UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Natural Bioactive Compounds

2526-1-F0602Q110-F0602Q11002

Aims

The Bioactive Molecules module aims to provide students with fundamental theoretical and practical knowledge of the main techniques used to obtain biologically active compounds from various plant and food sources (e.g., leaves, fruits, seeds) collected in the field during the Biological Complexity module.

By the end of the course, students will have acquired knowledge of both conventional and green extraction and isolation techniques, aimed at obtaining bioactive phytocomplexes of interest in the food and nutraceutical sectors. Students will be able to evaluate the environmental impact of the developed processes and choose the most appropriate strategy based on the class of molecules present in the matrix, in order to avoid degradation and improve yield.

Expected Learning Outcomes (Dublin Descriptors)

1. Knowledge and understanding
   Students will acquire both theoretical and practical knowledge of the methodologies used for the extraction and purification of bioactive compounds from natural sources.

2. Applying knowledge and understanding
   They will be able to select and apply suitable green extraction strategies based on the matrix and target compounds, and assess their effectiveness through analytical methods.

3. Making judgements
   Students will develop the ability to identify and structurally characterize bioactive compounds and assess their potential applications in the nutraceutical, cosmetic, pharmaceutical, and chemical industries.

4. Communication skills
   The course aims to enable students to clearly and accurately describe the topics covered using appropriate technical and scientific terminology.

5. Learning skills
   Students will be encouraged to independently deepen their understanding of the covered topics, including analytical aspects and the relevance of natural product chemistry.

Contents

This laboratory module focuses on the extraction and purification of bioactive compounds from plant matrices collected in different ecosystems, with the aim of developing analytical protocols to obtain phytocomplexes with potential applications in the food and nutraceutical sectors.

Detailed program

The Bioactive Molecules module of the “One Health Laboratory” will guide students in understanding the role of biodiversity as a source of bioactive metabolites beneficial for health and disease prevention, as well as its function in environmental mitigation (e.g., reduction of pollution, temperature, and promotion of psychophysical well-being).

Risk factors such as antinutritional compounds, natural and process-related contaminants that may negatively affect human health will also be addressed.

Technical and Practical Objectives:

1. Application of green extraction techniques (maceration, decoction, sonication, pressurized liquid extraction, supercritical fluid extraction)
2. Development of analytical strategies for pre-concentration, purification, and isolation (evaporation, lyophilization, solid-phase extraction – SPE, low-pressure chromatography)
3. Qualitative and quantitative analysis of major compounds in the extracts using mass spectrometry
4. Evaluation of health-promoting properties such as antioxidant activity (spectrophotometric assays DPPH, ABTS).

Prerequisites

Knowledge of chemistry and organic chemistry is useful both for the full learning of the theoretical lessons, but also to be able to carry out practical laboratory activities safely

Teaching form

The course includes a mix of lectures and laboratory activities, with approximately 80% of the sessions delivered in-person through interactive laboratory work, and 20% delivered through traditional lectures.

1 in-person frontal lecture (2 hours)
3 in-person laboratory sessions (6 hours each)

Textbook and teaching resource

Slides and supplementary materials will be available on the e-learning.

Semester

second semester

Assessment method

The final exam consists of an oral examination. No interim tests are scheduled during the course.

The final exam will evaluate the following competencies:

Knowledge and understanding: Key concepts related to extraction, separation, and purification techniques.
Applying knowledge and understanding: Ability to connect theoretical concepts with laboratory practice.
Making judgements: Scientifically sound critical discussion and reasoning.
Communication skills: Clear presentation and use of appropriate technical language.
Learning skills: Evidence of autonomous study and topic exploration.

Evaluation Criteria
Grading will be based on scientific accuracy, practical application, logical presentation, and technical language use.

Grading Scale:

18–21: Basic knowledge, simple exposition.
22–25: Good understanding, moderate application ability.
26–28: Comprehensive knowledge, appropriate technical vocabulary.
29–30L: Excellent understanding, confident exposition, strong critical thinking.

Office hours

On appointment by e-mail: luca.campone@unimib.it

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING