FACULTY OF PHARMACY

STUDY PROGRAM PHARMACY

CHAIR OF PHARMACOGNOSY AND PHARMACEUTICAL BOTANY

APPROVED
at the meeting of the Commission for Quality Assurance and Evaluation of the Curriculum in Pharmacy
Minutes No. 2 of 09.11.2021
Chairman, associate professor, PhD of pharmacy
Uncu Livia _____

APPROVED
at the Council meeting of the Faculty of Pharmacy
Minutes No 3 of 16.12.2021
Dean of Faculty, associate professor, PhD of pharmacy
Ciobanu Nicolae _____

APPROVED
at the meeting of the Chair of pharmacognosy and pharmaceutical botany
Minutes No. 27 of 30.06.2021
Head of chair, professor, Dr. hab. of biol.
Calalb Tatiana _____

SYLLABUS

DISCIPLINE **BIOTECHNOLOGIES ON MEDICINAL PLANTS**

Integrated studies

Type of course: **Optional discipline**

Curriculum was elaborated by author:

Calalb Tatiana, Dr. hab. of biol., professor

Chisinau, 2021

I. INTRODUCTION

- General presentation of the discipline: place and role of the discipline in the formation of the specific competences of the professional/specialty training program

The discipline Biotechnology *in vitro* on medicinal plants is intended for 3ed-year students to complement knowledge with information of cell and tissue culture *in vitro*. The knowledge will contribute to the training of the contemporary pharmacist specialist, because today the modern biotechnologies *in vitro* represent the bioindustries of producing active principles for pharmacy, cosmetics in continuous flow, ecologically controlled conditions, regardless of seasonal rotation and natural calamities. Students will be familiar with the *in vitro* techniques of multiplication of the avirotic material of medicinal plants.

This knowledge will serve as a basis for understanding the principles of biotechnological technologies to produce the current generation of drugs and foods in the era of modern *in vitro* biotechnology.

- Mission of the curriculum (aim) in professional training

To familiarize future pharmacists-specialists with *in vitro* cellular and tissue microtechniques, which form the basis of modern biotechnologies to produce active principles and modern microtechniques for *in vitro* plant multiplication, homogenous and avirotic material for industrial herb plantations.

This knowledge is needed to educate students about a modern vision of the production of contemporary food and medicine based on *in vitro* microtechniques, because *in vitro* cellular and tissue cultures serve as new sources of non-traditional raw material for biotechnological products, which in the near future will be the basic component of the food, pharmaceutical and cosmetics industry.

- Languages of the course: English, Romanian;
- Beneficiaries: students of the IIIth year, Faculty of Pharmacy.

II. MANAGEMENT OF THE DISCIPLINE

Code of discipline		**S.05.A.046.2**	
Name of the discipline		**Biotechnologies on medicinal plants**	
Person(s) in charge of the discipline		**dr. hab. of biol., univ. prof., Tatiana Calalb**	
Year	**III**	Semester/Semesters	**V**
Total number of hours, including: **60**			
Lectures	**15**	Practical/laboratory hours	**-**
Seminars	**30**	Self-training	**15**
Form of assessment	**Exam**	Number of credits	**2**

III. TRAINING AIMS WITHIN THE DISCIPLINE

At the end of the discipline study the student will be able to:

- ***at the level of knowledge and understanding:***
- general concepts of *in vitro* biotechnology microtechniques;
- producers involved in biotech processes;
- principles of biotechnological laboratory activity;
- instrumentation, apparatus and equipment required for the biotechnological experiment and biotechnological production process;
- the stages of the scientific and industrial biotechnological process of various products producing for the pharmaceutical, cosmetic and food industry;
- the need for caution and responsibility at different stages of the biotechnological process;
- to be aware of the risks of biotechnology *in vitro*, biosecurity and the role of the human factor.

- ***at the application level:***
- the correct use of biotechnological and genetic engineering terminology;
- to determine the biological indices for the selection of the producers;
- to determine optimal manipulative chemical and physical parameters for biotechnological processes;
- to determine chemical and physical indices to vectorize and increase the yield of the biotechnological production;
- to determine the composition of the culture media and indices for selection and usage;
- to identify sources of industrial raw material for nutrient environments.
- ***at the integration level:***
- to determine the necessity and perspectives of *in vitro* biotechnologies applied in the pharmaceutical, cosmetic and food industry;
- to compare chemical, biotechnological and traditional methods of production and to determine the benefits of biotechnology;
- to become aware of the proper attitude towards the protection of nature and the environment through the use of modern biotechnologies;
- to be able to use the knowledge in the subsequent acquisition of other pharmaceutical disciplines and to become a modern pharmacist.

