University of Gdańsk

Subject card

Subject name and code	Integrated approaches to cosmetic bioactives: molecular design, sustainability and industrial translation, PG_00197341		
Field of study	Chemical Business, Chemistry, Environmental Protection		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2026/2027
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study Optional subject group
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	English
Semester of study	6	ECTS credits	2.0
Learning profile	academic	Assessment form	credit
Conducting unit	Faculty of Chemistry -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Aleksandra Walewska	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	0.0	15

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	15	10.0	25.0	50

Subject objectives

1. To provide advanced knowledge on the molecular design of bioactive ingredients used in cosmetology, with particular emphasis on structure activity relationships (SAR), physicochemical properties, and mechanisms of action in the skin.
2. To familiarize students with the principles of sustainable design and production of bioactive ingredients, including the application of biotechnology, green chemistry, and environmental impact assessment tools.
3. To present the process of development and industrial implementation of a bioactive ingredient from molecular concept to market-ready product including formulation, stability, regulatory, and safety aspects.
4. To develop students ability to critically analyze scientific data regarding the efficacy and safety of bioactive ingredients and to interpret these data in an industrial context

Learning outcomes

Course outcome	Subject outcome	Method of verification
[CHEML3_U12] Reads with understanding scientific and popular science chemical texts in English.	The student is able to read and analyze professional literature concerning the molecular design, sustainability, and industrial development of cosmetic bioactive ingredients. The student understands specialized scientific articles, research reports, and industry publications related to innovative bioactives, their mechanisms of action, formulation challenges, and implementation in cosmetic products.	[SU1] oral statement/conversation/ discussion [SU5] implementation of a problem task
[CHEML3_U01] Identifies, analyses and solves problems in the field of broadly understood chemistry on the basis of the acquired knowledge.	The student identifies, analyzes, and solves problems related to the design, property evaluation, and implementation of bioactive ingredients in the cosmetic industry, based on interdisciplinary chemical knowledge and the principles of rational molecular design.	[SU1] oral statement/conversation/ discussion [SU5] implementation of a problem task
[CHEML3_W04] Characterises the basic methods of chemical compound analysis.	The student characterizes methods for the analysis and evaluation of bioactive ingredients used in cosmetology, including techniques for determining their structure, purity, stability, and biological activity.	[SW1] oral statement/ conversation/discussion [SW5] implementation of a problem task
[CHEML3_W03] Explains the relationship between the structure of matter and its observed properties.	The student explains at an advanced level the relationships between the molecular structure of bioactive ingredients and their physicochemical properties, biological activity, and functionality in cosmetic formulations	[SW1] oral statement/ conversation/discussion [SW5] implementation of a problem task
[CHEML3_U08] Presents in an understandable way the basic facts about chemistry using a scientific language typical of chemical sciences.	The student formulates and presents chemical concepts in a clear and precise manner, using terminology and a style appropriate for the chemical sciences.	[SU1] oral statement/conversation/ discussion [SU5] implementation of a problem task

Subject contents

The course covers an integrated approach to the design and implementation of bioactive ingredients in the cosmetic industry, with particular emphasis on the relationships between molecular structure, physicochemical properties, and biological activity. It addresses the principles of rational compound design, factors influencing bioavailability and stability, and their functionality in cosmetic formulations.

The course also includes issues related to sustainability in the design and production of bioactive ingredients, including the application of biotechnology and the principles of green chemistry. Aspects of efficacy and safety assessment, as well as selected topics related to industrial implementation and regulatory requirements, are also discussed.

Prerequisites and co-requisites

Fundamentals of Organic Chemistry and Biochemistry

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
The condition for passing the course is active participation in classes and obtaining a positive grade on the final test	51.0%	100.0%

Recommended reading

Basic literature	1. Introduction to Cosmetic Formulation and Technology, Gabriela Baki, 2nd Edition, 2023 2. Cosmetic Science and Technology, Theoretical Principles and Applications, Kazutami Sakamoto et al, Elsevier, 2017
Supplementary literature	Articles from scientific journals: International Journal of Cosmetic Science, Journal of Cosmetic Dermatology, Cosmetics, European Journal of Pharmaceutics and Biopharmaceutics, Natural Product Reports, Biotechnology Advances,

	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Explain how the molecular structure of a bioactive ingredient influences its bioavailability, stability, and efficacy in a cosmetic formulation. 2. Analyze a selected bioactive ingredient in terms of structureactivity relationships (SAR) and propose possible modifications to improve its stability or effectiveness. 3. Discuss the factors that must be considered when transitioning from the molecular concept of a bioactive ingredient to its industrial implementation. 4. Propose a strategy for designing a cosmetic bioactive ingredient in accordance with the principles of green chemistry and sustainable development.	
Work placement	Not applicable	

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