

REVIEW ARTICLE

Advancement of Organic Chemistry and its impact on Environment

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ABSTRACT

This brief review deals with the progress and application of chemistry, particularly the synthetic organic chemistry in our society from the ancient time. Modern society has come to depend on the different types of products of chemical industry to maintain our current standard of living and improve our quality of life. Chemicals and chemical industry affects our daily life in a number of ways. Chemistry is associated with our food, clothing, furniture and medicines. Chemistry has provided relief from deadly diseases developing vaccines, saved us from starvation by the synthesis of fertilizers, discovered various materials for our ease. Beside this, this review also deals with the different harmful effects of chemicals on the environment and nature as well as the necessity of eco-friendly atmosphere in nature.

Key words: Heterocycles, Drugs, Environment, Toxicity, Iatrochemist, Hazardous, Green chemistry, Eco-friendly.

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INTRODUCTION

The Chemistry is an integrated study of matter, its properties, interactions with other matter, composition and the changes it undergoes. This science is concerned not only with changes in the composition of matter, but also with the gain or loss of energy which accompanies such changes and the natural laws which govern these changes. Chemistry, often called the "Central Science" is concerned with atom (or subatomic domain) as building block of matter. On the other hand, analysis of matter is the backbone of chemistry. Analysis involves the chemical characterisation of matter, both qualitatively and quantitatively. Qualitative analysis of any matter or compound will tell us its chemical composition. Quantitative measurement will help us to know the amount of different components present in it.

Chemical analysis of any matter can explain its character, composition as well as properties (toxicity, carcinogenic behaviour etc.) and activities in nature. Like all other branches of science, chemistry occupies a unique place in understanding of the universe. It is the science of molecules. But organic chemistry is something more. It often studies life by making new molecules that give information not available from the molecules actually present in living things [1,7]. Role of organic compounds in our daily life and their effect on nature has created interest to the author to undertake this study.

PROGRESS OF CHEMISTRY

The beginnings of the chemistry could not be stated certainly [1]. No one can tell precisely when and how it began. But it is certain that the origin of Chemistry lies in the technical arts and crafts of primitive civilisations. The hoary civilisations of ancient Egypt, India, China and Babylon- all made positive contributions to the science of chemistry or chemical education. Of all the early civilized people, the Egyptians were a practical race and developed the art of chemistry very much. The Greek philosophers, who were no practical chemists made speculations as to the physical background of the universe. Aristotle's (384-322 B.C.), the theory of four elements, viz, fire, air, earth and water which represented but four fundamentals qualities only, was one of the earliest attempts to explain the nature of matter. In India, a system of philosophy assumed the existence of five elements, viz, khiti, apas, teas, marut, and byoma prior to Aristotle.

The vague metaphysical speculations of the ancients let alone, there are three distinct stages in the development of chemical science : they are the periods of

(1) Alchemy up to the 15th century

(2) Iatrochemistry from the 16th century up to the middle of the 17th century and

(3) Scientific Chemistry when the study of chemistry was taken up for its own sake. It is generally agreed that Chemistry had its origin in the Egyptian city of Alexandria which was a great citadel of science and culture in the beginning of the Christian era.

Alchemy in India made parallel and independent developments under the Tantric school of thoughts in the 8th century. It ended with the closing of 15th century. With the end of Alchemy, school of iatrochemist was started and the founder was Paracelsus. He stated the preparation of medicine to be only target of chemistry. Vegetable remedies were very familiar to ancient Indians. Charaka, Susruta, Nagarjuna and many others were the leading iatrochemists of India.

Renaissance in Europe in the 16th and 17th centuries created a new spirit in science. The founder of modern science is Francis Bacon. He laid stress on the inductive method of studying science. The period of scientific chemistry began with Robert Boyle. Towards the latter part of the 18th century knowledge of chemistry was largely extended through the discovery of oxygen and the principle of indestructibility of matter. In the 19th century John Dalton, Avogadro, Mendeleef, Robert Meyer, Clausius, Maxwell, Arrhenius and other scientists had great contribution in the advancement of Chemistry [1].

