People's Democratic Republic of Algeria
Ministry of Higher Education and Scientific Research

Training Program

L.M.D
Academic License
Academic Year: 2017–2018

Institution	Faculty	Department
University of Jijel	Natural and Life Sciences	Department of Applied Microbiology and Food Sciences

Field	Branch	Specialty
Natural and Life Sciences	Food Sciences	Food Industry Technology and Quality Control

Semester 5

Teaching Unit	Total hours	Weekly hours				Coefficient	creadit	Evaluation mode	
	15 weeks	Cours	Lecture	Practical woork	others			Continuous (40%)	Final exam 60%)
Core Teaching Unit									
UEF 3.1.1 (O/P)									
Subject 1 : Food Microbiology	45h00	1h30	-	1h30	55h00	2	4	x	X
Subject 2 : Food Biochemistry	67h30	3h00	-	1h30	82h30	3	6	x	X
UEF 3.1.2 (O/P)									
Subject 1 : Food Processing Technology**1**	67h30	3h00	-	1h30*	82h30	3	6	x	X
Subject 2 : Food Hygiene and Safety	22h30	1h30	-	-	2h30	1	2	x	X
Methodological teaching unit									
UEM 3.1.1 (O/P)									
Subject 1: Microbiological Control technique	67h30	1h30	-	3h00	82h30	3	6	x	x
Subject 2 : Analytical chemistry	37h30	1h30	-	1h00	37h30	2	3	x	x
Discovery Teaching Unit									
UED 3.1.1 (O/P)									
Subject 1 : Valorization of Food By-products	**45h00**	**1h30**	**-**	**1h30**	**5h00**	**2**	**2**	**x**	**x**
Transversal Teaching unit									
UET 3.1.1 (O/P)									
Subject : Laboratory Organization and Management	22h30	1h30	-	-	2h30	1	1		x
Total semester 5	**375h00**	12h00	1h30	11h30	**375h00**	**17**	**30**		

Semester 6

Teaching Unit	VHS	V.H hebdomadaire				Coefficient	Creadits	Evaluation mode	
	15weeks	Cours	Lecture	Practical woork	others			Continuous (40%)	Final exam (60%)
Core Teaching Unit									
UEF 3.2.1 (O/P)									
Subject 1 : Food Toxins	45h00	1h30	-	1h30	55h00	2	4	x	x
Subject 2 : Analytical Techniques	67h30	3h00	-	1h30	82h30	3	6	x	x
UEF 3.2.2 (O/P)									
Subject : Food Processing Technology 2	90h00	3h00	-	3h00	110h00*	4	8	x	x
Methodological teaching unit									
UEM 3.2.1 (O/P)									
Subject 1: Industrial Microbiology	67h30	3h00	-	1h30	82h30	3	6	x	x
Subject 2 : Sensory Evaluation	37h30	1h30	-	1h00	37h30	2	3	x	x
Discovery Teaching Unit									
UED 3.2.1 (O/P)									
Subject 1 : ا Molecular Biology	45h00	1h30	1h30	-	5h00	2	2	x	x
Transversal Teaching unit									
UET 3.2.1 (O/P)									
Subject : Free and Open Source Software	22h30	1h30	-	-	2h30	1	1		x
Total semestre 6	**375h00**	15h00	3h00	7h00	**375h00**	**17**	**30**		

Detailed Program by Subject for the Fifth and Sixth Semesters

Semester: Fifth
Core Educational Unit 1 (UEF 3.1.1)
Subject 1: Food Microbiology
Credits: 4
Coefficient: 2

Teaching Objectives:
The aim of teaching Food Microbiology is to provide students with the necessary knowledge about the main microorganisms of importance in the agri-food industry, to assess the sanitary quality and hygiene of food products, and to highlight that the growth of such microorganisms can lead to health problems when pathogenic germs are involved.
From a technological perspective, emphasis is also placed on the properties and capacities of these microorganisms in the production of useful substances for the food and biotechnological industries.

Recommended Prerequisite Knowledge:
General microbiology, biochemistry, microbiological analysis, chemistry, etc.

Course Content:
In general, the content of the Food Microbiology course covers the following topics:

- Identification of microorganisms of importance in the food sector, especially bacteria and fungi (yeasts and molds), including their classification, properties, and their effects on food safety and quality.
- Study of the effects of food processing techniques (such as heat, refrigeration, and chemical agents) on the growth, inhibition, or destruction of these microorganisms.

- Discussion of microbial issues in the food industry, including various sources of contamination (air, workers, raw materials) and production-related incidents.
- Use of microorganisms in biotechnological processes to produce useful compounds such as amino acids, vitamins, and proteins.
- Identification of foodborne intoxications and infections, such as salmonella poisoning or poisoning caused by mycotoxins.

