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PECULIARITIES OF TEACHING THE ACADEMIC DISCIPLINE “PHARMACEUTICAL BIOTECHNOLOGY” AT THE FACULTY OF PHARMACY

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ОСОБЛИВОСТІ ВИКЛАДАННЯ НАВЧАЛЬНОЇ ДИСЦИПЛІНИ «ФАРМАЦЕВТИЧНА БІОТЕХНОЛОГІЯ» НА ФАРМАЦЕВТИЧНОМУ ФАКУЛЬТЕТІ

Abstract. The article highlights the current issues of organizing and improving the experience of teaching process the normative discipline “Pharmaceutical Biotechnology” for students of specialty 226 “Pharmacy, Industrial Pharmacy”, who are studying at the second (master's) level in the field of study 22 “Health Care”. The main objective of the course is to develop professional skills of future pharmacists, including the ability to ensure the quality of technological processes, as well as participate in organising and implementing the production of medicines of biotechnological origin in accordance with the requirements of good manufacturing practice (GMP), and to make a reasonable choice of technologies and equipment. Particular attention is paid to the relevance of this discipline, its impact on the formation of professional competence of students, their critical thinking and ability for continuous learning, the introduction of practice-oriented methods in the training of future specialists. Considering the rapid development of biotechnology as a science and the growing need of the pharmaceutical industry for highly qualified specialists, special importance is attached to improving the content of the curriculum, the introduction of interactive teaching methods, digital technologies, interdisciplinary connections and a practice-oriented approach. The emphasis is on the role of this discipline in forming in students a modern understanding of biotechnological processes used in the production of medicinal products of biological origin. The importance of constant updating of educational content in accordance with modern achievements of biotechnological science and the needs of pharmaceutical practice is emphasized. It's concluded that effective teaching of pharmaceutical biotechnology contributes to the training of competitive specialists capable of working in the conditions of innovative development of pharmacy.

Key words: biotechnology, pharmacy, teaching, pharmaceutical production, education.

Анотація. У статті висвітлено актуальні питання організації та вдосконалення процесу викладання нормативної дисципліни «Фармацевтична біотехнологія» для студентів спеціальності 226 «Фармація, промислова фармація», які здобувають освіту на другому (магістерському) рівні за напрямом 22 «Охорона здоров'я». Основна мета курсу – формування у майбутніх фармацевтів професійних навичок, зокрема здатності забезпечувати якість виконання технологічних процесів, брати участь в організації та здійсненні виробництва лікарських засобів біотехнологічного походження відповідно до вимог належної виробничої практики (GMP), а також здійснювати обґрунтований вибір технологій і обладнання. Особливу увагу приділено актуальності цієї дисципліни, її впливу на формування професійної компетентності здобувачів освіти, їх критичного мислення і здатності до безперервного навчання, впровадженню практикоорієнтованих методів у підготовці майбутніх фахівців. Враховуючи стрімкий розвиток біотехнології як науки та зростаючу потребу фармацевтичної галузі у висококваліфікованих фахівцях, особливе значення надається вдосконаленню змісту навчальної програми, впровадженню інтерактивних методів викладання, цифрових технологій, міждисциплінарних зв'язків і практикоорієнтованого підходу. Акцентовано увагу на ролі цієї дисципліни у формуванні у студентів сучасного уявлення про біотехнологічні процеси, що використовуються у виробництві лікарських засобів біологічного походження. Підкреслюється важливість постійного оновлення навчального контенту відповідно до сучасних досягнень біотехнологічної науки та потреб фармацевтичної практики. Зроблено висновок, що ефективно викладання фармацевтичної біотехнології сприяє підготовці конкурентоспроможних фахівців, здатних працювати в умовах інноваційного розвитку фармації.

Ключові слова: біотехнологія, фармація, викладання, фармацевтичне виробництво, освіта.

