

ROLE OF CHEMISTRY IN EVERYDAY LIFE

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ABSTRACT

All physical and chemical processes occurring in this universe include chemistry. The living as well as non living substances may be it a goat, a cow, a brick, a stone, a bed sheet, a piece of bread, a biscuit or a drink etc. are made up of chemical compounds. All processes occurring on earth take place as a result of chemical reactions. These reactions may be spontaneous or non-spontaneous i.e. some reactions occur by themselves and for some reactions external agency is required. However in all these reactions chemistry is involved. It means that the chemical reactions or chemistry plays vital role in everyday life. The foods we eat are chemical products and the ways in which they are converted into various substances in the body is greatest chemical mystery. To study the chemistry of these processes will not be possible to cover in the present paper. However knowledge of some chemistry can help a person to take day to day decisions that affects the life processes. In the present paper efforts have been made to summarize the role of chemistry related to the liquids used by us in daily life.

KEYWORDS: Adulterants, Contamination, Purification, Chemical Processes

INTRODUCTION

Chemistry is defined as the branch of science which deals with the composition of matter, the physical and chemical changes which it undergoes and the laws which govern these changes. Due to vast area and scope and for the sake of convenience it has been broadly divided into three main branches viz. Inorganic chemistry, Organic chemistry and Physical chemistry.

- Inorganic chemistry deals with study of compounds of elements other than carbon. The entire material used in this world (except polymeric substances and substances of organic origin) are studied in this branch of chemistry.
- Organic chemistry deals with the study of compounds of carbon. Carbon forms a large number of compounds with hydrogen and along with other elements like nitrogen, oxygen, sulfur, halogens etc.
- Physical chemistry deal with the physical and chemical changes which the matter undergoes and the various principals which govern these changes.

All these branches of chemistry are closely related and are used to study the processes occurring on earth. There are some other branches of chemistry viz. analytical chemistry, industrial chemistry, pharmaceutical chemistry, chemical engineering etc. which have been designed for specific purposes. Knowledge of some chemistry can help us to make day to day decisions which affect our life processes. There are many physical and chemical processes which occur around us every day but we never pay attention to these processes. We never try to understand the nature of chemicals used in our kitchen, bed-room or toilet. There are always some simple questions in the minds of people like: Can I mix these household chemicals? Whether this soap is safe or not for new born baby? What are safe mosquito repellents? Will

my bottled water expire? Whether the food articles we are eating are safe or not? In actual practice everything is made up of chemicals. We are made up of chemicals. The clothes worn by us are made up of chemicals. The pen which we use is made up of chemicals. Drugs are chemicals. Foods are chemical products. There are many processes which occur around us every day but we never pay attention to them. Even the processes which are directly related to us, we do not try to understand them. We do not know why burning sensation occur in our eyes when we cut an onion or why does the mouth get cold while eating Ice Cream? The changes which we observe around us are caused by chemical reactions. A minor change in the composition of a compound or the change in the reaction process may become fatal to us. To avoid such a situation elementary knowledge of chemistry is necessary. It means chemistry plays vital role in everyday life.

MATERIAL AND METHODS

There are many physical and chemical processes which occur around us every day but we are never aware of them. We shall consider here some simple liquids of daily use, common types of impurities present in them, their effect on human health and methods to remove or minimize them.

Water: Water is known as universal solvent as it is essential for all forms of life. The water which we use is known as mineral water which contain optimum amount of salts dissolved in it. If the quantity of dissolved salts is too low or too high the water becomes unfit for use. Due to rapid industrialization, unorganized urbanization and uncontrolled population the contamination in water bodies has reached at an alarming stage. There are many forms of contamination of water viz. water pollution, bacterial contamination, surface water contamination, well water or ground water contamination, mineral impurities, water turbidity, waste water contamination,⁽¹⁾ non-biodegradable water contamination, colloidal water impurities etc. Contaminated water affects the entire biosphere.⁽²⁾ It causes a number of diseases which are harmful to human health. Some of these diseases are very dangerous and are difficult to cure. To minimize contamination and effect of diseases causing organisms it is suggested to boil the water before its use. The traditional methods of purification of water include filtration through winnowing sieve, filtration through cloth (common in India), filtration through clay vessels, clarification and filtration through plant material, japing stone filter methods etc. However now a days, to purify the contaminated water the modern techniques like RO or use of UV are in practice. These techniques minimize dissolved impurities in water. However these are mainly concentrated in urban areas.

