicals (8 %).Oil palm (*Elaeis guineensis Jacq.*) was first reported by the Portuguese sailor Eannes in 1434. The oil palm is native to West and Central Africa where its food use dates back to over 5000 years. Its botanical classification is derived from the Greek *elaion* (oil) and the specific name of *guineensis* is indicative of its origin from the equatorial Guinea coast. In 1763, Nicholas Jacquin produced one of the earliest illustrations of the oil palm tree and he is remembered in its scientific name (*Hartley, C.W.S. The Oil Palm 1988 3rd edn*),

This plant is the oil producer with the highest yield, one tree can produce up to 20 tonnes of fruit bunches per year. Each fruit consists of a hard kernel (seed) inside a soft shell (endocarp), which is surrounded by a fleshy mesocarp. The mesocarp contains about 49% palm oil and the kernel about 50% palm kernel oil. It has been reported that the commercial palm oil contains about 96% neutral lipids, 2.4% phospholipids and 1.4% glycolipids.

The triglyceride composition of palm oil is related to the formation of two main fractions, one is liquid, the other solid at ambient temperature. The composition in triacylglycerol species is characterized by the presence of LOP (24%), OOP (17%), LLP (8%), OLO (5%), and OOO (4%) (Holcapek M et al., J Chromatogr A 2003, 1010, 195). According to Voon PT et al., (Palm oil development, 2008, 48, 14) , palm olein TG contains only 7–11% palmitic acid at the sn-2 position, while 60– 70% of this position is occupied by oleic acid. An exhaustive review on the chemistry and biochemistry of palm oil has been written by Sambanthamurthi R et al. (Prog Lipid Res 2000, 39, 507). The oil is mostly used as shortening, margarine and frying fat. It is also used in soap, candle manufacture and in the tin-plate industry. Its use as fuel in oil based biodiesel is increasing, mainly in Europe (about 500,000 tons in 2005).

About 37% of palm oil are produced from Malaysia where two thirds of the cultivated land are under oil palm. The average yield is about 4 ton/ha on a worldwide basis. The world production of palm oil was about 48 million tonnes in 2010/11. The highest production is in 2012 in South East Asia (49% in Indonesia, 37% in Malaysia , 3% in Thailand) and in Africa (2% in Nigeria, 1% in Cameroon and Côte d'Ivoire). Statistics of world supply and consumption may be found in a specialized web site.

High amounts of saturated fats in palm oil (high amount of palmitic acid) have been considered as less cardiovascular friendly than others. Generally, health care professionals consider palm oil as a hypercholesterolaemic fat. New data on the incidence of the sn-2 position of oleic acid seem to lead to new nutritional concepts for palm oil. Several features and applications of palm oil have been reviewed (Norhaizan ME et al., Lipid technol 2013, 25, 39).

FATTY ACID COMPOSITION

3 – **Rape oil**, about 12% of the world oil production, in EEC (26%), China (20.2%), India (11.3%), Canada (9.3%), and Japan (6.6%). Nearly 27.3 million metric tons in 2019/2020.. The major usages of rape oil are for food industry (67%), biofuels (27%) and oleochemicals (3%)

The origin of rape (*Brassica napus, B. campestris*) is not clear but its first mention is around 2000 B.C. in India. Analysis of archaeological materials has proved that Brassicaceae seed oil was used as illuminant in Nilotic shells from a first millennium AD Coptic church in Egypt (*Romanus K et al., Anal Bioanal Chem 2008, 390, 783*). Rape oil appears in Nederlands in 1360. As the plant withstands frost, it was cultivated in the moderate climates of the north or the far south.

