



THE ROLE OF ANALYTICAL CHEMISTRY IN THE FORMATION OF PROFESSIONAL COMPETENCES IN THE TRAINING OF PHARMACIST STUDENTS

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Abstract. *The paper describes the role of the discipline "Analytical Chemistry" in the preparation of masters of pharmaceutical education, assimilation and acquisition by them specified in the educational and professional program "Pharmacy" of the second (master's) level of higher education, specialty 226 "Pharmacy, industrial pharmacy" field of knowledge 22 "Health care" I", educational qualification: master of pharmacy, industrial pharmacy and professional qualification: pharmacist, a number of integral, general and professional competencies. Programmatic learning outcomes for higher pharmaceutical education in specialty 226 "Pharmacy, industrial pharmacy" and possible learning outcomes in the process of studying the academic discipline "Analytical Chemistry" are displayed. Professional competences were analyzed through the prism of acquired knowledge, abilities and skills during the study of analytical chemistry at the Bukovyna State Medical University.*

Keywords: *professional competences, pharmaceutical education, analytical chemistry, study results.*

Introduction.

A significant contribution to the development of modern pharmaceutical education in Ukraine is the introduction and application of innovative methods and approaches in education, international standards and principles in compliance with regulatory and legal requirements. The main task of higher pharmaceutical education is the training of professionally competent and competitive specialists who are capable of self-development and self-education.

One of the fundamental chemical disciplines in the process of training pharmacists in higher medical institutions of Ukraine is the discipline "Analytical Chemistry", which is one of the basic disciplines in the system of higher pharmaceutical education. The discipline "Analytical Chemistry" in the professional training of future pharmacists and pharmacists lays the foundations for the formation of programmatic, general, professional or special competencies, in accordance with the requirements of the educational and professional program "Pharmacy, Industrial Pharmacy" of the second (master's) level of higher education, specialty 226 "Pharmacy, Industrial pharmacy", fields of knowledge 22 "Health care" [1,2]. The requirements set out in the educational program regarding the acquisition of a list of competencies during training, as well as the corresponding program learning outcomes, are aimed at the development of professional competencies in the pharmaceutical field and are adapted according to the requirements of employers not only in the field of sales of medicinal products, but also in their industrial production and quality control of medicinal products. The course of analytical chemistry at the pharmaceutical faculties is a basic subject due to the direct connection to the study of such subjects as "Pharmaceutical chemistry", "Drug technology", "Biochemical



chemistry", "Clinical laboratory diagnostics", "Toxicology", "Standardization of medicinal means" and others [3- 5].

Main text.

The purpose of teaching the discipline "Analytical Chemistry" is the formation of students' systematic theoretical knowledge of the basics of qualitative and quantitative chemical analysis, as well as the acquisition of practical skills and abilities aimed at the possibility of identifying unknown chemical substances (components of medicinal products) or compounds using modern methods of analysis. In accordance with the goal, the main tasks that must be solved during the study of analytical chemistry are formulated:

- to form students' knowledge of the theoretical foundations of qualitative and quantitative methods of analysis;
- ensure that students master the technique of performing basic analytical operations;
- teach students to work with the main types of equipment used in chemical and pharmaceutical analysis;
- to teach students to apply the acquired knowledge for the analysis of medicines and chemicals;
- teach how to evaluate the results of an analytical experiment using mathematical processing;
- to form chemical-analytical thinking in order to use the most rational method of analysis to solve a specific analytical task, develop a research plan and perform an experiment.

The regulatory document "Educational and professional program" defines the list of general and special (specialist) competencies that should be obtained by student pharmacists in the process of studying analytical chemistry and correspond to the program learning outcomes [6].

