UNIVERSITÀ DI PISA

BIOACTIVE COMPOUNDS AND METABOLOMICS

ANTONELLA CASTAGNA

Anno accademico	2020/21
CdS	PLANT AND MICROBE BIOTECHNOLOGIES
Codice	380GG
CFU	9

Moduli	Settore/i	Tipo	Ore	Docente/i
COMPOSTI BIOATTIVI E METABOLOMICA	AGR/13	LEZIONI	84	ANTONELLA CASTAGNA

Learning outcomes

Knowledge
At the end of the course, the student will acquire a solid knowledge of the main classes of bioactive compounds and of the metabolic pathways responsible for their production, with particular regard to the secondary plant metabolism and to some bacterial and fungal pathways.
The student will also gain information related to the biotechnological production and to some alternative approaches to increase the production of bioactive molecules and will acquire knowledge on the biological properties of the different compounds, with particular regard to their nutraceutical action.

Assessment criteria of knowledge
The assesment of the knowledge acquired by the student will be ascertained through a written test at the end of the course, followed by an oral exam. The student must demonstrate the degree of learning of the topics covered during the course and his ability to correctly explain the main topics addressed.

Skills
At the end of the course, the student will have acquired solid theoretical knowledge related to different aspects of secondary metabolism, as well as scientific and technical skills related to the quantitative and qualitative analysis of bioactive compounds, through the execution of laboratory exercises.
The student will also have acquired knowledge about the different technological approaches that can be used for the production of secondary metabolites by plants and bacteria.

Assessment criteria of skills
The student must demonstrate the ability to put into practice and to perform, with critical awareness, the activities illustrated by the teacher or performed under the guidance of the teacher, both during practical exercises, and through the preparation of laboratory reports.

Behaviors
At the end of the course the student will be able to conduct and manage a team work and correctly use some main biochemical laboratory instruments and will have acquired precision and accuracy in the collection and processing of experimental data.

Assessment criteria of behaviors
During the laboratory sessions, behavior will be verified through the assessment of the degree of accuracy and precision of the activities carried out, the ability to manage the different phases of the experimental work and to face any problems and unexpected events.
Students will also be asked to report on the topics covered during the exercises and the experimental results obtained.

Prerequisites
General and inorganic chemistry. Organic chemistry. Agricultural biochemistry.

Teaching methods
Lectures are held with the aid of slides (power point presentations).
Practical exercises will be carried out in the didactic laboratory. Students will be divided into working groups.
Seminar lessons by experts in the sector are planned.

The teaching material (used in lectures and laboratory exercises) is available on the e-learning site of the course. E-learning site will also be used for teacher-student communications.
Student-teacher interaction also takes place through meetings and e-mail communications

Syllabus

The course will last 84 hours (48 hours lessons; 36 hours practical training)

1. Presentation of the course. The concept of secondary metabolism and metabolomics
2. Recalls of organic chemistry and biochemistry: nomenclature, enzymes, cofactors and prosthetic groups, notes on primary metabolism and the main biochemical cycles
3. The phenolic compounds
    - The path of scichimic acid
    - The biosynthesis of aromatic amino acids
    - Lignin biosynthesis
    - Phenylpropenes, benzoic acids, coumarins and psoralens
    - Quinones
    - Biosynthesis of complex phenols
        - Flavonoids
        - The hydrolysable and condensed tannins
        - Aurones, stilbenes
4. Terpenes
    - The mevalonic acid pathway
    - The MEP pathway
5. Nitrogen-containing secondary metabolites
    - Vitamins
        - Bacterial synthesis of some vitamins
    - Alkaloids
6. Glucosinolates
7. Plant metabolomics: study of metabolic profiles to characterize phenotypes of biotechnological interest
8. Plants as plant factories: examples of production of metabolites of biomedical interest in plants
9. Applications and development of biosensors in the analysis of plant products, in the food industry and in the monitoring of the production of metabolites

Excercitations (36 hours)

- Power Point presentations of the main experimental techniques used during the pratical excercitation
- Extraction of proteins and determination of enzyme activity by spectrophotometric assay and electrophoresis followed by specific staining
- Extraction and quantification of fruit and leaf carotenoids by HPLC analysis
- Extraction of total phenols and quantification of content of phenols and the main subclasses by spectrophotometric assays
- Evaluation of phenolic profile by HPLC analysis
- Evaluation of the antioxidant activity of plant samples
- Extraction and quantification of fruit ascorbic acid (vitamin C) by spectrophotometric assay
- Data analysis by Excel datasheets and statistical softwares

Seminars and lessons may be held by experts in the sector.

Bibliography

1. Slides and didactic material provided on e-learning website
2. Maffei M. – Biochimica vegetale. Piccin (1999)
3. Maffei M. – Metaboliti e prodotti secondari delle piante. UTET (1999)
4. Dewick P.M. – Medicinal Natural Products. A biosynthetic approach. 3rd Edition. John Wiley & Sons (2009) (English edition)
5. Dewick P.M. - Chimica, biosintesi e bioattività delle sostanze naturali. II edizione italiana sulla III edizione inglese. (2013)
6. Bidlack W.R, Omaye S. T., Meskin M. S., Topham D.K.W. - Phytochemicals as Bioactive Agents. CRC Press (2000)

Assessment methods

The exam will consist of a final written test, with a mark out of thirty, to be carried out at the end of the course or in an oral exam.
The written test consists of a series of questions concerning the topics covered during the course and has a duration of two hours

The oral test must be supported by students who have not reported the sufficiency (18/30) in the written test and by those who wish to improve the voting of the written test.

Both the written and oral tests must be integrated with the presentation of a report on the activities carried out during the escercises.

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Updated: 10/09/2020 16:01