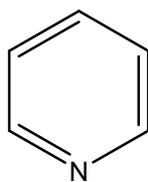
Progress in any discipline of education comes slowly and often requires the efforts of many workers. One is sometimes inspired by the findings of the others, which result in a viable solution to the problem. This is true in particular, of the modern concept of atomic structure. Matter was considered to be composed of atoms, which in turn were thought to be the smallest particle possible. Such an idea traces back to the classical times and was based mainly on the speculations of the Greek philosophers. But as scientific thought advanced and experimentation became possible, this view concerning the atom proved to be quite inadequate to explain the observed facts. Modern concept of atom commenced with the work of Dalton and finally Schrodinger's "wave equation" summed up the present concept of electron and atomic structure. Then idea about matter begins to be clear in more scientific and advanced level. It should be noted that the theory of atom was conceived in our country very early much before the Christian era, by Kanad [1,2].

Development in organic Chemistry:

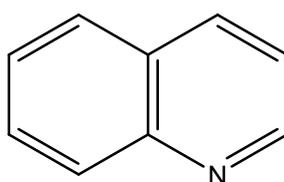
Organic chemistry made steady and phenomenal progress since 1828-the year Wohler discarded the vital force theory by the synthesis of urea from purely inorganic materials in the laboratory. The advancement of organic chemistry was mainly due to the contribution of Liebig, Kekule, Emil Fisher, Van't Hoff and many other famous scientists. In the 18th century, it was believed that organic compounds could not be prepared in the laboratory. They are god gifted and are present in naturally occurring substances, e.g., plants, animals etc. According to modern concept, organic compounds contain carbon as their essential constituent and they may have either natural or synthetic origin [1,3].

ROLE OF ORGANIC CHEMISTRY

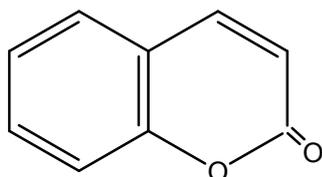
Organic chemistry has played an important role in the life of the people of 20th century [6,7]. Organic chemistry started as a tentative attempt to understand the chemistry of life. Chemists are taking the cooperation of physicists and mathematicians to understand how molecules behave and they cooperate with biologists to understand how molecules determine life processes. Our eyes are using 11-cisretinal, an organic compound to convert visible light into nerve impulses when we open our eyes. We live longer, healthier and more comfortable because of this organic chemistry. Vitamins, sugar, starch, milk, proteins, oils, fats etc. are organic compounds. Food enriched with these products goes a long way in improving the health of the individual. Life is a chemical process. In case of sickness, medicines are used to bring it in order. There are large number of synthetic and natural drug that chemists has given to medicine. Most important among these are sulpha drugs, analgesics, antipyretics, antimalarials, antibiotics etc. There are so many heterocyclic compounds containing coumarin, thiocoumarin, pyridine, pyrimidine, pyrazole, quinoline and isoquinoline moiety which are used as life saving drugs, even some of them are used in the treatment of cancer



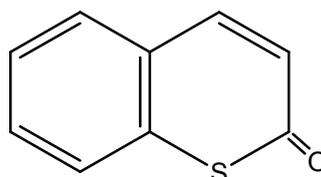
Pyridine



Quinoline



Coumarin



Thiocoumarin

and to inhibit HIV protease etc [6,11-13]. Heterocycles are important because about two-thirds of organic compounds belong to this class. Heterocyclic compounds are abundant in plant and animal products. Alkaloids, dyes, drugs, proteins, nucleic acid and enzymes etc are the important representatives of this group. Nucleic acids contain the genetic information of every organism, and they control the synthesis of protein. Nucleic acids are the polymers whose building blocks are nucleotides. Nucleotides contain three parts, a heterocyclic base, sugar and a phosphate ester [6, 7]. If we think only of drugs we can define history of medicine by heterocycles. In the 16th century quinine was used to prevent and treat malaria. The first synthetic drug was antipyrene to reduce fevers. The first effective antibiotic was sulfapyridine. The first multi-million pound drug was tagamet, the anti-ulcer drug. The most topical current drug is Viagra for the treatment of male impotence. The most important achievements at the discovery of the 21st century are new methods in medicine from collaborations between organic chemists and biologists. For example, Crixivan, a drug for the treatment of HIV was developed from joint activities of biochemists, virologists, X-ray crystallographers, molecular modellers and organic chemists [7]. Before this treatment most of the HIV patients were dead within two years. The application of medicines and drugs has increased our life span. The use of insecticide, pesticides has saved the plants from being destroyed by insects and pests. Organic compounds like urea are good fertilizers. These have brought green revolution. TNT, picric acid, gelatine, gun cotton etc. are used in the manufacture of explosives. Manufacture of vegetable fat from oil, alcohol from molasses, sugar from cane juice, paper, dyes, rubber is based on the application of organic chemistry. Cosmetics, toilets, synthetic fibres like Nylon, Terrylene, Decaron etc. are all the products of organic chemistry [6, 7].

