

MEDICAL UNIVERSITY – PLOVDIV
FACULTY OF PHARMACY
DEPARTMENT OF PHARMACEUTICAL SCIENCES

SYLLABUS
in
BIOPHARMACY

Approved by the Department Council - Protocol № 11/11.11.2024

Confirmed by the Faculty Council - Protocol № 09/13.11.2024

BIOPHARMACY

Syllabus

Discipline	Final exam/ semester	According to the Faculty of Pharmacy curriculum of MU-Plovdiv Academic hours				ECTS	Academic hours in semester	
		IX semester						
		Auditorium	Lectures	Practices	Non-auditorium		L	P
Biopharmacy	IX	60	30	30	93	6,1	30	30

DISCIPLINE:

Biopharmacy

TYPE OF DISCIPLINE ACCORDING TO THE UNIFORM STATE REQUIREMENTS:

Compulsory

LEVEL OF QUALIFICATION:

MPharm

FORMS OF TRAINING:

Lectures, seminars, practicals, self-training

YEAR OF TRAINING:

V course

DURATION OF TRAINING:

One semester

ACADEMIC HOURS:

30 hours lectures, 30 hours practicals

TECHNICAL EQUIPMENT APPLIED IN THE TRAINING:

Multimedia presentations, discussions, individual tasks, preparation of papers

FORMS OF EVALUATION:

Current assessment, individual problem-solving

EVALUATION CRITERIA:

A current average mark for the semester is formed

ASPECTS OF EVALUATION CRITERIA:

Participation in discussions, evaluation of the colloquiums, tests

SEMESTER EXAM:

Yes (theoretical exam – oral and written form)

STATE EXAM:

Yes (written and oral exam combined with Pharmaceutical technology I and Pharmaceutical technology II)

LECTURER:

Professor from the department of Pharmaceutical sciences

DEPARTMENT:

Pharmaceutical sciences

ANNOTATION

The discipline Biopharmacy and pharmacokinetics is one of the basic fields in the pharmaceutical science, which aims to build on the knowledge gained in Pharmaceutical technology, focusing on all processes and factors which influence the behavior of the drug in the body related to route of administration and type of the dosage form in order to optimize drug bioavailability.

Biopharmacy considers the interaction between the dosage form as a physicochemical system and the living organism as a complex biological macrostructure, mainly by studying the drug kinetics and drug metabolism in the biological environment. The basic concept of biopharmacy is that the therapeutic effect of drugs is determined not only by their specific molecular structure, but also by a number of additional factors (anatomical-physiological and biochemical characteristics of the organism, physicochemical and biopharmaceutical properties of the drug and the dosage form).

BASIC AIMS OF THE DISCIPLINE

Biopharmaceutical evaluation include both theoretical and experimental approaches. Theoretical training provides knowledge on the influence of physicochemical drug properties on the drug behaviour in the body, the main biopharmaceutical parameters and their determination. The experimental aspects include *in vitro* study of the processes of drug release from different types of dosage forms, determination of the similarity factor, basic principles of biopharmaceutical control and overall assessment of the quality of the pharmaceutical product.

EXPECTED RESULTS

After completing the course, students must have the following knowledge and skills:

- Identification of biopharmaceutical relevant information from various sources and critical evaluation of dosing regimes.
- Application of relevant mathematical and statistical approaches and models for analysis of biopharmaceutical data.
- Proposing an appropriate route/routes of administration based on prior biopharmaceutical information; predicting the effects of changing the route of administration.
- Conducting *in vitro* biopharmaceutical control of medicinal products, performing biopharmaceutical evaluation and analysis of the influence of the physicochemical and technological-pharmaceutical properties of the drug and its stability on therapeutic effectiveness and safety.