In the mid-1930s it was grown almost entirely (90%) in China and India. Interest in this oilseed crop was developed during and after World War II. Until 15 years ago, rape oil was unsuitable for human nutrition because of its high content in erucic acid (up to about 50% of C22:1 n-9) which was shown to influence negatively the metabolism of several organs. The erucic acid-rich oil was used in Europe as a lamp oil, in the production of soaps and paints, and for cooking and in Canada as a lubricant. New varieties were developed with low erucic acid content (lower than 2%) and are known under the name **Canola**. Yields in the range 900-3000 kg/ha are reported. There is still a need for some high-erucic oil for industrial use (*Lipid Technol 1994, 6, 79*). Increasing quantities of rape oil are being used in Europe for biodiesel fuel, in the form of ethyl esters. Seed breeders are trying to reduce the content of saturated fatty acids, to reduce the level of linolenic acid, to increase the level of oleic acid, lauric acid or g-linolenic acid. Rapeseed oil is also unusual in having substantial amounts of eicosenoic acid (C20:1 n-9). Its level has been reduced by plant breeding from about 10% to a level lower than 1%.
The average composition in triacylglycerol species is characterized by the presence of OLO (23%), OOO (17%), OLnO (11%), OLL (8%), OLLn (6%), OLnLn (4%) and LLLn (3%) (*Holcapek M et al., J Chromatogr A 2003, 1010, 195*).
The world production of rape seed was about 60.4 million tonnes and of oil was about 24.3 million tonnes in 2011/12. The EU-27 is the first producer of seeds (34%), then China (22%), Canada (21%), and India (11.6%). The major exporters of oil are Canada and Europe, the United States being the major importer. More than 33 million hectares are used in the world for rapeseed culture. The use of that oil has changed rapidly during the 21rst century since the non-food use of rapeseed oil was only about 8% the production in 2000 while it amounted to about 33% in 2010.
General information and many links on Canola may be found on the web site of the Canola Council of Canada.

FATTY ACID COMPOSITION

4 – **Sunflower oil**, about 13% of the world oil production. The top ten countries Ukraine, Federation of Russia, Argentina, China, Romania, Bulgaria, Turkey, Hungary, France and USA represent 84% of the production. In 2011, the major usages of sunflower oil is for food industry (96%). Sunflower is the third oilseed produced in the world, the fourth vegetable oil and third oilseed meal among protein feed sources. The total world production of sunflower oil was 45 million tonnes in 2014-18. On the period 1975–2019, the global oilseeds production doubled every 20 years.
Sunflower (*Helianthus annuus*) originated from America where it was present when Europeans arrived. It was reported to be present in Arizona and New Mexico 3000 years before Christ. The Spanish explorer Monardes brought the plant in Spain in 1569 and from there it spread in Europe and Russia. Tsar Peter the Great brought himself the plant from Europe in Russia where its production reached the first rank in the world: about 18 % in Russia and 24 % in Ukraine, and 22.5 % in EU-27 (France, Spain, Hungary, Romania, Bulgaria) in 2011. Russian seed was later taken back to North America and to Argentina.

The production of sunflower seed yields between 500 and 2600 kg seeds/ha. The whole seed contains about 40% oil and about 25% protein suited for animal feeding. Neutral triacylglycerols constitute the major lipid class in sunflower seeds. Phospholipids and glycolipids constitute less than 4% of the total lipids.
The composition in triacylglycerol species is characterized by the presence of LLL (33%), OLL (25%), LOP (11%), and OLO (6%) (Holcapek M et al., J Chromatogr A 2003, 1010, 195) (*Holcapek M., J Chromatogr A, 2003, 1010, 195*).
This oil is available with three fatty acid compositions. The regular oil is linoleic-rich (46-74 %) and two variants are also found, the high-oleic acid (Sunola, Highsun, 75-90 % oleic acid and 2-17 % linoleic acid) and mid-oleic (NuSun, 43-72 % oleic acid and 19-45 % linoleic acid). The variant NuSun is grown only in the United States. High oleic sunflower contains 4 times more oleic acid than classical sunflower, with 84% oleic acid in oil. It competes on global scale with other high oleic oils but has the highest oleic level compared to oleic safflower (78%), oleic rapeseed and canola (75–73%) and oleic soybean (73%). In 2019, the oleic production ranges by 3.8 MnT, i.e. 7% of the global sunflower production. For almost 20 years, France has been a pioneer regarding oleic sunflower, more than 60% of its production being converted to oleic varieties since 2010, reaching 76% in 2019.
Other sunflower oils have been developed with enhanced tocopherol content and with a higher content of saturated acids.
According to Sofiproteol, France, 6% of the European sunflower oil consumption would have been used in biodiesel in 2018, meaning 290 to 300 kT. Sunflower oil would represent around 2.5% of the European biodiesel production.