- **The practical aspect** focuses on the **microbiological analyses** of various types of food to assess their quality and safety (milk, meat, plant-based products, water, etc.).

This content aims to enable the student to understand the role of microbes in food from both **health and technological perspectives**, and to apply this knowledge in the field of **control and quality assurance** within the food industry.

Core Educational Unit 1 (UEF 3.1.1)
Subject 2: Food Biochemistry
Credits: 6
Coefficient: 3

Teaching Objectives:
The aim of teaching Food Biochemistry is to introduce students to the main nutritional components and their importance in terms of technological and functional properties.
This course also aims to enable students to understand the biochemical changes or transformations that occur in these components during food processing operations.

Recommended Prerequisite Knowledge:
Biochemistry, chemistry, physics, thermodynamics, etc.

Course Content:
In general, the content of the Food Biochemistry course involves the study of the basic food components such as water, proteins, lipids, and polysaccharides, and the analysis of their physical, chemical, and functional properties.
The course also focuses on:

- The reactions of these components during processing and storage operations,
- Their technological and nutritional importance,

- Understanding the mechanisms of food spoilage (microbial, enzymatic, chemical).

The course aims to enable the student to link the biochemical composition of food components with the ways to control them in order to improve the quality and safety of food products.

Core Educational Unit 2 (UEF 3.1.2)
Subject 1: Food Industry Technology 1 (Technologie des IAA 1)
Credits: 6
Coefficient: 3

Teaching Objectives:
This course aims to enable students to master the techniques and processes involved in the transformation of milk, sugar, and fats by studying the various technological stages used in the food industry.

Recommended Prerequisite Knowledge:
Chemistry, biochemistry, microbiology, physics, thermodynamics, energy science, etc.

Course Content:
In general, the content of the course "Food Industry Technology 1" covers the processing techniques of basic food materials across four main sectors:

1. **Milk and Dairy Products**
   Students will learn about:

- The composition of milk and its biochemical components,
- The manufacturing processes of milk, butter, cheese, and ice cream,
- The treatment and utilization of by-products from the dairy industry.

2. **Sugar Industry**
   Covers:

- The stages of sugar production from sugar beet (preparation, extraction, purification, evaporation, crystallization),

- Raw sugar refining processes such as filtration, concentration, and packaging.

3. **Fats and Oil Industry**
   Includes:

- The characteristics of raw fats and chemical processes such as hydrolysis, saponification, and esterification,
- Oil extraction techniques (pressing, solvent extraction, refining),
- Margarine production, microbiological considerations, legal aspects,
- And olive oil production technology.

4. **Beverages (especially juices and soft drinks)**
   Includes:

- Economic aspects,
- Juice production stages (preparation, extraction, treatment, pasteurization),
- Components of soft drinks, their manufacturing processes, and packaging.

The course aims to help students understand the entire food production chain — from raw material to final product — with an emphasis on technical and practical aspects.

Core Educational Unit 2 (UEF 3.1.2)
Subject 2: Food Hygiene and Safety
Credits: 4
Coefficient: 2

Teaching Objectives:
This course aims to study compliance with hygiene and food quality requirements in order to protect consumer health. It also seeks to equip students with the necessary tools to understand and monitor the concept of quality from the perspective of the consumer, the user, and professionals in the food industry sector.

Recommended Prerequisite Knowledge:
Microbiology, food microbiology, biochemistry, and food biochemistry.

Course Content:
In general, the content of the Food Hygiene and Safety course covers the following:

Chapter 1: What is meant by quality?
Definition of the concept of quality in food products.

Chapter 2: Components of quality
Includes the study of:

- Quality labels that distinguish a product,
- Quality tools used for control and monitoring,
- Good Hygiene Practices (GHP),
- Hazard Analysis and Critical Control Points (HACCP) system,
- ISO 22000 standards for food safety management.

Practical Training:
Visits to production units that have implemented the HACCP system and/or obtained ISO 22000 certification, to assess good hygiene practices, monitor critical control points (CCPs), and review the preventive control procedure plan (PRPO).

This course focuses on understanding and applying food quality and safety assurance systems to protect consumer health and improve product quality.

Methodological Educational Unit (UEM 1)
Subject: Microbiological Control Techniques
Credits: 3
Coefficient: 2

Course Objective:
This course aims to introduce students to the concepts of microbiological control of food products, how to interpret test results, and finally, how to compare these results with national and/or international standards.

Required Prerequisite Knowledge:
A solid understanding of general microbiology is required.

Course Content:
In general, the content of the course *Microbiological Control Techniques* includes the following topics:

- Introduction to microbiological control
- Purpose of microbiological analysis
- Objectives of microbiological control
- Control policies and quality assurance
- Implementation of microbiological control throughout the production chain
- Hygiene in facilities, equipment, and personnel
- Risk analysis to control critical points: the HACCP system (Hazard Analysis and Critical Control Points)

This course focuses on understanding and implementing microbiological control to ensure the safety and quality of food products, by monitoring all stages of production while adhering to hygiene practices and risk management systems.