IV. PROVISIONAL TERMS AND CONDITIONS

Student of the IIIth year requires the following:

- knowledge of the language of instruction;
- knowledge in Biology, Pharmaceutical botany, Transgenic organisms, Organic chemistry, Pharmacognosy;
- competences in modern information technologies (Internet use, document processing, electronic tables and presentations, use of graphics software);
- teamwork skills;
- analytical and synthesis skills, generalization and communication skills;
- qualities – tolerance, compassion, autonomy, collegiality.

V. THEMES AND ESTIMATE ALLOCATION OF HOURS

Lectures, practical hours/ laboratory hours/seminars and self-training

No. d/o	THEME	Number of hours		
		Lectures	Practical hours	Self-training
1.	**Introduction. Biotechnology as science** Notions. History. Premises and necessity of modern biotechnology development. Advantages and risks.	1		
2.	**Biotechnology laboratory and biotechnological scheme.** - Equipment and technical rules. Biotechnology laboratory and industrial models. Physical, chemical and biological factors. Stages of biotechnology process. - Biotechnology producers (bacteria, fungi, microalgae, plants and animals). Nutritive media and sources. Technique of inoculation. Fermentation. Micropropagation. Monitoring of the fermentation process. Analyzing and testing of the biotechnological products.	4	2 2	2
3.	**Cell and tissue culture *in vitro*** Advantages of the culture *in vitro*. Explants. Physiological, physical and chemical conditions of inoculation and subcultivation. Calusal mass and biomasses. Monitoring of the culture *in vitro*. Morphogenesis and non-morphogenesis. Vitroplants. Manipulating factors in *in vitro* bioindustries.	2	2	2
4.	**Applied vegetal biotechnologies *in vitro*** - In pharmaceutical, cosmetic and alimentary industries by producing chemical natural compounds: vitamins, alkaloids, flavonoids (anthocyanins), carotenoids, essential oils, cardiac compounds, amino acids, proteins, fatty oils, enzymes, antibodies, vaccins. - Production of flavorings, stabilizers, pigments, dyes of cosmetics, foods and pharmaceuticals. - Medicinal plants and industrial *in vitro* biotechnological lines.Vitoplants production. Multiplication and micropagation of medicinal plants by biotechnological microtechnics. - Biotechnological centers, cpmpanies, schools and seminars, biotechnological fairs and pavilions.	2 2 2 2	6 4 6 2	10
5.	***In vitro* biotechnologies and legal framework.** Global and national framework in the field of biological biosecurity. The risks of modern biotechnologies and the role of the human factor.	2	2	1
6.	**Perspectives of biotechnologies.** Development directions. The future of modern biotechnologies. Preparing cadres for biotechnology industries. Information and biotechnological education of producers and consumers. Opinions.	-	2	-
Total		**15**	**30**	**15**

VI. PRACTICAL ABILITIES PURCHASED AT THE END OF THE COURSE

- the correct use of biotechnological and genetic engineering terminology;
- to determine the biological indices for the selection of the producers;
- to determine optimal manipulative chemical and physical parameters for biotechnological processes;
- to determine chemical and physical indices to vectorize and increase the yield of the biotechnological production;
- to determine the composition of the culture media and indices for selection and usage and to identify sources of industrial raw material for nutritive media.

VII. REFERENCE OBJECTIVES OF CONTENT UNITS

Objectives	Content units
Theme 1. Introduction. Biotechnology as science	
• To define the concept of biotechnology and biotechnological product *in vitro*. • To know the premises for the emergence of modern biotechnologies. • To demonstrate that they can identify the advantages and disadvantages. • To apply knowledge to other disciplines.	Modern biotechnologies and biotechnological products *in vitro.* Short history. The need for the emergence of modern biotechnologies. Advantages and risks. Sources of traditional and non-traditional natural raw material.
Theme 2. Cell and tissue culture *in vitro*	
• To define cell cultures and tissue cultures *in vitro*. • To know the terminology:biotechnology laboratory, explant, inoculation, subcultivation, nutritive media, morphogenesis, non/morphogenesis, growth regulators etc. • To demonstrate that they understand the *in vitro* laboratory biotechnological scheme. • To integrate knowledge in the field of contemporary medicine, based on modern biotechnology.	Cell and tissue cultures *in vitro.* Terminology specific to modern biotechnologies. Requirements and conditions (physical, chemical, utensils and equipment) in the biotechnology lab. Working rules. Biotech laboratory scheme. Optimal nutrition. Physical, chemical and biological factors that can be manipulated in *in vitro* cultures.
Theme 3. Aplied vegetal *in vitro* biotechnologies	
• To know sources of raw material for the production of natural compounds for pharmaceutical and food purposes. • To demonstrate that they understand the principles of the industrial biotechnology scheme. • To develop own views on the role of the human factor in obtaining qualitative and ecologically pure biotechnological products. • To integrate knowledge in order to become contemporary pharmacist specialists.	Industrial biotechnological scheme (bioindustry). Sources of raw material and advanced rigor. Physical and chemical factors in conducting industrial biotechnology lines. *In vitro* production of various chemical compounds (primary and secondary metabolites) for the pharmaceutical, food and cosmetic industries: amino acids, proteins, lipids, organic acids, volatile oils, alkaloids, vitamins, cardiotonic heterosides, flavonoids, anthracene-derivatives, carotenoids, tannins, vegetable pigments, enzymes, antibodies, etc.