REFINED VEGETABLE OIL

Refining vegetable oils produces edible oil which has characteristics that consumers desire such as a bland flavour and odour, clear appearance, light colour, stability to oxidation and suitability for frying.

Definition

According to **<u>Food Safety and Standards</u> (Food Products Standards and Food Additives) Regulations**, **2011,** the word 'refining' means that the oil from an expressed vegetable oil or a solvent-extracted oil has been deacified in one of the following ways

- With Alkali,
- By physical refining or both
- By miscella refining using permitted food grade solvent, followed by bleaching with absorbent earth and/or activated carbon or both of them and deodorized with steam without using any other chemical agent
- Refining may also include the process of degumming using phosphoric/citric acid.

When refining oil

- no other chemical agent can be used.
- It is mandatory to clearly specify on the label of the container the name of the vegetable oil from which the refined oil has been manufactured
- Besides the standards mentioned in the regulations for refined vegetable oil, manufacturers must also conform to the standards of each of the edible oils in the regulations when used for refining
- acid value shall not be more than 0.5
- Moisture shall not exceed 0.10% by weight
- Test for argemone oil shall be negative.

The refined vegetable oil is permitted to be obtained from the following vegetable oils. It can be obtained from any of the following **oils** mentioned in the regulations Coconut, Cottonseed, Groundnut, Nigerseed, Safflower, Sesame, Soyabean, Sunflower, Mustard/Rapeseed, Linseed Mahua, Olive, Poppyseed, Taramira , Maize (Corn), Watermelonseed, Palm, Palmolein, Palm Kernel or Rice Bran**.**

Fats that can be used to obtain refined oil are Salseed, Mango Kernel, Kokum Dhupa or Phulwara.

In addition refined vegetable oil shall comply with the following requirements

- The oils shall be clear and free from rancidity, adulterants, sediments, suspended and other foreign matter, separated water, added colouring and flavouring substances and mineral oil
- However, it may contain food additives permitted in these Regulations and Appendices

Further, if the oil is obtained by the method of solvent extraction and the oil imported into India; whether obtained by solvent extraction or otherwise, shall be supplied for human consumption only after refining and shall conform to the **standards laid down under regulation 2.2.1**.

Restrictions on Sale

According to regulations Food Safety and Standards (Prohibition and Restrictions on sales) Regulations, 2011; no person is permitted to sell or expose for sale, or distribute, or offer for sale, or dispatch, or deliver to any person for the purpose of sale any edible oil –

- Which does not conform to the standards of quality as provided in the Food Safety and Standards Act, 2006 and rules made there under
- Which is not packed in a container, marked and labeled in the manner as specified in FSSAI regulations

Provided that the State Government may, in the public interest, for reasons to be recorded in writing, in specific circumstances and for a specific period by a notification in the Official Gazette, exempt any edible oil from the provisions of this Act.

In addition manufacturers need to keep in mind that all edible oils, except coconut oil, olive oil, imported in crude, raw or unrefined form shall be subjected to the process of refining before sale for human consumption. Such oil shall bear a label declaration as laid down in the **Regulation 2.4.2** of Food Safety and Standards (Packaging and Labelling) regulations, 2011.

