

Ministry of Health of the Republic of Belarus
Educational institution
"Gomel State Medical University"

Department of Biological Chemistry

Authors:

O.S. Logvinovich, Head of the Department, PhD (Biol. Sci.), Associate Professor

A.N. Koval, Associate Professor (position and title), PhD (Biol. Sci.)

A.V. Litvinchuk, Associate Professor (position and title), PhD (Biol. Sci.)

M.V. Gromyko, Senior Lecturer

METHODOLOGICAL RECOMMENDATIONS

for a practical lesson in the academic discipline "Biological Chemistry"
for 2nd year **students** of the Faculty of Foreign Students
majoring in 1-79 01 04 "Medical Care"

Topic: Lipids 2. Tissue lipid metabolism: lipolysis, fatty acids β -oxidation, ketone bodies metabolism.

Duration 4 hours

Approved at the meeting of the Department of Biological Chemistry
(Protocol No. 10 dated 29.08.2025)

Gomel, 2025

1. TRAINING AND EDUCATIONAL OBJECTIVES, MOTIVATION FOR COMPLETION OF THE TOPIC, REQUIREMENTS FOR THE INITIAL LEVEL OF KNOWLEDGE

The main source of fatty acids used as "fuel" is the reserve fat, which is contained in adipose tissue. It is believed that triglycerides of fat depots play the same role in lipid metabolism as liver glycogen in carbohydrate metabolism, and higher fatty acids in their energy significance resemble glucose formed during glycogenolysis. During physical work, stress and other energy-intensive conditions of the body, the utilization of adipose tissue triglycerides as an energy reserve increases.

Purpose of the class: to study the main metabolic pathways of the main classes of lipids: triacylglycerols, fatty acids, ketone bodies, to form ideas about the mechanisms of fat mobilization and the role of hormones in this process. To learn how to determine the concentration of triglycerides in blood plasma by the enzymatic colorimetric method. To instill in students a sense of pride in their chosen profession and to form in them a culture of caring for their health.

Class objectives:

The student must know:

1. Mechanisms of fat mobilization, the role of hormones, cAMP and Ca^{2+} .
2. Sequence of TAG oxidation reactions in tissues, glycerol oxidation and its energy balance.
3. Pathways of FFA transport in the blood.
4. Stages of β -oxidation of saturated fatty acids, features β -oxidation of unsaturated fatty acids and fatty acids with an odd number of atoms.
5. Ways of formation and utilization of acetyl-CoA.
6. Biosynthesis, utilization and physiological role of ketone bodies.

The student must be able to:

1. Analyse the concentration of triglycerides in blood plasma by enzymatic colorimetric method and evaluate the diagnostic significance of the result.
2. Calculate the energy balance of the oxidation of TAG, glycerol and fatty acids.

2. CHECKLIST OF THE QUESTIONS FROM RELATED SUBJECTS

- 2.1 Chemical structure of higher fatty carboxylic acids, saturated and unsaturated (bioorganic chemistry).
- 2.2 Lipid metabolism (human physiology).
- 2.3 Device, principle of operation on a semi-automatic biochemical analyzer (medical and biological physics).

3. CHECKLIST OF CONTROL QUESTIONS FOR THE LESSON

- 3.1 The mechanism of fat mobilization (the role of hormones, cAMP and Ca^{2+}).
Activation of hormone-sensitive TAG lipase.
- 3.2 Transport of FFA in the blood.
- 3.3 TAG oxidation in tissues, glycerol oxidation, its energy balance.
- 3.4 Stages of β -oxidation of saturated fatty acids. The mechanism of activation and transport of fatty acids across the mitochondrial membrane. The role of carnitine. Peculiarities of β -oxidation of unsaturated fatty acids and fatty acids with an odd number of

atoms. Energy balance of oxidation C₁₆, C₁₅, C_{18:2}.

3.5 Energy balance of tristearate oxidation. Physiological role of FFA in stress.

Calculation of the energy yield of aerobic oxidation of 1 palmitic acid molecule.

3.6 Metabolism of acetyl-CoA (ways of formation and utilization).

3.7 Ketone bodies - biosynthesis, utilization, physiological role.

3.8 Activation of hormone-sensitive TAG lipase.

3.9 Calculation of the energy yield of aerobic oxidation of 1 mole of palmitic acid

3.10 QUESTIONS FOR SELF-STUDY AND ADDITIONAL RESEARCH TASKS (SSART):

1. *Properties and physiological role of free fatty acids (FFA).*

4. PRACTICAL PART OF THE LESSON

Laboratory work No. 1 “Analysis of the concentration of triacylglycerols in the blood serum (plasma) by the enzymatic colorimetric method” is performed using a set of reagents (Vital).

Laboratory work No. 2 “Analysis of total lipids in blood serum by the sulfophosphovaniline method”; laboratory work No. 3 “Qualitative reactions to acetone and acetoacetic acid” are performed according to the publication “Biological Chemistry: Workbook” (in 2 parts, part 1) / Gritsuk A.I. [et al.]. - Gomel: GomSMU, 2021. - 76 p.

5. PROCESS OF THE LESSON

5.1 Introduction

5.2 Theoretical part of the lesson: control questions are considered, an oral survey of students is conducted, the tasks of the SSART are analyzed.

5.3 Practical part of the lesson: laboratory work No. 1 “Analysis of the concentration of triacylglycerols in the blood serum (plasma) by the enzymatic colorimetric method” is performed experimentally according to the instructions. Laboratory work No. 2 “Analysis of total lipids in blood serum by the sulfophosphovaniline method”; laboratory work No. 3 “Qualitative reactions for acetone and acetoacetic acid” are performed according to the instructions.

5.4 The control of mastering the topic.

5.5 The final part of the lesson. Summing up, checking the protocols, announcing tasks (as well as the topics of the SSART abstract messages) for the next lesson.

SSART for the topic “Lipids-3” are performed according to the list.

Control questions on the topic “Lipids-3” include knowledge of the reactions of biosynthesis of fatty acids (saturated and unsaturated), cholesterol synthesis.

6. QUESTIONS FOR KNOWLEDGE SELF-CONTROL

Self-control of knowledge on the topic “Tissue lipid metabolism: catabolism of triacylglycerols. Metabolism of ketone bodies” is carried out by computer testing using the Moodle platform. Access mode: <https://dl.gsmu.by/mod/quiz/view.php?id=5034>

7. LIST OF REFERENCES:

1. Harper's Illustrated Biochemistry / Victor W. Rodwell [et al.]. — 30th edit. -New York[et al.] : McGraw-Hill Education, 2015. — 817 p.
2. Meisenberg, G. Principles of medical biochemistry / G. Meisenberg, W. H. Simmons. — 4th ed. -Philadelphia: Elsevier, [2017]. — xii, 617 p.
3. Vasudevan, D. M. Textbook of biochemistry for medical students / DM Vasudevan, S Sreekumari. — 5th ed. — New Delhi : Jaypee brothers medical publishers, 2009. — xvi, 535 p.
4. Gritsuk, A. I. Biochemistry. P. 1 : lectures, notes / A. I. Gritsuk, A. N. Koval ; Gomel state medical University, Department of biochemistry. — Gomel, 2016. — 380 p.