SYLLABUS FOR LECTURES

V course, IX semester

№	TOPIC	HOURS
1.	Stability of pharmaceutical products. Types of stability. Approaches for stabilization.	2 h.
2.	Stability assessment. Kinetics of degradation reactions.	2 h.
3.	Biopharmacy – basic concepts. Behavior of the drug substance in the body (LADMER model). Pharmaceutical factors. Basic concepts.	2 h.
4.	Mechanisms of drug release in the body.	2 h.
5.	Biopharmaceutical control. Pharmacopoeial dissolution tests.	2 h.
6.	"Biosubstitutes". In vitro/in vivo correlation.	2 h.
7.	Drug absorption in the body. Biopharmaceutical Classification System (BCS).	2 h.
8.	Biopharmaceutical evaluation of oral dosage forms.	2 h.
9.	Biopharmaceutical evaluation of the transdermal route of administration.	2 h.
10.	Biopharmaceutical evaluation of rectal and vaginal routes of administration.	2 h.
11.	Biopharmaceutical evaluation of dosage forms for pulmonary and nasal administration.	2 h.
12.	Biopharmaceutical evaluation of ophthalmic dosage forms.	2 h.
13.	Biopharmaceutical evaluation of the parenteral route of administration.	2 h.
14.	Drug delivery systems for targeted drug delivery. Principles of targeted therapy.	2 h.
15.	Biological drug products. Biotechnologies in drug delivery systems. Vaccines.	2 h.

TOTAL: 30 h.

SYLLABUS FOR PRACTICALS

V course, IX semester

№	TOPIC	HOURS
1.	Seminar. Stability. Stability tests. Predicting the shelf life of pharmaceutical products.	4 h.
2.	Studying the stability of easily oxidizable drugs in solution. Stability of ascorbic acid. Stabilization approaches. Investigating the influence of different approaches on chemical stability.	4 h.
3.	Studying the stability of easily hydrolyzable drugs in solution. Hydrolytic degradation of indomethacin under stress conditions. Predicting the shelf life.	4 h.
4.	Colloquium – stability. Seminar – <i>in vitro</i> tests for biopharmaceutical evaluation of the drug release process from dosage forms and processing the obtained results. Solving tasks.	4 h.
5.	<i>In vitro</i> dissolution tests. Comparative study of the dissolution behavior of two generic, pharmaceutically equivalent products (same type of formulation, same dose). Obtaining dissolution profiles. Determining the influence of the type and amount of excipients on <i>in vitro</i> release process.	4 h.
6.	<i>In vitro</i> dissolution tests. Comparative study of the biopharmaceutical behavior of two products, different type of dosage forms with the same drug dose (e.g. tablet and capsule). Processing the results and evaluating the influence of the biopharmaceutical factor – type of the dosage form.	4 h.
7.	<i>In vitro</i> dissolution tests for semisolid and rectal drug formulations. Studying the drug release profile from modified, controlled release formulations (tablets and transdermal patches).	4 h.
8.	Colloquium – biopharmaceutical control.	2 h.

TOTAL: 30 h.

LECTURES – THESES

LECTURE № 1 – 2 hours

STABILITY OF PHARMACEUTICAL PRODUCTS. TYPES OF STABILITY. APPROACHES FOR STABILIZATION

1. Stability of pharmaceutical products – definition.
2. Types of stability. Approaches for stabilization.
3. Chemical stability. Approaches for stabilization.
4. Physical stability. Approaches for stabilization.
5. Microbiological stability. Approaches for stabilization

LECTURE № 2 – 2 hours

STABILITY ASSESSMENT. KINETICS OF DEGRADATION REACTIONS

1. Reasons for stability assessment.
2. Stability tests:
 - long term stability studies
 - accelerated stability studies
 - intermediate stability studies
 - stress testing
3. Application of chemical kinetics in stability tests.
4. Order of chemical reaction.
5. Kinetic models.

LECTURE № 3 – 2 hours

BIOPHARMACY – BASIC CONCEPTS. BEHAVIOR OF THE DRUG SUBSTANCE IN THE BODY (LADMER MODEL). PHARMACEUTICAL FACTORS. BASIC CONCEPTS

1. Biopharmacy.
2. Prerequisites for its development.
3. Basic concepts.
4. Behavior of the drug substance in the body – processes of release/dissolution, absorption, distribution, metabolism and elimination of drugs (LADMER model).
5. Pharmaceutical factors.
6. Basic concepts:
 - pharmaceutical availability
 - drug bioavailability
7. Pharmaceutically equivalent, bioequivalent and therapeutically equivalent pharmaceutical products.