Food testing facility

It is one of the requirements for obtaining FSSAI registration that all oil manufacturing units must have

- A well equipped laboratory for testing of vegetable oils/fats
- All necessary chemicals and supporting facilities needed for testing must be available
- The laboratory employs must have the required qualification as chemists
- Quality parameters of raw oils and finished products are to be tested as per standards
- Records on quality control are to be maintained satisfactorily

Self-Inspection Checklist for Oil Manufacturing Units

1. **Location and Layout of Establishment**

- Manufacturers must make sure that the factory ideally located away from industries which are emitting harmful gases, obnoxious odour, chemical etc.
- ceiling roof is permanent made form Iron sheet/Asbestos sheet/ R.C.C.
- floor of building is cemented, tiled or laid in stone/ pakka floor.
- production walls are smooth, made with impervious material up to a height of not less than five feet and the junction between the walls and floors are curved
- premises of the factory is adequately lighted and ventilated, properly white washed or painted
- provision for disposal of refuse and effluents is in place
- food production area has adequate drainage facility
- doors must have automatic door closer and all doors, windows and other opening are fitted with net or screen to prevent insects from entering
- provide Antiseptic/ disinfectant foot bath at the entrance of the production area
- ensure there are sufficient numbers of latrines and urinals for worker are provided and located outside the processing hall.
- All the machinery is installed in such a manner which may allow continuous flow of production and it must not occupy more than 50% of the total production area.

2. **Equipment and fixtures**

Manufacturers must ensure that

- appropriate facilities for the cleaning and disinfecting of equipment and instruments and must have preferably cleaning in place (CIP) system wherever necessary
- equipment is made of stainless steel /galvanised iron/ non corrosive materials
- temperature and pressure/vacuum of processing vessels are maintained as per requirements

3. **Processing Plant**

- manufacturers must employ only approved processes in the factory
- De-odourization is done at a temperature more than 180°C
- For hydrogenation/ interesterification units, post neutralization is being done.

4. **Packaging and Storing**

- appropriate arrangement for storage of packing materials and the place must be clean and free from pest/rodent infestation
- containers used for packing must be made of food-grade or prime quality materials
- Use only those tin containers that are rust free
- Provide cold storage facility, wherever necessary
- Packing sections must be covered and protected from insects and flies
- Packing sections must be tiled, clean and tidy
- Batch numbering devises must run to satisfaction
- Label declarations on the packs must be as per norms

5. **Personal Hygiene**

- The staff and workers must be provided with aprons, head cover, disposable gloves and footwear
- There must be adequate facilities for toilets, hand wash and footbath, with provision for detergent/bactericidal soap, hand drying facility and nail cutter

6. **Water Supply**

- There must be adequate supply of potable water.
- Appropriate facilities for safe and clean storage of water
- Ice and steam wherever in use during processing is made from potable water
- Identifying marks must be applied to the pipelines for easy identification of potable and non-potable water.

7. **Pest Control System**

The manufacturing unit must have adequate control measures are in place to prevent insect and rodents from the processing area.

SATURATED AND UNSATURATED FATS

The main difference between saturated and unsaturated fat is their form at room temperature and their impact on your health.
Dietary fats are important for your body to stay healthy. They provide energy, protect your organs, maintain cell growth, stabilize blood pressure, and help your body to absorb certain nutrients.[1] The key is eating healthy types of fat.

Saturated fats (including a type called trans fat) tend to stay solid at room temperature and can cause fatty deposits in blood vessels, leading to atherosclerosis ("hardening of the arteries"). By contrast, unsaturated fats stay liquid at room temperature and are less likely to clog your arteries.

In addition, most unsaturated fats are derived from plant sources (like olive, avocado, and nuts), while most saturated fats come from animal sources (like red meat, poultry, and dairy).

This article takes a look at saturated vs. unsaturated fat, including examples of each and which are more likely to put you at risk of high cholesterol and heart disease. It also explains how to include each in a healthy, balanced diet.

What Is Saturated Fat?

Saturated fats are called "saturated" because of their chemical structure. All fats are made up of carbon, hydrogen, and oxygen molecules. Saturated fats are "saturated" with hydrogen atoms. They have the greatest number of hydrogen atoms possible and no double bonds in their chemical structure.