Tea: This is the early morning drink for many people. It is obtained from cured leaves of the shrub⁽³⁾ *Camellia sinensis* by boiling in water. It is considered that after water it is the most widely consumed drink in the world.⁽⁴⁾ Tea is divided into different categories based upon the methods how they are processed.⁽⁵⁾ Some examples are white, yellow, green, oolong, black, post-fermented tea etc. Out of these the most common are white, green, oolong and black tea. Tea contains mainly caffeine and small amount of the bromine and theophylline.

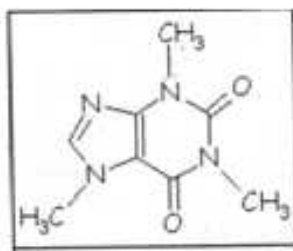


Figure 1: Caffeine

It has been found that no essential nutrients are present in black or green teas with the exception of dietary mineral, manganese as 0.5 mg per cup. It has been suggested that green and black tea may protect against cancer⁽⁶⁾ or diseases like obesity⁽⁷⁾ and Alzheimer⁽⁸⁾ but the compounds found in green tea have not been conclusively demonstrated to have any effect on human diseases.⁽⁹⁾ Multiple recent reports have found that most Chinese and Indian teas contain residues of banned toxic pesticides.⁽¹⁰⁾⁽¹¹⁾⁽¹²⁾ At the same time use of too much tea can lead to anxiety, restlessness and difficulty in sleeping. More over the impurities present in tea are also harmful. The impurities or unwanted material such as dust, fiber, wooden splinter, stones, sand particles, sometimes small glass pieces, ferrous and nonferrous particles, plastics, dead insects etc. are embedded in leaves. These particles get mixed with tea at the time of production. If not cleaned, they can cause large harm to human health. At the same time some adulterants like Prussian blue, indigo, graphite, gypsum, soapstone etc. are mixed from outside.

It is very difficult to identify adulterants mainly the colour in tea. However some simple tests can be used to detect colour in tea. One such test includes the use of microscope. The portion of the leaves can be mounted as an opaque object; the colouring matter present will appear in small dots. Artificially coloured tea can also be detected by simply rubbing a small quantity of tea between thumb and fore finger. Artificially coloured tea leaves a bright stain when rubbed. Another simple test to detect colour in tea is to fill a clear glass with cold water and then put some tea on the surface. If the colour of water changes immediately, it surely means that the tea has been dyed with some water soluble colour.

If iron filling is present in tea they can be removed by moving a magnet through the sample.

Due to pollution, fluoride and aluminum are also sometimes present in tea.⁽¹³⁾

Milk: Milk and milk products is very important constituent of food used in daily life. It is a white liquid produced in the mammary glands of mammals. It is the primary source of nutrition for the young ones of the mammals before they are able to digest other foods. Early lactation milk contains colostrums which carries the mother's antibodies that provide protection to the new born baby as well as nutrients and growth factors⁽¹⁴⁾ and reduces the risk of many diseases. Milk contains many other nutrients⁽¹⁵⁾ and the carbohydrate lactose. In almost all mammals milk is fed to infants through breastfeeding, either directly or by extracting the milk to be stored and consumed later. The formation of colostrums and the period of secretion vary from species to species. In humans World Health Organization has recommended breastfeeding for six months and breastfeeding along with some food for at least two years.⁽¹⁶⁾ In some cultures breastfeeding to children is common for three to five years or even longer.⁽¹⁷⁾ Sometimes fresh goats' milk is used as substitute of milk. But it may be harmful because it introduces the risk of child developing electrolyte imbalances, metabolic acidosis, megaloblastic anemia, and a host of allergic reactions.⁽¹⁸⁾ The milk act as a source of food and all its contents are beneficial. It is an emulsion or colloid of butterfat globules in water which contain dissolved carbohydrates and protein aggregates with minerals.⁽¹⁹⁾

