

Mikhailo Slivka, Yurii Farinuk, Ruslan Mariychuk

ORGANIC CHEMISTRY

**Organic chemistry for students of ecological
specialities**

Handbook

Prešov – 2021

This handbook contains material that is useful for students to prepare for workshops, modul control and exams – it contains summarized schemes and theoretical issues of program material of Organic Chemistry.

Handbook is intended for students of ecological specialties of universities.

Authors: Mikhailo Slivka
Yurii Farinuk
Ruslan Mariychuk

Reviewers: Assoc. Prof. Michajlo Onysko, DrSc.
Prof. Sergii Sukharev, DrSc.

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PREFACE

Organic chemistry in higher educational institutions is a basic discipline of teaching, necessary for the thorough mastering of fundamental disciplines of chemical profile – general and inorganic chemistry, analytical chemistry, physical chemistry. Organic chemistry is a "molecular tool" in the study of components of living matter and is a necessary basis for the study of chemistry of natural compounds, bioorganic chemistry, medical and pharmaceutical chemistry, green chemistry. At the present stage of development of science, there is a deep interpenetration of these sciences, which leads to the emergence of new scientific areas that study the surrounding world of wildlife.

The purpose of the publication: to provide students with basic knowledge, skills and abilities in the field of theoretical and applied organic chemistry, which are necessary for the development of scientific and methodological worldview, mastering general chemical disciplines and training at the modern level, mastering the most important methods of scientific experiment, skills, their use in the synthesis, isolation, purification and identification of organic compounds. The handbook is primarily aimed at students majoring in "Ecology and Environmental Protection" and is based on the principle of initial teaching of fundamental theoretical principles of organic chemistry, followed by a description of methods of obtaining and chemical properties of important classes of organic substances involved in natural processes and those that may be potential contaminants. The handbook presents the main theoretical principles of organic chemistry: classification and isomerism of organic substances, the nature of chemical bonds, the mutual influence of atoms in organic molecules, spatial structure and geometry of molecules, acid-base properties of organic substances, and mechanisms of organic reactions.

When considering the most important classes of organic compounds by functional groups, attention is paid to the methods of their production, chemical properties and practical application because organic substances have become dominant in human activities. Considerable attention is paid to hetero-functional and aromatic compounds, as most of the materials that accompany human life and its impact on the environment, in their structure contain the above compounds. Separate sections provide information on some important classes of organic compounds, the use, production and properties of which are often associated with the emergence of environmental problems. The presentation of the material is illustrated with the necessary drawings, diagrams and tables.

The handbook is recommended both for students majoring in "Ecological and Environmental Sciences" and non-chemical specialties.

INTRODUCTION TO ORGANIC CHEMISTRY

A History of Organic Chemistry

Conscious acquaintance of man with organic compounds began about 4000 years ago, when there is information about the first recipes for making alcoholic beverages (wine, beer), about dyeing fabrics with natural dyes (indigo, purple), about the extraction of various oils, perfumes, fats, and later and drugs.

Formally, the development of organic chemistry in historical perspective can be divided into five periods:

- Empirical (4000 years ago – early eighth century)
- Alchemy (early eighth – end of the eighteenth century)
- Analytical (end of eighteenth – the middle of the nineteenth century)
- Structural (second half of the nineteenth – early of the twentieth century)
- Modern (early twentieth – to these days).

The phase of long accumulation of factual material in the process of practical human activity was preceded by Empirical period. For example, in Egypt and India the art of dyeing cloth with natural dyes have been developed long ago. The ancient Romans and Egyptians were able to make the soap. Since ancient times people used the fermentation process to produce alcoholic beverages. Many natural substances were applied in ancient medicine.

The next epoch of organic chemistry, known as the Alchemy Period, was characterized by the empirical study of organic matter, and later by the isolation and purification of individual organic substances (for example, ethyl alcohol was obtained individually by English monks from fermentation products in the 10th century AD). During the Alchemy Period – the knowledge of organic matter was evolving very slowly. In this period the researchers have not noticed the difference between substances, isolated from inanimate nature, and substances, derived from plants and animals. However, later they began to pay attention to different stability and chemical behavior of substances of animate and inanimate nature, resulting division of chemistry (second half of XVII century) on mineral chemistry and chemistry of plants and animals. By the end of the eighteenth century the notable success in obtaining individual organic compounds, isolated from plants have been achieved: tartaric, citric, malic, lactic, mucous acids (Scheele, 1769-1785) and other substances. A number of organic compounds of animal origin were received – urea (Rouelle, 1773), uric acid (Scheele) and others. However, in the Empirical Period all studies were carried out lacking clear theoretical knowledge but through trial and error.

At the end of XVII – early XIX century the main attention of chemists was focused on studying the qualitative and quantitative composition of received

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doc. Ruslan Mariychuk, CSc.

Reviewers: Assoc. Prof. Michajlo Onysko, DrSc.
Prof. Sergii Sukharev, DrSc.

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