# .- Additives and Contaminants in Foods

## Prof. Paola Battilani, Prof. Terenzio Bertuzzi

***Text under revision. Not yet approved by academic staff.***

# Mycotoxin Module

## Prof. Paola Battilani

***COURSE AIMS*** ***AND INTENDED LEARNING OUTCOMES***

The aim of the course is to: 1) describe the main mycotoxigenic fungi and outline their ecological needs; 2) examine the role of mycotoxin-producing fungi in the production chains of wheat, maize and grapes, with brief notes on apples, peanuts and pistachios; 3) define the preventive and corrective actions that can be implemented along the aforementioned supply chains to mitigate mycotoxin contamination; 4) highlight the emerging problem of mycotoxin contamination in products of animal origin; 5) frame the relevance of mycotoxins worldwide. The practical activities will involve the use of biological methods to isolate mycotoxin-producing fungi and identify them at the level of genus and species, along with an outline of molecular methods.

The intended learning outcomes are detailed below.

Knowledge and ability to understand

At the end of the course, students will know and understand:

Problems related to mycotoxin contamination in the main production chains and possible preventive interventions.

Understanding and applying knowledge

At the end of the course, students will be able to:

Apply the acquired knowledge regarding the relevance of mycotoxin contamination for human and animal health, as well as the mitigating actions applicable to the fungi present on different crops, even those not specifically covered in the course.

Autonomous judging skills

At the end of the course the student will be able to:

Assess the impact of the main mycotoxins on production chains, as well as identify if and what actions can be implemented to mitigate contamination and the risks to consumers.

Communication skills

At the end of the course, students will be able to:

Appropriately use the scientific language and specific lexicon of the subject matter to describe and communicate the concepts learnt in oral and written form.

**Learning skills**

At the end of the course, students will be able to:

Supplement their knowledge on mycotoxins and related fungal producers through the autonomous consultation of specialised texts, scientific and educational magazines, including those topics not specifically discussed in lectures.

COURSE CONTENT

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| --- | --- |
|  | ECTS |
| Importance of mycotoxins worldwide. Main mycotoxin-producing fungi and their ecological needs. *Fusarium* spp and fusariosis of the wheat ear; optimisation of the wheat production chain to minimise the mycotoxin content. Keynotes on *Claviceps purpurea* and the alkaloids produced. | 1.0 |
| *Fusarium* spp and *fusariosis of the corn ear*, *Aspergillus* section *Flavi*in corn; optimisation of the corn production chain to minimise the mycotoxin content. *Aspergillus* section *Flavi* in peanuts and pistachios; outline of nut production chain management aimed at minimising the mycotoxin content. | 1.0 |
| *Aspergillus* section *Nigri* in grapes; optimisation of the production chain to minimise the mycotoxin content. *Penicillium expansum* in fresh produce with a particular focus on apples. *Penicillium* spp. in seasoned cured products derived from pork and cheese. | 1.0 |
| Laboratory classes  Applications of biological methods for the identification of mycotoxigenic fungi. Introduction to molecular methods. | 1.0 |

READING LIST

The PowerPoint presentations used during the course will be made available to students in pdf format on the Blackboard platform.

Since a reference text is not available, reading list indications, mainly based on recently published scientific articles, will be provided to students during the course.

TEACHING METHOD

Classroom lectures (3 ECTS), laboratory exercises (1 ECTS).

Frontal lectures will be conducted with the support of PowerPoint presentations.

A *cooperative learning* experience will be organised on the use of podcasts (short videos) as a means of communication. Workgroups will be organised to carry out a project on topics related to mycotoxins and of interest to students; the results of the work carried out will be presented collegially by the students in the form of a podcast.

The course will be supplemented with at least 1 in-depth seminar, to which experts on specific topics will be invited.

Practical tutorials will be carried out in the laboratory for the identification of mycotoxin-producing fungi.

ASSESSMENT METHOD AND CRITERIA

A formative assessment will be conducted in the second half of the course; this will assess students' communication skills through the presentation and discussion of podcasts prepared by the students upon conclusion of their project work.

The summative (final) assessment will be written. The test will consist of 25 closed-ended questions (multiple-choice, true/false) and 2 open-ended questions. The following marks are assigned for correct answers: 1 mark for closed questions; a maximum of 4 marks for open questions. For closed questions, any incorrect answer will result in a penalty of -0.5 marks. No mark is assigned to any question left unanswered. The maximum mark obtainable in the summative assessment will be 33/30. The total duration of the written test will be 25 minutes. A mark of 18/30 is required to pass the exam. The results of the summative assessment will be made available to students on the Blackboard platform.

The lecturer will organise a meeting with the students, after the summative assessment has been carried out, in order to discuss any doubts regarding the test.

NOTES AND PREREQUISITES

Class attendance, although not compulsory, is strongly recommended.

Students taking the course should have knowledge of funghi and their characteristics.

Should the health situation relating to the Covid-19 pandemic not allow face-to-face teaching, remote teaching in synchronous or asynchronous mode will be guaranteed; this will be communicated in good time to students.

Information on office hours available on the teacher's personal page at http://docenti.unicatt.it/.

# Analysis Module

## Prof. Terenzio Bertuzzi

COURSE AIMS AND INTENDED LEARNING OUTCOMES

The course aims to provide students with advanced knowledge for evaluating foodstuffs in relation to their micronutrients, additives and contaminants.

