A COURSE SYLLABUS – DOCTORAL SCHOOL

REGARDING THE QUALIFICATION CYCLE FROM 2025/2026 TO 2028/2029.

REGARDING THE QUALIFICATION CYCLE FROM 2024/2025 TO 2027/2028

GENERAL INFORMATION ABOUT COURSE	
Course title	**OPTIONAL SPECIALISED SUBJECT: Antioxidants in food**
Name of the unit running the course	Doctoral School at the University of Rzeszów
Type of course *(obligatory, optional)*	optional specialised
Year and semester of studies	year I, II semester: II, IV
Discipline	**food technology and nutrition**
Language of Course	Polish language/English language
Name of Course coordinator	**Prof. Izabela Sadowska-Bartosz, PhD**
Name of Course lecturer	**Prof. Izabela Sadowska-Bartosz, PhD**
Prerequisites	In-depth knowledge of chemistry and human nutrition. Knowledge of English at B2 CEFR level, with a focus on specialist vocabulary related to the discipline in which the education takes place.

BRIEF DESCRIPTION OF COURSE
(100-200 words)

The aim of the OPTIONAL SPECIALISED SUBJECT is to familiarise doctoral students with knowledge about oxidation processes in food, in particular free radical processes. The sources of free radicals, both oxygen-based and those with other unpaired electron carriers, will be presented. The mechanisms of action of antioxidants, their chemical structure, occurrence in raw materials and food products, and interactions of antioxidants in food will be discussed. Issues related to the bioavailability of natural antioxidants and their role in the human body will be presented. Doctoral students will also learn about methods for determining antioxidant content (sample preparation, extraction, spectroscopic methods, chromatography methods) and methods for analysing antioxidant capacity.

COURSE LEARNING OUTCOMES AND METHODS OF EVALUATING LEARNING OUTCOMES

Learning outcome	The description of the learning outcome defined for the course	Relation to the degree programme outcomes (symbol)	Learning Format (Lectures, classes,...)	Method of assessment of learning outcomes (e.g. test, oral exam, written exam, project,...)
Knowledge (NO.)	***Knows and understands, expresses knowledge***			
P8S_WG1	He has extensive theoretical knowledge backed by research experience and is familiar with the current state of research on the interaction of antioxidants in food, which he uses to objectively address existing views in the field of modern redox biochemistry.	P8S_WG	seminar	oral exam, written exam, project, test
P8S_WG2	He has extensive knowledge and is familiar with the latest global scientific achievements, as well as having knowledge of the optimisation/selection of methods for determining antioxidant content (sample preparation, extraction, spectroscopic methods,	P8S_WG	seminar	oral exam, written exam, project, test

	chromatography methods) and methods for analysing antioxidant capacity.			
P8S_WG3	Knows and understands the functions of antioxidants, their metabolism and the basics of absorption, as well as their impact on quality in the life cycle of a food product.	P8S_WG	seminar	oral exam, written exam, project, test
P8S_WK1	Has knowledge of the impact of technical and technological progress on the advancement of civilisation, including the discovery of new opportunities related to modern research using real-time imaging (real-time biosensing) for real-time redox mapping and artificial intelligence (AI) for redox signalling modelling.	P8S_WK	seminar	oral exam, written exam, project, test
Skills (no.)	***Able to***			
P8S_UW1	Based on interdisciplinary knowledge in the field of exact and natural sciences, they are able to formulate and set ambitious research goals related to the study of antioxidant interactions in food. They are able to identify and improve research methods, techniques and tools, as well as draw constructive conclusions based on the results of their research work.	P8S_UW	seminar	oral exam, written exam, project, test
P8S_UW2	Based on available interdisciplinary scientific publications, they are able to identify and solve a research problem that can be used to create a new element of their work.	P8S_UW	seminar	oral exam, written exam, project, test
P8S_UW3	Is able to use their interdisciplinary knowledge and research experience to analyse and evaluate scientific achievements, expert opinions and other studies, formulating opinions on this basis, including critical judgements.	P8S_UW	seminar	oral exam, written exam, project, test
P8S_UK6	They are able to carry out and present scientific work, actively participate in the national and international scientific and professional community, communicating in a foreign language at level B2 of the Common European Framework of Reference for Languages.	P8S_UK	seminar	oral exam, written exam, project, test
Social competence (no.)	***Ready to***			
P8S_KK3	Is ready to responsibly perform professional roles, taking into account social needs in terms of creating new food products rich in antioxidants.	P8S_KK	seminar	oral exam, written exam,

				project, test

LEARNING FORMAT – NUMBER OF HOURS

Semester (no.)	Lectures	Seminars	Lab classes	Internships	others	ECTS
II and IV	**-**	**15**	**-**	**-**	**-**	**2**

METHODS OF INSTRUCTION

Lecture: lecture with multimedia presentation, discussion.