Objectives	Content units
Theme 4. *In vitro* biotechnologies and legal framework	
• To know the national and world legal frameworks. • To understand and realize the role of the human factor in biotechnological production *in vitro*. To demonstrate that they can identify the risks of modern biotechnologies in food/medicine production. • To integrate their knowledge into the formation of the right professional and civic attitude in the modern " biotechnological era ".	National legal Framework. Modern biotechnologies, biosecurity and the role of the human factor. National policies and strategies in *in vitro* biotechnology. Biotechnological education of younger generations. The role of the pharmacist in the "biotechnological era".

VIII. PROFESSIONAL (SPECIFIC (SC) AND TRANSVERSAL (TC) COMPETENCES AND STUDY OUTCOMES

✓ Professional (specific) (SC) competences

- CP 1. Knowledge of the theoretical basis of the discipline Biotechnologies at medicinal plants, the general theory of biotechnology microtechnologies *in vitro*; knowing the principles of biotechnology lab activity.
- CP 2. Knowing the benefits and risks of biotechnological products *in vitro*. Assessment of development trend and *in vitro* biotechnology prospects in food/drug production.
- CP 3. Using and adapting the theoretical knowledge in the field of modern *in vitro* biotechnology in the pharmaceutical and everyday activity, increasing the efficiency of the professional activity by introducing innovative elements in the field of *in vitro* biotechnology. Application of the requirements of the legal framework for biotechnological products and biosafety.
- CP 4. Active organization of the specialist in the conscientious promotion of biotechnological products (medicines/food) and the development of the right civic attitude.
- CP 5. Highlighting and awareness of the risks in the application of biotechnologies *in vitro* for the production and promotion of the biotechnological product and determining the role of the human factor in ensuring the quality and security.
- CP 6. Involvement in volunteer social activities to promote conscious attitude towards biotechnological products, consistent information with innovations in *in vitro* biotechnology.

✓ Transversal competences (TC)

- CT 1. Awareness and compliance with pharmaceutical ethics and deontology rules in the application of modern biotechnologies *in vitro* in professional activity.
- CT 2. Identifying the knowledge needs of *in vitro* microelectronics and the specificity of application in the production of drugs and food in becoming a contemporary pharmacist specialist.
- CT 3. Promoting the spirit of initiative, cooperation and collegiality in working teams. Continuous improvement of biotechnological products *in vitro* in the "era of modern biotechnology".

✓ Study outcomes

- To know the principles of developing *in vitro* biotechnological lines for the production of natural compounds in order to product contemporary food /medicine and în the medicinal plants micropropagation.
- To be able to highlight the benefits and awareness of the risks of biotechnological products in vitro.
- To know biotechnological lines *in vitro* on medicinal plants.
- To be informed and competent to use biotechnological knowledge *in vitro* in order to become a contemporary pharmacist specialist.
- To be competent to use critically and confidently the scientific information obtained using the new information and communication technologies.

Note. Study outcomes (are deduced from the professional competencies and formative valences of the informational content of the discipline).