The first part of the module aims to provide students with the basics of the most advanced analytical techniques for checking additives and contaminants in food. The second part provides the student with an overview of European legislation concerning food contaminants. All contaminants for which a legal limit is envisaged will be dealt with, with a particular focus on toxic metals, mycotoxins, dioxins and polychlorinated biphenyls, polycyclic aromatic hydrocarbons, pesticides, and acrylamide. The origin (natural, anthropic, processed), toxicity, diffusion, legislation and analysis methods for each class of contaminants will be dealt with.

The third part provides the student with a general overview of the European legislation concerning food additives, and examines in detail the colourants, preservatives, sweeteners and antioxidants which may be used. The origin (natural, synthetic), usage modalities, possible toxicological problems, and control techniques of these additive classes will be dealt with.

In particular, at the end of the course students will possess the following knowledge and ability to understand:

* the most advanced analytical techniques (screening and confirmatory) for analysing contaminants and additives present in food, even at a trace level; this goal will be achieved through both lectures and specific laboratory tutorials;
* the origin and spread of food contaminants, toxicological problems, European legislation and methods of analysis;
* assess which contaminants are most at risk in the main food supply chains and the methods of prevention and control;
* the European legislation concerning food additives, the classes into which they are divided, and their methods of use and control;
* determine, based on the analysis data reported in a test report, whether a batch is compliant or non-compliant under current legislation.

Furthermore, students will have developed the following skills:

* Interpret and evaluate the results of analyses relating to the presence of contaminants and additives;
* Perform even advanced laboratory instrumental techniques (LC-MS and GC-MS);
* Interpret analytical results including the validation parameters, and compare them with the values provided for by legislation.

COURSE CONTENT

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| --- | --- |
| Topics | ECTS |
| Advanced instrumental techniques for food control. | 1.5 |
| Validation of an analysis method, screening and confirmatory methods, measurement uncertainty (keynotes). The official sampling methods for food control. | 0.5 |
| Characteristics and analysis of fat-soluble and water-soluble vitamins, analysis of natural and synthetic xanthophylls. | 0.5 |
| European legislation on food additives. Characteristics, usage methods, analysis and legislation of colourants, sweeteners, preservatives, antioxidants. | 1 |
| Characteristics, dissemination, analysis and legislation of the main natural toxic factors and toxic residues in food. | 1.5 |
| The main mycotoxins: chemical, biological, toxicological aspects. Risk assessment and legislative limits. Decontamination and detoxification interventions. | 1 |
| Laboratory tutorials | 1 |

READING LIST

P. Cabras-C. Tuberoso, *Analisi dei prodotti alimentari,* Piccin, Padua, 2014.

P. Cabras-A. Martelli, *Chimica degli alimenti,* Piccin, Padua, 2004.

IJ Jeon-WG Ikins, *Analyzing food for nutrition labeling and hazardous contaminants,* Marcel Dekker, New York, Basel, Hong Kong, 1995.

G. Cerutti, *Residui,* *additivi e contaminanti negli alimenti*, Tecniche Nuove, Milan, 1999.

T.P. Coultate, *La chimica degli alimenti,* Zanichelli, Bologna, 2009.

TEACHING METHOD

The course is divided as follows:

Classroom lectures (6 ECTS);

Laboratory activities (1 credit).

Frontal lectures will be conducted with the support of PDF presentations. The presentations in PDF used during the course will be made available to students on the Blackboard platform.

The laboratory activities will consist of 4 tutorials of 3 hours each. The tutorial topics will cover the application of analytical techniques instrumental to the analysis of certain additives and contaminants. In principle, the topics will be as follows: 1) analysis of aflatoxins in cereals and oilseeds by HPLC with fluorimetric detection; 2) analysis of acrylamide in potato chips and coffee by HPLC with MS/MS (triple quadrupole) detector; 3) analysis of vitamins A and E in supplements and foods by HPLC with fluorimetric detection; 4) analysis of nitrates and nitrites in preserved plants and meats by HPLC with UV detection; 5) analysis of fumonisins in corn and derivatives by HPLC with MS/MS (triple quadrupole) detector.

ASSESSMENT METHOD AND CRITERIA

The course includes an interim test on the content covered in the first part of the module (after about 22 hours), and a final test at the end of the module. These tests will both be written; they will last two hours and will be based on eight open-ended questions. The eight questions will be of equal weight, evaluated with a mark out of thirty, and will also cover the laboratory activities. The test mark will be based on the arithmetic average of the marks for the eight questions; to pass the exam, the student must obtain a mark of at least 18/30 for both the first and the second part of the course. The written tests are optional. For the student who passes both interim tests, the exam will be based on a brief discussion of the topics covered in the written tests.

At the end of the module and in subsequent sessions, the exam will be carried out in written or oral form, at the student's choice. For students who did not take or failed to pass the interim tests, the oral exam will focus on the entire programme, including the laboratory exercises.

NOTES AND PREREQUISITES

During the course further reading indications will be provided.

The laboratory tutorial cycle envisages the checking of attendance and compliance with the safety regulations already included in the previous tutorials.

It is recommended that students possess a fair knowledge of the main basic notions of general and inorganic chemistry, food chemistry and analytical chemistry.

Information on office hours available on the teacher's personal page at http://docenti.unicatt.it/.