In accordance with the highlighted main tasks of studying analytical chemistry in the specialty 226 "Pharmacy, Industrial Pharmacy" at the Bukovyna State Medical University at the Faculty of Pharmacy and according to the requirements of the Standard, the discipline ensures that students acquire the following competencies:

- *integral*: the ability to solve typical and complex specialized problems and to critically consider and solve practical problems in professional pharmaceutical or research and innovation activities using the provisions, theories and methods of fundamental, chemical, technological, biomedical and socio-economic sciences; integrate knowledge and solve complex issues, formulate judgments based on insufficient or limited information; clearly and unambiguously convey one's own knowledge, conclusions and their validity to a professional and non-professional audience.

- *general*: ZK 01. Ability to abstract thinking, analysis and synthesis; ZK 02. Knowledge and understanding of the subject area; understanding of professional activity; ZK 05. Ability to evaluate and ensure the quality of performed works.

- *special (professional, subject)*: FC 01. Ability to integrate knowledge and solve complex problems of pharmacy in broad or multidisciplinary contexts. FC 02. Ability to collect, interpret and apply data necessary for professional activity,



research and implementation of innovative projects in the field of pharmacy. FC 09. The ability to identify medicinal products, xenobiotics, toxins and their metabolites in biological fluids and body tissues, to conduct chemical and toxicological studies for the purpose of diagnosing acute poisoning, drug and alcohol intoxication; FC 18. Ability to develop and evaluate methods of quality control of medicinal products of natural and synthetic origin, including active pharmaceutical ingredients, medicinal plant raw materials and auxiliary substances using physical, chemical, physico-chemical, biological, microbiological and pharmaco-technological methods; carry out standardization of medicinal products in accordance with current requirements [7-8].

Accordingly, according to the requirements of the "Educational and Professional Program" in the specialty 226 "Pharmacy, Industrial Pharmacy", the following learning outcomes are allocated: PRN 01. To have and apply specialized conceptual knowledge in the field of pharmacy and related fields, taking into account modern scientific achievements; PRN 02. Critically consider scientific and applied problems in the field of pharmacy; PRN 03. Have specialized knowledge and skills/skills for solving professional problems and tasks, including for the purpose of further development of knowledge and procedures in the field of pharmacy; PRN 11. Determine the advantages and disadvantages of drugs of natural and synthetic origin of various pharmacological groups, taking into account their chemical, physicochemical, biopharmaceutical, pharmacokinetic and pharmacodynamic features and the type of dosage form. Recommend to consumers medicinal products and other products of the pharmacy assortment with the provision of advisory assistance and pharmaceutical care; PRN 23. Determine the main chemical and pharmaceutical characteristics of medicinal products of natural and synthetic origin; choose and/or develop quality control methods for the purpose of their standardization using physical, chemical, physicochemical, biological, microbiological and pharmacotechnological methods in accordance with current requirements.

As a result of studying the academic discipline "Analytical Chemistry", the applicant must:

1) to know: basic concepts and laws underlying analytical chemistry; the main stages of the development of analytical chemistry, its current state; the main provisions of the theory of ionic equilibria in relation to acid-base, redox, precipitation and compleximetric reactions; methods and methods of qualitative analysis; methods, techniques and methods of performing chemical and physico-chemical analysis to establish qualitative composition and quantitative determinations; methods of detecting cations and anions; methods of separation of substances (chemical, chromatographic, extraction); the basics of mathematical statistics regarding the assessment of the correctness and reproducibility of the results of quantitative analysis; safety rules when working in a chemical laboratory; the role and significance of analytical chemistry methods in pharmacy, in the practical activity of a pharmacist; main literary sources, reference literature on analytical chemistry;

2) be able to: use measuring utensils, analytical scales; to possess the technique of performing basic analytical operations in the qualitative and quantitative analysis



of a substance, to prepare and standardize solutions of analytical reagents; select an average sample, draw up an analysis scheme, carry out qualitative and quantitative analysis of the substance within the limits of using the main techniques and methods provided by the program; work with the main types of devices used in analysis (microscopes, photoelectrocolorimeters, spectrophotometers, potentiometers, conductometers, polarimeters, etc.); choose the optimal method of qualitative and quantitative analysis of a substance; to construct titration curves and to establish on their basis the volumes of titrant used for each component of the mixture; separate cations and anions by chemical and chromatographic methods; conduct laboratory experiments, explain the essence of specific reactions and their analytical effects, draw up report documentation based on experimental data; perform initial calculations, final calculations using statistical processing of quantitative analysis results; work independently with educational and reference literature on analytical chemistry;