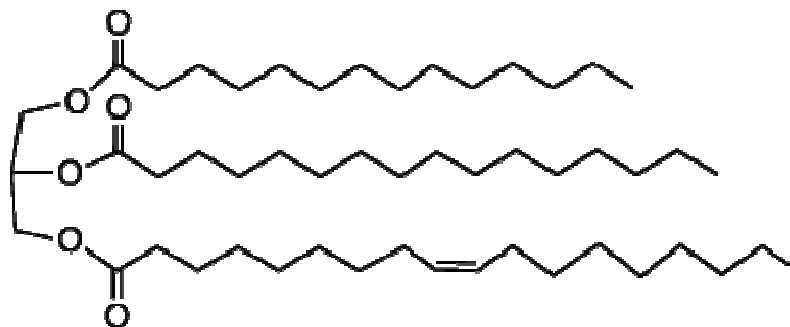


Figure 2: Butterfat

(Triglyceride (fat) formed from fatty acids such as stearic, palmitic and oleic acid.)

Milk is one of the healthiest food sources available. In fact, it is one of the most widely used food sources. It is generally known for its high content of calcium, but it is a treasure of many other vital nutrients which provide endless health benefits. Along with protein, milk contains a number of nutrients like biotin, iodine, magnesium, pantothenic acid, potassium, riboflavin, selenium and thiamine, Vitamin A, Vitamin B12, Vitamin D and Vitamin K etc. Due to the presence of a large number of nutrients, milk and its products play an important role in overall nutrition and health. It keeps bones and teeth healthy, helps in weight loss, beats stress, and builds muscles.

It means milk and milk products are essential for us and therefore we must be careful about the purity of milk and milk products. The addition of any foreign material can make the milk impure or adulterated. However, there are certain simple tests which we can perform easily to distinguish between adulterated and pure milk.

ADULTERANTS PRESENT IN MILK

Some common adulterants present in milk and methods to check them are given below

- **Water:** water is the most common liquid which is mixed in the milk. To check its presence in milk, put a drop of milk on a shiny, polished slanting surface. Milk leaves no trail behind, but if water is present in the milk, you will find a white trail behind the drop.
- **Starch:** starch may be present as an adulterant in milk. To test its presence, add a drop of iodine. Appearance of blue colour indicates the mixing of starch in the milk.
- **Vanaspati:** To check the presence of vanaspati, take 3 ml of milk in a test tube. Add 1 ml of HCl to it. Appearance of red colour after some time indicates the presence of vanaspati in the milk.
- **Detergent:** Take 5 ml of milk in a test tube. Add the same amount of water to it and shake well for some time. Appearance of lather indicates the presence of detergent.
- **Formalin:** Take about 10 ml of milk in a test tube. Pour conc. H_2SO_4 along the sides of the test tube. Do not shake. Appearance of a violet ring at the intersection indicates the presence of formalin.
- **Synthetic Milk:** Synthetic milk has a bitter after-taste, gives a soapy feeling on rubbing between the fingers and turns yellowish on heating.

Adulterants Present in Ghee/Cottage Cheese or Paneer/Condensed Milk, Khoa, Milk Powder

The common adulterants present in the above milk products are coal tar dyes and starch.

- **Coal Tar Dyes:** Take melted sample of the product. Add about 5 ml of dil. H_2SO_4 . Appearance of pink colour indicates the presence of coal tar dye. If we add conc. HCl red colour shows the presence of coal tar dye.
- **Starch:** Add a few drops of iodine to the sample; if the brown colour becomes blue, it indicates the presence of starch in the form of mashed potatoes.

Adulterants Present in Ghee/Butter

The adulterants present in Ghee or Butter and the tests to indicate their presence are given below.

- **Vanaspati:** Take a little melted ghee, add equal amount of HCl and a pinch of sugar to it. Shake well and then let it set for about 5 minutes. The appearance of crimson colour in lower layer shows the presence of vanaspati.
- **Mashed Potatoes/Sweet Potatoes:** Take a little sample in a test tube. Add few drops of iodine solution to it. If the brown colour becomes blue, it indicates the presence of massed potatoes.