Introduction. In the context of modern pharmaceutical education, one of the main challenges is to ensure high-quality training of specialists for the pharmaceutical industry. An important component of this process is the introduction of an interdisciplinary approach that promotes the integration of knowledge from various scientific and practical areas, and innovative approaches to the educational process that combine theoretical training with practical activities. This contributes to the development of communication skills, critical thinking, and lifelong learning skills. Such an approach allows students to develop a holistic and deep understanding of the educational material. As a result, students not only master the theoretical foundations but also acquire the skills of practical application in real life, which is especially important for training specialists who will work in complex and dynamic conditions of industrial pharmaceutical production (Lysenko, 2023, p. 151; Lysenko & Hnatenko, 2024, p. 36).

The training of specialists in the field of pharmacy includes the study of a wide range of specialized disciplines, including Drug Technology, Pharmacology, and Pharmaceutical Chemistry. At the same time, within the specialty “Pharmacy, Industrial Pharmacy”, in order to form a base of knowledge and skills necessary for professional activity in the conditions of modern pharmaceutical production, it is essential to study the discipline “Pharmaceutical Biotechnology”. Given the rapid development of biotechnological methods in the development of medicines, a future pharmacist must have thorough knowledge not only of classical pharmacology but also understand the mechanisms of production, quality control, and the effects of biological products, including recombinant proteins, monoclonal antibodies, vaccines, etc.

Modern biotechnology is gradually replacing traditional methods of manufacturing medicines, opening up new prospects in the pharmaceutical industry. Biotechnological processes are used to produce genetically engineered proteins (including interferons, interleukins, insulin, vaccines), enzymes, diagnostic products (test systems for detecting drugs, hormones), as well as vitamins, antibiotics, biocompatible materials, and other products. The share of biotechnology-based medicines in the total volume of pharmaceutical products is steadily increasing (On the approval of the Strategy for the Development of Higher Education in Ukraine for 2022–2032, 2022).

The creation of high-tech production of pharmaceutical biological products requires highly qualified specialists who are proficient in modern biotechnological methods, are well aware of European quality standards for medicines, and understand the specifics of their industrial production.

The aim – to analyze the peculiarities of teaching the discipline “Pharmaceutical Biotechnology” to students of the Faculty of Pharmacy.

Theoretical framework. The purpose of studying the discipline “Pharmaceutical Biotechnology” is to form a holistic view of the key stages of development and formation of pharmaceutical biotechnology in Ukraine, to master modern approaches to the manufacture of medicines in various forms using biotechnological methods – microbial synthesis, cellular technology, genetic engineering – as well as to get acquainted with the main equipment used in biotechnological production (Krasnopolsky & Pylypenko, 2022).

Pharmaceutical biotechnology as an academic discipline is based on fundamental knowledge of such subjects as physics, organic and inorganic chemistry, physical and colloidal chemistry, biochemistry, biology with genetics, microbiology, pharmaceutical chemistry, drug technology and others. This discipline forms the basis for further knowledge acquisition and promotes the development of skills for practical application both in the process of further education and in future professional activities.

According to the curriculum, the discipline is taught in the eighth semester, at the stage when students already have a solid professional foundation and are equipped with knowledge of drug technology, pharmaceutical chemistry, pharmacology, and other pharmaceutical disciplines. In fact, the discipline is taught to already well-prepared students who have a considerable stock of theoretical knowledge and are motivated to learn a new subject, so the main task of the teacher remains to systematize and supplement the knowledge previously acquired (Course materials “Pharmaceutical Biotechnology”, 2025; Korda et al., 2021). The discipline is designed to last 90 hours, including 20 hours of lectures, 30 hours of practical classes, and 40 hours of independent work. The curriculum includes lectures, practical classes, and independent work. Lecture topics cover both general and special aspects of the discipline. Teaching is based on relevant scientific and practical data, which contributes to the formation of the necessary level of theoretical knowledge. In accordance with the curriculum, 10 lectures and 5 practical classes are planned, covering the following topics (Table 1).

According to the curriculum, 40 hours are provided for independent student work. The main purpose of independent work is to master issues not included in lectures and practical classes. The quality of mastering this discipline depends not only on attending lectures and preparing for practical classes but also on independent study, self-discipline, and motivation.

Thus, the topics of lectures, practical classes, and independent work cover key issues that must be mastered by higher education students while studying this discipline and form an important basis for their future professional activities.