For one, this chemical structure means that, like butter, they become solid at room temperature.

Foods that contain saturated fats include:[2]

- **Animal meat** including beef, poultry, pork
- **Certain plant oils** such as palm kernel or coconut oil
- **Dairy products** including cheese, butter, milk, ice cream, sour cream, and cream cheese
- **Processed meats** including bologna, sausages, hot dogs, and bacon
- **Pre-packaged snacks and desserts** including crackers, chips, cookies, and pastries

Why Limit Saturated Fats in Your Diet

Saturated fat should make up less than 6% of your daily caloric intake, according to the American Heart Association (AHA) recommendations.[2] Limiting your saturated fat intake, especially certain types of saturated fat could improve your heart health.

Some studies have shown that consuming a high amount of saturated fats may increase your low-density lipoprotein (LDL), also known as "bad" cholesterol. Some research indicates high LDL levels can increase your risk of heart disease.[3] However, there have been other studies that say saturated fat does not actually have a negative effect on your heart.[4]

The more saturated fat you eat, the more LDL you seem to have in your body. However, some studies have shown that not all LDL is bad. Saturated fat increases the amount of large, buoyant LDL you have in your blood. These larger LDL particles do not appear to increase your risk of heart disease.

On the other hand, small, dense LDL has been shown to contribute to atherosclerosis—the build-up of plaque in your arteries—which leads to heart disease. Eating saturated fat doesn't appear to increase your small, dense LDL. In a few cases, the risk of plaque build-up even went down when saturated fat was consumed.[5]

The type of saturated fat-containing foods you eat also seems to make a difference in your heart health. One large study suggested that consuming dairy products may actually lower the risk of cardiovascular disease.[6] At the same time, including processed meats in your diet could increase your risk of cardiovascular disease.

Saturated Fat: Good or Bad?

Based on available evidence, experts disagree on how important it is to limit saturated fats in your diet. Still, the AHA does recommend limiting it. Fats from dairy products are considered a safer choice. And all experts agree that processed meats should be avoided.

Trans Fats

Although not the same as saturated fat, trans fat can also increase your risk of heart disease. Trans fat raises LDL cholesterol levels and lowers protective HDL cholesterol levels. These changes in cholesterol are associated with a higher risk of heart disease.

Trans fat can be found in small amounts in animal foods, such as red meat or full-fat dairy. But most trans fats are found in processed foods, fried foods, and commercially baked goods (pastries, pies, cookies, crackers, and other snack foods).[27]

What Is Unsaturated Fat?

Unsaturated fats are typically liquid at room temperature. They differ from saturated fats in that their chemical structure contains one or more double bonds.

They can be further categorized as:[2]

- **Monounsaturated fats**: This type of unsaturated fat contains only one double bond in its structure. Monounsaturated fats are typically liquid at room temperature and include canola oil and olive oil.

- **Polyunsaturated fats**: This type of unsaturated fat contains two or more double bonds in its structure. They are also liquid at room temperature. Polyunsaturated fats include safflower oil, sunflower oil, and corn oil.

Monounsaturated and polyunsaturated fats reduce harmful LDL cholesterol levels, reduce inflammation, and provide nutrients that your body needs to develop and maintain your cells. Polyunsaturated fats provide omega-6 and omega-3 fatty acids that are good for your heart and essential to your health.[8]

Dietary Recommendations

The American Heart Association (AHA) recommends that between 20% and 35% of your total daily calories should consist of fat.[9] Most of your intake should be from unsaturated fat. However, studies suggest that consuming only unsaturated fats may not be as heart-healthy as once thought, and consuming saturated fats may not be as harmful.[10]

Vafeiadou K, Weech M, Altowaijri H, et al. Replacement of saturated with unsaturated fats had no impact on avscular function but beneficial effects on lipid biomarkers, e-selectin, and blood pressure: Results from the randomized controlled Dietary Intervention and VAScular Function (DIVAS) study. *American Journal of Clinical Nutrition.* 2015;102(1):40-8. doi:10.3945/ajcn.114.097089

Incorporating Unsaturated Fats in Your Diet

Monounsaturated and polyunsaturated fats should make up most of your daily fat intake, according to AHA recommendations.