IX. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Working with information sources	Analysis of the informational material from the class hours. Working with recommended bibliographic sources. Selection of the main postulates, highlighting the basic elements of the topic discussed, argumentation, exemplification. Exploring current electronic sources on the subject. Formulation of conclusions.	Ability to analytical analysis and highlighting a the essential; Logical orientation skills in the volume of informational material. Interpretive skills and balanced selection of information.	During semester
2.	Thematically project	Analysis of relevant sources in the thematic project. Compilation of the work plan and presentation of the paper. Analysis, systematization and synthesis of information on the proposed theme. Compilation of the paper according to the requirements in force and presentation to the chair.	The quality of systematization and analysis of the informational material obtained through own activity. Concordance of the information with the proposed theme. The ability to highlight key positions, the need to address the subject, and the amount of concrete information on the subject.	During semester
3.	Graphic representation and presentation	Establishing PowerPoint project / theme components - theme, purpose, results, conclusions, practical applications, bibliography. Selection of	Quality and fairness of presentation formulation. The volume of information material.	During semester

	support	graphical presentation (tables, figures, diagrams, graphs, etc.). Determining the way of presentation (narrative, forwarding challenging questions, formulating the case issue, individual analysis of a problem, in the form of a dispute, etc.)	Balanced use of different forms of graphical presentation. Ability to describe and present concrete and accessible material. The volume of work, the degree of penetration in the essence of the project theme, the level of scientific argumentation, the quality of the conclusions, the elements of creativity, the formation of the attitude. Ability to answer questions.	

X. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

- ***Teaching and learning methods used***

Discipline Biotechnologies at medicinal plants is taught in classical ways: lectures and seminars. Course hours are read by the course owner through the involvement of modern information technologies. At seminars, students will prepare reports from current and current information on websites and forums for Internet views and discussions. Methodological and didactic procedures will be practiced: disputes, interactive discussion, mini-conferences, and team discussions with arguments, proofs, opinions and beliefs for and against about modern biotechnology *in vitro* activities in the food, pharmaceutical, cosmetic industries. All activities will be targeted to raise awareness, understanding and knowledge about modern biotechnology by students, which will be exploited and promoted by them during their work in the field of national pharmacy.

- ***Applied teaching strategies / technologies*** *(specific to the discipline)*

Front work, individually and in micro groups. "Discussion Round table" interactive debates; "Case study"; "Creative controversy"; Virtual practices; Watching and discussing thematic videos.

- ***Methods of assessment*** *(including the method of final mark calculation)*

✓ ***Current:*** will be done through 2 assessments of students' knowledge (1 assessment - written on topics or frontal discussions, individual, thematic debates; 1 assessment - the thematic project).

✓ ***Final:*** **Exam**

The final assessment will consist of the annual average grade (consisting of the grade of the individual work on the project/thematic portfolio and the grade from a knowledge assessment) with the coefficient 0.5 and the grade from the oral test - the coefficient 0.5.

Note: At the final exam, students with the average annual score below grade 5, as well as students who have not recovered absences from the practical works are not admitted**.**

Method of mark rounding at different assessment stages

Intermediate marks scale (annual average, marks from the examination stages)	National Assessment System	ECTS Equivalent
1,00-3,00	**2**	**F**
3,01-4,99	**4**	**FX**

5,00	**5**	**E**
5,01-5,50	**5,5**	
5,51-6,0	**6**	
6,01-6,50	**6,5**	**D**
6,51-7,00	**7**	
7,01-7,50	**7,5**	**C**
7,51-8,00	**8**	
8,01-8,50	**8,5**	**B**
8,51-8,00	**9**	
9,01-9,50	**9,5**	**A**
9,51-10,0	**10**	

The average annual mark and the marks of all stages of final examination (computer assisted, test, oral) - are expressed in numbers according to the mark scale (according to the table), and the final mark obtained is expressed in number with two decimals, which is transferred to student's record-book.
Absence on examination without good reason is recorded as "absent" and is equivalent to 0 (zero). The student has the right to have two re-examinations.

XI. RECOMMENDED BIBLIOGRAPHY:

A. Compulsory:

1. Supporting information course on Department web-site.
2. Sasson A. Medicinal Biotechnology. Achievements, Prospects and Perceptions, United Nations University Press Tokyo, New York, Paris, Rawat, 2007.
3. Sahoo L. Plant biotechnology lab manual. Department of Biotechnology Indian Institute of Technology Guwahati, 2014.

B. Additional:

1. Cadrul Național pentru Securitatea Biologică. Elaborat în cadrul Proiectului UNEP/GEF nr. GE/2716-02-4520. Tipografia Centrală, Chișinău, 2004, 47 p.
2. Internet informations.
3. Current national and mondial publications on biotechological domain.
4. Biosafety Concerns in the Republic of Moldova: opportunities and challenges. By Dr. A. Lozan, Ministry of Ecology and Natural Resources, UNEP-GEF Biosafety, Chișinău, 2008. 52 p.
5. First Biennial Update Report of the Republic of Moldova under the United Nations Framework Convention on Climate Change, Resp. V. Munteanu, Tipogr. "Bons Offices", Chisinău, 2016.