The last century has witnessed development in science including Chemistry and society has come to depend on the products of chemical industry to maintain our current standard of living and improve our quality of life. Chemicals and chemical industry affects our daily life in a number of ways. Chemistry is associated with our food, clothing, furniture and medicines. Chemistry has provided relief from deadly diseases developing a lot of vaccines, saved us from starvation by the synthesis of fertilizers, particularly ammonia (increasing the production of crops), discovered various materials for our comfortable life. Beside the plant and animal kingdom, two chief sources of organic compounds are namely, petroleum and coal tar. Coal tar provides a rich source of industrial chemicals. The main source of chemicals available to 19th century chemists was coal. Distillation of coal to give gas for lighting and heating also gave a brown tar rich in aromatic compounds such as benzene, pyridine, phenol, aniline and thiophene etc. In the 20th century oil overtook coal as the main source of organic compounds. Petroleum is a complex mixture of hydrocarbons along with some N, S derivatives. Important compounds obtained from these sources are drugs, perfumes, sugar, rubber, oils, fats, proteins, insecticide, dyes, lubricants, refrigerants, fuels and explosives. Our present life style depends very much on the application of those compounds obtained from different sources [2].

Impact on environment:

However, this widespread manufacturing without maintaining proper quality, condition and no judicious application of chemicals particularly in food processing, agriculture etc. has resulted in an adverse impact on the nature and environment, causing depletion of ozone layer, global warming, pollution in water(

rivers, lakes even in ground water), pesticide residues in food and water can damage ecosystem in nature. Any material in undesirable amount will disturb the balance in ecosystem [2]. To save our nature and existence, awareness of proper chemical education is very essential. Proper chemical education will help us to know the exact nature of matter. If we want to know the chemistry properly, we have to take proper education from nature. The rapidly growing population has put pressure on natural resources like air, water, land, forest etc. This has led intensive agriculture, urbanisation and industrialization which have direct impact on the environment and nature. Man has himself created an environment which is not at all eco-friendly. So man should adopt necessary steps to ensure sustainable development for him and future generation. Nature has its own cleaning systems in the form of chemical reactions which were effective and self sustaining before industrial revolution. Human activity is now producing huge amounts of new types of particulates, gaseous pollutants and industrial effluents and other non-biodegradable substances which nature cannot fully absorb or clarify and it will disturb the balance in ecosystem. Proper knowledge will help us to distinguish between eco-friendly and non eco-friendly chemicals or any compound. Ultimately, we should be very careful about the effect of every chemical on the nature and environment. If environment is disturbed, life of us including bacteria, fungi, plants and other living organisms will be disturbed and their existence will be questionable. Eco-friendly organic chemistry may be defined as the invention, design, development and application of chemical products and processes to reduce or eliminate the substances hazardous to human health and environment. This is also termed as green Chemistry [8,10].

CONCLUSION

To satisfy the objectives of green Chemistry and save our nature, we have to use starting materials and solvents in chemical reaction that are less polluting. Also we have to use raw materials more efficiently so that less waste is generated. In industry, large amounts of gases like carbon monoxide, carbon dioxide, sulphur dioxide and oxides of nitrogen are produced due to burning of fossil fuels such as coal and oil. Hydrogen sulphide gas is evolved during petroleum refining, in coke ovens, manufacturing of dyes, tanning industry, rayon manufacturing plants etc. Release of chlorine occurs from the industrial processes like manufacture of paper, plastics, chlorinated hydrocarbons, dyes, chlorochemicals and bleaching of cotton pulp etc. To be eco-friendly, waste and also the use of toxic and dangerous chemicals should be avoided, compounds which perform better and are biodegradable should be produced. It is better to use renewable materials. An effective method to reduce undesirable chemicals is to increase the green cover, especially broad leaved plants which can reduce various pollutants. Pollution prevention involves technologies that will improve the environment and our quality of life and it will avoid the formation and the use of hazardous substances.³⁻⁵

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