3) demonstrate: the ability to choose the optimal method of qualitative and quantitative analysis of a substance; the ability to argue the choice of methods of conducting experimental research and appropriate methods for performing the research task, analyze the obtained results, draw the necessary conclusions; demonstrate the skills of searching, processing and analyzing information from various sources, competently display and present the results of professional (pedagogical, scientific, innovative) activities using modern information technologies; the ability to use modern methods of analytical chemistry, the use of which in the analysis is dictated by the requirements for identification and classification tasks that can be solved using modern tools.

Students of the Faculty of Pharmacy of Bukovyna State Medical University (BSMU) study analytical chemistry in the 2nd year in the 3rd and 4th semesters. 240 hours are allotted for the study of the academic discipline "Analytical Chemistry". The discipline program is structured into two modules. Each module includes content modules: Module I "Qualitative analysis", which consists of three content modules and Module II "Quantitative analysis. Instrumental methods of analysis", which consists of five content modules.

The amount of study load in the study of analytical chemistry, which is necessary to obtain the specified learning outcomes, is described for students in 8 ECTS credits - credit credits, which are credited to students upon successful assimilation of modules (credit credits). It is important to note that the assimilation of the credit includes all types of the student's educational work, both classroom work: lecture, practical, laboratory, seminar, as well as independent work, performance of individual work.

For high-quality assimilation of information from the discipline "Analytical Chemistry" taking into account student-centered and problem-oriented learning at the Bukovyna State Medical University, the educational process is carried out in the form of lectures, practical and laboratory classes, consultations, independent study based on textbooks, manuals, methodological instructions, BSMU distance learning server, periodical scientific publications, use of the Internet, as well as individual research work [9].



In the 1st module "Qualitative analysis", special attention is paid to the study of analytical reactions for the detection of cations and anions, which are included in the State Pharmacopoeia of Ukraine to help students in mastering professional disciplines. And the list of practical works is selected so that students can learn practical skills as much as possible. When studying module II "Quantitative analysis", special attention is paid to the study of pharmacopoeial chemical and physicochemical methods of analysis. In the practical classes of the II module, laboratory work is performed on the study of the quantitative composition of medicinal products using pharmacopoeial methods of analysis.

Conclusion.

In the course of carrying out all types of work in the educational process during the study of analytical chemistry modules, students have the opportunity to learn and acquire integral competences through the ability and ability to solve typical and complex specialized problems, to critically consider and solve practical problems in professional pharmaceutical or research innovative activity with the application of provisions, theories and methods of fundamental chemical, technological, biomedical sciences; integrate acquired knowledge and solve complex issues, formulate judgments based on insufficient or limited information, clearly and unambiguously convey own knowledge, conclusions and their validity to professional and non-professional audiences. The acquisition of general competences is primarily based on students' ability to think abstractly, assess the quality of the work performed, understand and know the subject area and professional activity. Professional competences include the ability to collect, interpret and apply data that is necessary for professional activity, the ability to identify medicinal products, conduct chemical research, develop methods for performing experimental tasks using physical, chemical and physico-chemical methods. Choose optimal methods for qualitative and quantitative analysis of a substance and work with the devices used in the analysis.

The formation of professional, general and integral competencies in the educational process of training future masters of pharmacy involves taking into account not only basic theoretical and practical knowledge of chemical disciplines, in particular analytical chemistry, but also must take into account interdisciplinary integration throughout the entire educational process and must meet the requirements of today, regarding changes and innovations in the pharmaceutical industry of Ukraine.

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