Examples of foods that contain unsaturated fats include:[2]

- Nuts

- Plant oils

- Certain fish like salmon, tuna, and anchovies, which contain omega-3 unsaturated fatty acids
- Olives
- Avocados

Difference between Fat and Cholesterol

Cholesterol and fats are both lipids. They are found in the food you eat, and they circulate in your bloodstream. Cholesterol has a more complex chemical structure compared to fats.

In the body, cholesterol is bound to protein as low-density lipoprotein (LDL) or high-density lipoprotein (HDL). LDL may increase your risk of heart disease, while HDL, often called "good" cholesterol, is considered to be protective against heart problems.

WHAT IS AN IODINE VALUE?

Let us look at the iodine value definition in analytical chemistry. The iodine value, also known as the iodine number, is a measure of the degree of unsaturation of fat, wax, or oil; it is expressed in gms, the amount of iodine, which is taken up by 100 gms of the fat, wax, or oil. Iodine is not taken up by saturated oils, waxes, or fats, because their iodine value is zero; however, iodine is taken up by unsaturated fats, oils, and waxes.

Saturated vs Unsaturated Fats

Fat is an ester of fatty acids found in a variety of food materials and animals. This is a hydrocarbon chain that has glycerol in one of its ends. There are usually two types of fat we find saturated and unsaturated. Saturated fats are the chain that contains all single-bonded carbon-carbon bonds. This is denoted by the C-C bond and as the carbon atoms are fully bonded with two hydrogens there is no possibility of any more hydrogen atoms being bonded with the carbon. Each carbon atom is bonded with two other carbon and two hydrogen atoms in the chain. These are very stable molecules and it is very hard for them to get emulsified. Unsaturated fats have a double or triple-bonded carbon chain in them. This leaves room for future reactions of the chain where it can get bonded with the hydrogen atoms and even get emulsified with relative ease. Each triple or double bond can be broken into a single bond and hydrogen atoms get added to the carbon atom.

When it comes to fat they have a very bad reputation as many of them are associated with life-threatening diseases like cardiovascular disease, diabetes, and obesity. But not all fats are the same and our body requires certain types of fats to carry out its day-to-day activities. They are generally saturated fats. Researchers have found that unsaturated fats have a good impact on our body metabolism and are useful in maintaining it. So the unsaturated fats are usually called good fats.

Iodine Value

The purity of fats is an important thing to measure and is mandatory by many government regulations to mention it on the packaging of food materials. The best way to find the purity of saturated/unsaturated fats is iodine value. Iodine value or Iodine number as it is commonly known as is the amount of Iodine that can react with the fat of a common mass (100 grams). This denotes the degree of unsaturation of fats. The saturated fat takes up no Iodine so their Iodine value is said to be of value zero. But the unsaturated fats have double or triple bonds which are generally very reactive towards the iodine. With the increase in double or triple bonds in carbon, the reactivity with iodine increases and it consumes more Iodine in reaction and so has a higher iodine value.

For the method of the test, a known amount of Iodine in the form of iodine monochloride is left in a beaker of 100 grams of fats, oils, or wax. This starts the reaction between them and after the reaction is over the remaining amount of Iodine is found out by titration and so we can get the amount of Iodine that reacted with the fat and that becomes the iodine value of the fat.

In summary, the Iodine Value is the degree of unsaturation of fats, oils, and wax.