Fruit Juices: The fruit juices are considered the healthiest drinks for human beings. They provide large number of nutrients including vitamins, essential elements, carbohydrates, minerals, proteins, fiber etc. to human body. However the presence of any adulterant in juice makes it not only unfit for drinking but harmful too. We shall discuss here some common juices and the adulterant present in them.

- **Orange Juice:** The orange juice is a rich source of vitamin C. Along with sugar (Approx. 8%) it supplies potassium, thiamin and folate. It is a good source of antioxidant hesperidin. The juice is acidic due to citric acid content with a pH around 3.5. The pulp of orange juice contains flavonoids.

For adulteration the juice is diluted and synthetically produced juices are mixed in it which includes other juices or sugar derived from fruits or vegetables. One adulterant which is commonly added is partially inverted sucrose in which about one- half of the sucrose has been hydrolyzed to glucose and fructose. The ratio in this mixture is approximately 1:1:2 (glucose: fructose: sucrose) which matches the ratio sugars found in actual orange juices.

- **Carrot Juice:** Carrot juice contains β -carotene which is a rich source of vitamin A. The juice also contains B complex vitamins like folate, fats, carbohydrates, fibers, protein, cholesterol and many minerals like calcium, copper, magnesium, phosphorus, iron etc. Thus carrot juice provides a number of nutrients to the body. However the carrot juice is not good for diabetic people. The sweet and enjoyable taste of carrots is due to high content of natural sugar. Therefore diabetics' people should take the carrot juice according to the advice of their doctor.

Like many products high in β - carotene, it may cause carotenoderma, a skin condition resulting an orange-yellow hue to the skin.(20) Drinking more carrot juice (above 3 cups) over a prolonged period of time may cause this condition. Diet-induced carotenemia is observed in infants and young children. Mothers may induce the condition by giving their infants large amounts of carrots in commercial infant food preparations.(21)

- **Mosambi or Sweet Lime Juice:** Citrus limetta commonly known as mosambi is a member of citrus family. It is a perfect combination of sweet and sour juice which can refresh you within no time. It can be used by chewing its pulpy flesh or by having a glass full of its yellowish green juice. Due to high content of vitamin C its juice

prevents and treat dehydration, boosts immunity and help in weight loss. It protects against arthritis, scurvy and gastrointestinal problems. It is useful in treatment of jaundice, heals peptic ulcers and boosts hair and skin health. Mosambi contains compound lemonades which fight against different types of cancers. Sweet lime remains fresh for two weeks at room temperature and four to eight weeks when refrigerated. However its juice becomes bitter after some time which is harmful.

- **Pine-apple Juice:** Pine-apple juice contains a large number of nutrients like calcium, magnesium, iron etc. It is very useful for human health. It possesses anti-inflammatory and anti- cancer properties. Its juice is useful for heart. It helps to prevent cataract and asthma. It is considered to boots fertility both in men and women. When pineapple concentrate is adulterated, organic acids are often added to “naturalize” the chemical composition which are harmful.

With today’s technology, it is not possible to detect all adulterants in juices. These tests cannot detect adulterant below 10 percent. The tests which examine sugars in the juices should be more sensitive. The tests used for this purpose generally detect adulteration rates as low as 10 to 20 percent.

RESULTS AND DISCUSSIONS

Chemistry is important branch of science. It tells about the nutrients present in different type of foods, vegetables and fruits. Thus a little knowledge of chemistry can help the people to live a healthy life. We have discussed adulteration and its effect for only few food articles. In daily life we come in contact of large number of items, we eat various types of food articles, drink several types of liquids, uses different substances of daily need such as tooth paste, toilet soaps, perfumes, oils, nail polish, shoe polish etc. Any unwanted chemical in these items may be harmful to human health. Without knowledge people suffer from various diseases. Therefore some knowledge of chemistry is necessary, otherwise we would not be able to know that the ice-cream which we are eating is safe for us or not, the cold- drink which we are drinking is not harmful for us. It means chemistry plays an important role in everyday life.

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