COURSE CONTENT

Seminar:

Topic 1 – Oxidation processes in food and in the human body.
Topic 2 – Antioxidants and their mechanism of action.
Topic 3 – Natural and synthetic antioxidants – occurrence in food.
Topic 4 – Bioavailability of natural antioxidants, interactions with other food components.
Topic 5 – Methods for determining total antioxidant capacity.
Topic 6 – Modern research using real-time imaging (real-time biosensing) to map redox status in real time and artificial intelligence (AI) to model redox signalling.
Topic 7 – Redox homeostasis disorders (impaired reduction capacity) associated with metabolic and neurodegenerative diseases and cancer. New, intensive research into iron- and redox-dependent cell death – ferroptosis.

COURSE ASSESSMENT CRITERIA

The examination takes place after the completion of the seminars.

Examination requirements:
- oral presentation on a selected topic related to the subject 'Antioxidants in food'; appropriate to the level of study;
- activity and regularity of the doctoral student's work;
- activity during classes

The doctoral student prepares an oral presentation related to selected topics discussed during the seminars.

Very good grade:
- very high activity and commitment during classes,
- visible ability to lead discussions and draw constructive conclusions,
- evident awareness of one's own artistic attitude, characterised by openness to substantive discourse and, at times, constructive criticism;
- very high substantive value of the presentation;
- attendance at least 4/5 of the total number of classes;
- active use of the recommended literature, expanded and deepened on one's own.

Good plus grade:
- high activity during classes;
- high substantive value of the oral presentation;
- attendance at least 4/5 of the total number of classes;
- visible satisfactory ability to lead discussions and draw conclusions;
- active use of the recommended literature.

Good grade:
- satisfactory activity during classes;
- satisfactory substantive value of the oral presentation;
- attendance at least 4/5 of the total number of classes;
- moderate ability to lead discussions and draw conclusions;

- satisfactory use of the recommended literature.

Pass with distinction:
- moderate level of participation during classes
- relatively poor content of the oral presentation;
- attendance at least 3/5 of the total number of classes;
- moderately poor ability to lead discussions and draw conclusions;
- moderate use of the recommended literature.

Satisfactory grade:
- low level of activity during classes
- poor substantive value of the oral presentation;
- attendance at least 3/5 of the total number of classes;
- poor ability to lead discussions and draw conclusions;
- sporadic use of the recommended literature.

Fail:
- lack of activity during classes;
- unacceptable substantive value of the oral presentation;
- lack of ability to lead discussions and draw conclusions;
- absence from more than 3/5 of the total number of classes;
- lack of use of the recommended literature.

TOTAL PhD STUDENT WORKLOAD REQUIRED TO ACHIEVE THE INTENDED LEARNING OUTCOMES – NUMBER OF HOURS AND ECTS CREDITS

Activity	Number of hours
Scheduled course contact hours	**15**
Other contact hours involving the teacher (consultation hours, examinations)	**1**
Non-contact hours – student`s own work (preparation for classes or examinations, project, etc.)	**44**
Total number of hours	**60**
Total number of ECTS credits	**2 ECTS**

INSTRUCTIONAL MATERIALS

Compulsory literature:	1. Bartosz G. Druga twarz tlenu. Wolne rodniki w przyrodzie. PWN, Warszawa, 2003. 2. Bartosz G. (ed.), Food Oxidants and Antioxidants: Chemical, Biological, and Functional Properties, CRC Press, 2013. 3. Kut K, Cieniek B, Stefaniuk I, Bartosz G, Sadowska-Bartosz I. A Modification of the ABTS• Decolorization Method and an Insight into Its Mechanism. Processes. 2022:10(7):1288. doi:10.3390/pr10071288. 4. Sadowska-Bartosz I, Bartosz G. Evaluation of The Antioxidant Capacity of Food Products: Methods, Applications and Limitations. Processes. 2022;10(10):2031. doi:10.3390/pr10102031. 5. Sadowska-Bartosz I, Bartosz G. Effect of antioxidants supplementation on aging and longevity. Biomed Res Int. 2014:404680. doi: 10.1155/2014/404680. 6. Grzesik M, Bartosz G, Stefaniuk I, Pichla M, Namieśnik J, Sadowska-Bartosz I. Dietary antioxidants as a source of hydrogen peroxide. Food Chem. 2019;278:692-699. doi: 10.1016/j.foodchem.2018.11.109.

Complementary literature:	1. Sadowska-Bartosz I, Bartosz G. Prevention of protein glycation by natural compounds. Molecules. 2015; 20(2):3309-34. 2. Jan Pokorny, Nedyalka Yanishlieva, Michael Gordon (ed.), Antioxidants in food. Practical applications, CRC Press, Boca Raton, Boston, New York, Washington DC, 2001.

**(1 ects credit correspondes to 25–30 hours of total workload of the doctoral student, needed to achieve the intended outcomes)*

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Date and signature of the subject instructor

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Approval of the Head of the Unit or an authorized person