The following teaching methods are used when studying the discipline “Pharmaceutical Biotechnology”: verbal (storytelling, conversation, expla-

Table 1

Topics covered in the study of the discipline “Pharmaceutical Biotechnology”

№	Name of theme
1	History of pharmaceutical biotechnology. The main stages of development of pharmaceutical biotechnology. The role of domestic scientists in the formation and development of pharmaceutical biotechnology. Basic concepts and methodology of the subject. Classification of dosage forms obtained by biotechnological methods.
2	Bio-objects and methods of pharmaceutical biotechnology. Main stages of the biotechnological process
3	Technology for obtaining antibiotic drugs
4	Obtaining enzymes by biotechnological methods. Use in medicine
5	Hormonal drugs obtained by biotechnological methods. Principles and stages of production, dosage forms
6	Production of drugs from human and animal blood
7	Biotechnological production of drugs from microorganism metabolites–amino acids and vitamins
8	Immunobiotechnology. Technology for the production of immunological preparations (vaccines, toxoids, serums, immunoglobulins, and diagnostic agents based on them)
9	Phyto- and zoobiotechnology: objects and methods; ways of use
10	Probiotics. Bacteriophages. General characteristics, preparations, production

nation), practical (technological scheme, practical work), explanatory and illustrative (lectures, educational literature, videos, etc.), inductive, deductive, analytical, reproductive, problem-based, heuristic, and research. The use of interactive technologies for collective group learning (general circle, microphone, brainstorming, case method, etc.) facilitates better assimilation of the educational material; situational modeling technologies (simulation or imitation, prose court); technologies for working through discussion questions (defining a position, defending it, changing a position, debates, talk shows, etc.); elements of distance learning (MS Teams service) (Pavliuk, 2022; Stechyshyn & Denys, 2020). As a result of studying the discipline “Pharmaceutical Biotechnology,” higher education students will be able to analyze the practical use of biotechnological processes for the industrial production of valuable products of microorganisms and other biotechnological objects, their biomass, useful substances, and medicines, as well as preventive and diagnostic agents based on them, which are used in various fields of medicine and pharmacy; carry out various technological processes of biotechnological production and manufacture of medicines; maintain optimal conditions for the biosynthesis of the target product and solve situational problems in case of deviations from these conditions; participate in the production of finished dosage forms and diagnostic preparations from medicinal substances of microbiological origin, select optimal storage conditions for therapeutic and diagnostic preparations and evaluate their quality during long-term storage, conduct research on improving the biotechnological process in order to obtain a high-quality final product.

When developing the teaching materials for the discipline “Pharmaceutical Biotechnology,” the most up-to-date data was used, in accordance with current

legislation in the field of pharmacy. When developing topics for practical classes, guidelines on obtaining medicinal products by biotechnological means in accordance with good practice requirements (Dub, Pokotylo, & Budniak, 2025; Nastanova ST-N MOZU 42-8.1:2013) textbooks, and scientific works (Nastanova ST-N 42-8.0:2013; Smoilovska et al., 2023) were used.

Conclusions and Prospects for Further Research. The teaching of “Pharmaceutical Biotechnology” at the Faculty of Pharmacy forms a solid understanding of the conceptual foundations of pharmaceutical biotechnology in Ukraine, modern technological approaches to medicine creation using biotechnological methods, and knowledge of the main equipment used in biotechnological production.

Well-structured educational material ensures a clear distinction between theoretical and practical parts of the course, providing logical consistency and thematic integrity. A systematic and comprehensive methodological approach is the key to the formation of in-depth theoretical knowledge, practical skills, and professional competencies in masters of pharmacy. The use of problem-based learning, interactive methods, and information and communication technologies improves the quality of the educational process and contributes to the training of competitive specialists.

Pharmaceutical biotechnology is an important discipline for forming modern specialists in the field of pharmacy. Teaching this course to 4th year students should be based on an interdisciplinary approach, with the involvement of modern information and communication technologies and the mandatory introduction of practical training. This contributes to the development not only of knowledge but also of skills and professional qualities necessary for future work in the pharmaceutical industry.

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