LECTURE № 4 – 2 hours

MECHANISMS OF DRUG RELEASE IN THE BODY

1. Mechanisms of drug release and their influence on bioavailability.
2. Immediate-release dosage forms: disintegration and dissolution as limiting factors for drug absorption.
3. Factors influencing drug dissolution.
4. Mechanisms and kinetics of drug release in modified release dosage forms.
5. Diffusion.

LECTURE № 5 – 2 hours

BIOPHARMACEUTICAL CONTROL. PHARMACOPOEIAL DISSOLUTION TESTS

1. Determination of the main biopharmaceutical indicators.
2. Pharmacopoeial tests for in vitro dissolution.
3. Evaluation of the results from in vitro dissolution test.
4. Linearization of dissolution profiles using mathematical models.
5. Demonstration of pharmaceutical equivalence.
6. Similarity factor.
8. Pharmaceutically equivalent drug products.

LECTURE № 6 – 2 hours

"BIOSUBSTITUTES". IN VITRO/IN VIVO CORRELATION

1. *In vitro* tests to replace bioavailability and bioequivalence studies.
2. Monographs on "biosubstitutes".
3. "Biosubstitutes" based on the Biopharmaceutical Classification System. Application, regulatory aspects.
4. *In vitro/in vivo* correlation - essence, levels of correlation.

LECTURE № 7 – 2 hours

DRUG ABSORPTION IN THE BODY. BIOPHARMACEUTICAL CLASSIFICATION SYSTEM (BCS)

1. Routes of drug administration.
2. Types of transmembrane transport.
3. Physicochemical and physiological factors affecting absorption.
4. Biopharmaceutical Classification System (BCS).

LECTURE № 8 – 2 hours

BIOPHARMACEUTICAL EVALUATION OF ORAL DOSAGE FORMS

1. Absorption sites.
2. Anatomic-physiological factors affecting the absorption of drugs in the gastrointestinal tract.
3. Drugs stability in the lumen.
4. Theories and models to explain the absorption of drugs in the gastrointestinal tract.

LECTURE № 9 – 2 hours

BIOPHARMACEUTICAL EVALUATION OF THE TRANSDERMAL ROUTE OF ADMINISTRATION

1. Absorption sites and mechanisms of drug absorption through the skin.
2. Factors affecting the percutaneous absorption of drugs.
3. Absorption enhancement.
4. Biopharmaceutical aspects of dermal application.
5. *In vitro* and *in vivo* methods.

LECTURE № 10 – 2 hours

BIOPHARMACEUTICAL EVALUATION OF RECTAL AND VAGINAL ROUTES OF ADMINISTRATION

1. Characteristics, therapeutic targets, and factors affecting drug absorption and bioavailability.
2. Therapeutic systems for the vaginal route: Mechanisms and kinetics of drug release.
3. Biopharmaceutical aspects of rectal dosage forms.
4. Physiological and pharmaceutical factors.

LECTURE № 11 – 2 hours

BIOPHARMACEUTICAL EVALUATION OF DOSAGE FORMS FOR PULMONARY AND NASAL ADMINISTRATION

1. Characteristics of the respiratory tract epithelium.
2. Advantages and disadvantages of pulmonary delivery.
3. Factors influencing drug absorption.
4. Mechanisms of absorption.

LECTURE № 12 – 2 hours

BIOPHARMACEUTICAL EVALUATION OF OPHTHALMIC DOSAGE FORMS

1. Biopharmaceutical aspects of ophthalmic dosage forms.
2. Physiological and pharmaceutical factors.

LECTURE № 13 – 2 hours

BIOPHARMACEUTICAL EVALUATION OF THE PARENTERAL ROUTE OF ADMINISTRATION

1. Intravascular and extravascular administration: injection sites, advantages, disadvantages and applications.
2. Drug release as a limiting factor in parenteral absorption.
3. Factors affecting parenteral absorption.
4. Drug formulations with modified release for parenteral administration: mechanisms and kinetics of parenteral absorption.