Aim-DeterminationofIodineValueofFatorOil

Principle: Iodine value is a measure ofthetotalnumber ofdouble bonds present in fats and oils. It is expressed as the number of grams of iodine that will react with the double bonds in 100 grams of fats or oils. Fat or oil contains both saturated and unsaturated fatty acids. Halogens when added across the double bonds of unsaturated fatty acids form additional compounds. Iodine monochloride or monobromide is allowed to react withthe oilin dark and the Iodine gets incorporated to the fatty acid chain where double bonds are present. The quantity of iodine consumed is directly proportionate to the number of double bonds present. The amount ofunused iodine monochloride or monobromide is determined from iodine liberated on addition of excess of potassium iodide by titrating the sample with standard sodium thiosulphate usingstarch as an indicator. The measure of iodine absorbed by the oil or fat in the reaction gives the degree of unsaturation. Iodine value or number is a useful parameter in studying oxidative rancidity of oil since higher the unsaturation, the greater is the possibility of the oil to become oxidised by the atmospheric oxygen.

Materials&Reagent

- Iodine flask.
- Hanu's iodine solution: 6.8g of iodine dissolved in 412 ml of glacial acetic acid. Well powdered iodine is taken in around bottom flask. 412 ml of glacial acetic acid is added in small quantities and the flask is heated on a boiling water bath. The clear solution is decanted from time to time followed by further addition of acid until all the iodine dissolves. The solution should be prepared in amber coloured bottle.
- Brominesolution: A1.5%solutionisprepared bydissolving1.5 mlofbromine in100 ml of glacial acetic acid and preserved in amber coloured bottle.
- 15% KI solution: the solution is prepared in water and preserved in amber colouredbottle.
- Standard 0.1N sodium thiosulphate solution: an approximately 0.1N solution of $Na_2S_2O_3$is prepared by dissolving 6.2g of $Na_2S_2O_3$, $5H_2O$ in 250ml of water. The

solution is standardized against standard $K_2Cr_2O_7$solution.

- 1% starch indicator: 1g starch is made into paste with about 10ml of distilled water and the suspension is pured into 90ml of boiling water and boil for 1-2min and colled.
- Chloroform.

Method:

- Accuratelyweigh0.2to0.3goffat oroil intoa500ml iodineflask.
- Add20mlofchloformintotheflasktodissolveoil completely.
- Pipetteout 25mlofHanu's iodine solutionand5mlofbromine solutioninto the flaskand mix well. (N.B. use burette for adding Hanu's iodine solution)
- Closetheflaskwithstopperandkeepindarkfor 30mins.
- Add20mlof15% KI solutionandmix well.
- Titrate the content of the flask by standard sodium thiosulphate solution using starch asan indicator with vigorous shaking to extract the iodine from the chloroform layer.
- Continuethetitrationtilldischargeofbluecolour(end point)
- Conductabank using20mlchloroforminstead offatoroil.
- Thebottlesmustbeshakenthoroughlythroughoutthetitrationtoensurethatallthe iodine is expelled from the chloroform layer.

Calculation:

1mlof1.0N$Na_2S_2O_3$= 0.12691gofIodine

$$\text{Iodine value of fat or oil} = \frac{(V1 - V2)\text{ml} \times N \times 0.12691 \times 100}{W} \text{ g}I_2\text{/100goilorfat}$$

Where,

W= Weight of the oil or fat

V1=Titrevalueofthesample

V2= Titre value of blank

N=Normalityof$Na_2S_2O_3$

WHAT IS SAPONIFICATION?

Saponification is a chemical reaction in which aqueous alkali converts fat, oil, or lipid into soap and alcohol (e.g. NaOH). Soaps are carboxylic acids with long carbon chains, which are salts of fatty acids. Sodium oleate is a standard soap.

Saponified materials include vegetable oils and animal fats. These oily compounds, known as triglycerides, are made up of a variety of fatty acids. Triglycerides can be made into soap in one or two steps. The triglyceride is processed with a strong base (e.g. lye) in the classic one-step procedure, which cleaves the ester link, producing fatty acid salts (soaps) and glycerol.

