

Course Unit	Chemistry of natural products	Field of study	Life Sciences
Master in	Natural Products and Bioprospecting	School	School of Agriculture
Academic Year	2023/2024	Year of study	1
Type	Semestral	Semester	1
Workload (hours)	162	Contact hours	T - , TP 60, PL - , TC - , S - , E - , OT 4, O -
Level	2-1	ECTS credits	6.0
Code	5012-740-1104-00-23		

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Clementina Maria Moreira dos Santos

### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Recognize and distinguish the difference between primary and secondary metabolites.
2. Identify the different pathways for synthesis of secondary metabolites and recognize and link the main families of natural products .
3. Understand and outline some common reactions in the biosynthesis of natural products.

### Prerequisites

Before the course unit the learner is expected to be able to:

Understand the general principles of chemistry and recognize the particularities of carbon chemistry

### Course contents

Summary of organic chemistry: nomenclature, hybridization, electronic and resonance effects, stereochemistry and reaction mechanisms. Primary and secondary metabolism. The evolution of secondary metabolites and their importance in the interconnection of living things. The metabolic pathways of natural products: acetate, mevalonate and the shikimate pathway. Structural characteristics of secondary metabolites. Common reactions in the biosynthesis mechanisms. Biosynthesis mechanisms.

### Course contents (extended version)

1. Introduction to the chemistry of natural products
  - Primary and secondary metabolism
  - The importance of secondary metabolites in the evolution of living beings
  - Functionality of secondary metabolites: the interaction between living beings
  - The metabolic pathways of natural products; acetate, shikimate and mevalonate
  - Origin and precursors for the different metabolic pathways
2. The acetate pathway. Structural characteristics and properties of its metabolites
  - Fatty acids
  - Polyketides and acetogenins
  - Prostaglandins
  - Antibiotics: macrolides and tetracyclines
  - Biosynthesis mechanisms.
3. The mevalonate pathway. Structural characteristics and properties of its metabolites
  - Terpenes
  - Steroids (triterpenoids) and vitamin D
  - Carotenoids (tetraterpenoids) and vitamin A
4. The shikimate pathway. Structural characteristics and properties of its metabolites
  - Benzoic and cinnamic acids
  - Coumarins
  - Lignans and lignins
  - Flavonoids and isoflavonoids
  - Tannins
5. Characteristics and properties of alkaloids. Classification
  - Derivatives of ornithine and lysine
  - Derivatives of aromatic aminoacids
  - Derivatives of tryptophan
6. Common reaction in biosynthesis
  - Claisen and aldolic condensation.
  - Elimination reactions and keto-enol equilibrium
  - Decarboxylation and transamination
  - Oxidative coupling of phenols
  - Aromatic electrophilic substitutions and nucleophilic substitutions
7. Summary revision or organic chemistry concepts
  - Nomenclature
  - Structure, hybridization and geometry
  - Electronic effects: inductive and resonance effects
  - Stereochemistry

### Recommended reading

1. Chemistry of Natural Products, Phytochemistry and Pharmacognosy of Medicinal Plants (2022) Ed. M. Napagoda, L. Jayasinghe, De Gruyter STEM
2. Medicinal Natural Products (2009) - P. M. Dewick, John Wiley & Son Ed. , 3rd Edition
3. Introduction to Natural Products Chemistry (2011) CRC Press

### Teaching and learning methods

Interactive approach, using audiovisual materials. Study materials available via e-learning.

### Assessment methods

1. Standard evaluation - (Regular, Student Worker) (Final)
  - Intermediate Written Test - 25% (Written exam - basic organic chemistry, nomenclature, coenzymes.)
  - Final Written Exam - 60% (Written exam: structural characterization, properties and biosynthesis of natural compounds.)

**Assessment methods**

- Reports and Guides - 15% (Continuous evaluation: reports, work in the class.)
- 2. 2nd Call - (Regular, Student Worker) (Supplementary, Special)
- Final Written Exam - 100% (Written exam - all contents of theoretical and practical lessons.)

**Language of instruction**

Portuguese

**Electronic validation**

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18-01-2024	19-01-2024	19-01-2024	20-01-2024