LECTURE № 14 – 2 hours

DRUG DELIVERY SYSTEMS FOR TARGETED DRUG DELIVERY. PRINCIPLES OF TARGETED THERAPY

1. Targeted drug delivery.
2. Principles of target therapy.
3. Passive targeting.
4. Active targeting.
5. Biological medicinal products.

LECTURE № 15 – 2 hours

BIOLOGICAL DRUG PRODUCTS. BIOTECHNOLOGIES IN DRUG DELIVERY SYSTEMS. VACCINES

1. Biological medicinal products.
2. Technological and biopharmaceutical aspects.
3. Biological drug delivery systems.

PRACTICALS – THESES

PRACTICAL № 1 – 4 hours

SEMINAR – STABILITY

1. Stability tests.
2. Predicting the shelf life of pharmaceutical products.

PRACTICAL № 2 – 4 hours

STUDYING THE STABILITY OF EASILY OXIDIZABLE DRUGS IN SOLUTION

1. Stability of ascorbic acid.
2. Stabilization approaches.
3. Investigating the influence of different approaches on chemical stability.

PRACTICAL № 3 – 4 hours

STUDYING THE STABILITY OF EASILY HYDROLYZABLE DRUGS IN SOLUTION

1. Hydrolytic degradation of indomethacin under stress conditions.
2. Predicting the shelf life.

PRACTICAL № 4 – 4 hours

COLLOQUIUM – STABILITY.

SEMINAR – *IN VITRO* TESTS

1. Biopharmaceutical evaluation of the drug release process from dosage forms.
2. Processing the obtained results.
3. Solving tasks.

PRACTICAL № 5 – 4 hours

***IN VITRO* DISSOLUTION TESTS**

1. Comparative study of the dissolution behavior of two generic, pharmaceutically equivalent products (same type of formulation, same dose).
2. Obtaining dissolution profiles.
3. Determining the influence of the type and amount of excipients on in vitro release process.

PRACTICAL № 6 – 4 hours

***IN VITRO* DISSOLUTION TESTS**

1. Comparative study of the biopharmaceutical behavior of two products, different type of dosage forms with the same drug dose (e.g. tablet and capsule).
2. Processing the results and evaluating the influence of the biopharmaceutical factor – type of the dosage form.

PRACTICAL № 7 – 4 hours

***IN VITRO* DISSOLUTION TESTS**

1. *In vitro* dissolution tests for semisolid and rectal drug formulations.
2. Studying the drug release profile from modified, controlled release formulations (tablets and transdermal patches).

PRACTICAL № 8 – 2 hours

COLLOQUIUM – BIOPHARMACEUTICAL CONTROL

BIBLIOGRAPHY

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3. Kevin M G Taylor, Bpharm, PhD (Editor), Michael E Aulton, Bpharm, PhD, Fsp (Editor). Aulton's Pharmaceutics: The Design and Manufacture of Medicines, 2021, Elsevier ISBN-13: 9780702081545
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CONSPECTUS IN BIOPHARMACY

1. Stability of pharmaceutical products. Types of stability. Approaches for stabilization.
2. Stability assessment. Kinetics of degradation reactions.
3. Biopharmacy – basic concepts. Behavior of the drug substance in the body (LADMER model). Pharmaceutical factors. Basic concepts.
4. Drug absorption in the body. Biopharmaceutical Classification System (BCS).
5. Routes of drug administration. Types of transmembrane transport. Physicochemical and physiological factors affecting absorption.
6. Biopharmaceutical control. Pharmacopoeial dissolution tests.
7. Biosubstitutes". In vitro/in vivo correlation.
8. Biopharmaceutical evaluation of the transdermal route of administration - drug transdermal patches, drug systems with controlled release.
9. Biopharmaceutical evaluation of rectal and vaginal routes of administration.
10. Biopharmaceutical evaluation of dosage forms for pulmonary and nasal administration.
11. Biopharmaceutical evaluation of ophthalmic dosage forms.
12. Biopharmaceutical evaluation of the parenteral route of administration.
13. Drug delivery systems for targeted drug delivery. Principles of targeted therapy.
14. Biological drug products.