SAPONIFICATION VALUE OR SAPONIFICATION NUMBER

The number of milligrams of potassium hydroxide (KOH) or sodium hydroxide (NaOH) necessary to saponify one gramme of fat under the stated conditions is referred to as the saponification value or saponification number (**SV** or **SN**).

It is a measurement of the average molecular weight (or chain length) of all fatty acids present as triglycerides in the sample. The smaller the average length of fatty acids, the lower the mean molecular weight of triglycerides, and vice versa, the higher the saponification value. In practise, fats or oils having a high saponification value (such as coconut and palm oil) are better for manufacturing soap.

Saponification Number of Vegetable Oils

Oil	**SN**
Babassu	241–253
Camelina	185–194
Canola	170–190
Cardoon	194

Cashew nut	168
Castor	176–187
Coconut	242–263
Corn	187–196
Cottonseed	190–207
Indian mustard	171
Jatropha	188–198
Jojoba	92–95
Karanja	189
Linseed	180–196
Mahua	187–197
Microalgal	189
Mustard	170–178
Nahor	191
Olive	187–196
Palm	200–205
Palm kernel	240–257
Peanut	184–196
Poppy seed	189–197
Rapeseed	166–198

Rubber seed	186–198
Safflower	186–203
Sesame	188–193
Soybean	189–195
Sulfur olive	193
Sunflower	186–194
Tigernut	190–194

Determining Saponification Value (Formula)

To quantify SV, the sample is saponified entirely with an excess of alkali, and the excess is measured by titration (in mg KOH/g). The molecular weight and percentage concentration of fatty acid components present in FAMEs of oil determine the saponification number. The SV is a useful tool for calculating the average relative molecular mass of oils and fats.

Glycerides, such as triglycerides, diglycerides, and monoglycerides, but also free fatty acids and other ester-like components such as lactones, consume alkali. The remaining alkali is titrated against a standard solution of hydrochloric acid at the end of the reaction (HCl). As a result, the SV (milligrams of potassium hydroxide per gram of sample) is calculated as follows:

$$SV = \frac{(B - S) \times M \times 56.1}{W}$$

where,

(B – S) is indicated as the difference between the volume (in mL) of HCl solution used for the blank run and for the tested sample;

M is defined as the molarity of HCl solution, in $mol \cdot L^{-1}$;

56.1 is indicated as the molecular weight of KOH , in $g \cdot mol^{-1}$; and

W is indicated as the weight of sample, in g.

The SV can also be estimated using gas chromatography data on fatty acid composition.

Relationship with Fats and Oils' Average Molecular Weight

A pure triglyceride molecule's theoretical SV can be computed using the following equation (where MW is its molecular weight):

*Molecular Weight (oil/fat) = (3 * 1000 * {56.1}/SV) + 38.049*

Where, 3 is the fatty acids residues per triglyceride, 1000 is a conversion factor (mg/g) and 56.1 is the molecular weight of KOH.

Three oleic acid residues are esterified to a molecule of glycerol with a total MW of 885.4 ($g \cdot mol^{-1}$) in triolein, a triglyceride found in many fats and oils. As a result, its SV is 190 (mg $KOH \cdot g^{-1}$). Trilaurin has a MW of 639 and an SV of 263, while lauric acid contains three shorter fatty acid residues.

The SV of a fat is inversely proportional to its molecular weight, as shown by the formula above. Because fats and oils contain a variety of triglyceride species, the average MW can be computed using the following formula:

$$MW_{oil/fat} = 3 \times 56,106 \div SV$$

This means that coconut oil, which is high in medium-chain fatty acids (mostly lauric), contains more fatty acids per unit of weight than olive oil, for example (mainly oleic). As a result, there were more ester saponifiable functions per gramme of coconut oil, implying that more KOH is needed to saponify the same amount of matter, resulting in a higher SV.

Fats and oils with substantial levels of unsaponifiable material, free fatty acids (> 0.1%), or mono- and diacylglycerols (> 0.1%) are not eligible for the computed molecular weight.