Subject 1: Analytical Chemistry
Credits: 3
Coefficient: 2

Course Content:
This course enables students to gain a broader understanding of the importance of chemistry in the field of quality control, in addition to mastering techniques for analyzing various types of molecules.

Required Prerequisite Knowledge:
To properly grasp the course content, students should have prior knowledge in general chemistry, inorganic chemistry, and organic chemistry.

In general, the *Analytical Chemistry* course covers three main areas:

1. Techniques for Analyzing Inorganic Molecules

- Titrimetric methods (using standard solutions)
- Potentiometric methods (measuring electric potential)
- Amperometric methods (measuring electric current)
- Polarographic methods (measuring current generated by ions in solution)
- Colorimetric analysis
- Conductometric analysis (electrical conductivity)

2. Techniques for Analyzing Organic Molecules

- Molecular absorption spectroscopy
- Molecular fluorescence spectroscopy
- Atomic absorption and emission spectroscopy
- Infrared spectroscopy
- Nuclear magnetic resonance (NMR) spectroscopy

3. Extraction Techniques

- **Traditional methods:** such as enfleurage, maceration, decoction, and infusion
- **Modern methods:** solvent extraction, steam softening, or steam distillation (hydrodistillation)

This content covers a wide range of essential analytical methods used to study and identify components of inorganic and organic substances, as well as techniques for extracting materials from various sources.

Exploratory Educational Unit (UED 1)
Subject 2: Valorization of Food Industry By-products
Credits: 2
Coefficient: 1

Course Description:
This course aims to introduce students to the environmental pollution caused by by-products of the food industry. Accordingly, students will learn methods for utilizing these by-products and strategies for turning them into profitable resources.

Required Prerequisite Knowledge:
To properly understand this course, students should have knowledge in food biochemistry, food microbiology, and food industry technologies (TIAA).

Course Content:
In general, the content of the *Valorization of Food Industry By-products* course includes:

- Treatment and utilization of municipal and industrial wastewater
- Utilization of dairy industry by-products
- Utilization of by-products from slaughterhouses
- Utilization of sugar factory by-products
- Utilization of cereal mill by-products
- Utilization of seafood industry by-products
- Utilization of oil factory by-products
- Utilization of paper factory by-products
- Other topics: plant biomass and protein production from single-cell organisms

This course focuses on various methods for treating and converting by-products from several food and non-food industries in order to benefit from them and reduce environmental impact.

Transversal Educational Unit (UET 1)
Subject: Laboratory Organization and Management

Credits: 2
Coefficient: 1

Course Description:
This course provides students with a comprehensive overview of the organization of various types of laboratories, as well as skills in managing them effectively.

Required Prerequisite Knowledge:
To understand this course properly, students should have knowledge in biology, toxicology, and chemistry.

Course Content: Laboratory Organization and Management

Chapter 1:

1. **Types of Laboratories** (preliminary testing, detailed analyses) with the characteristics of each type, such as:
    - Physicochemical analysis
    - Rheological analysis
    - Microbiological analysis
    - Toxicological analysis
2. **Laboratory Design:**
    - Location of the laboratory (inside or outside the production unit)
    - Building design and access routes
    - Design and installation of measuring equipment

Chapter 2:

1. **Analysis and Control Activities:**
    - Organization of analyses (daily records, sampling, etc.)
    - Coding and labeling
    - Inventory and stock management
2. **Financial and Accounting Management**
3. **Human Resource Management**

This content covers the technical, organizational, and managerial aspects necessary for comprehensive laboratory management.

Semester: 6
Core Educational Unit 1 (UEF 3.2.1)
Subject 1: Food Toxicology
Credits: 4
Coefficient: 2

Learning Objectives:

This course aims not only to explain how to establish a protocol for assessing the safety of substances that may be present in food, but also to study the biochemical approach to the interactions between toxins and the human body. It aims to explain the mechanisms of toxicity. Therefore, when facing a diet compromised by contaminants or the addition of xenobiotics, the course explains the dual aspects of the toxin-body interaction, introducing the concepts of **toxicokinetics** and **toxicodynamics** regarding the effects of toxins.

Recommended Prerequisite Knowledge:

Physiology, chemistry, biochemistry, microbiology.

Course Content:

In general, the Food Toxicology course is designed to introduce students to methods for assessing the safety of substances found in food and to understand the chemical and biological interactions between these substances and the human body.

The course explains:

- How toxins enter the body,
- The different stages of their effects (exposure, biotransformation, and biological effects),
- How to assess their toxicity.

It also covers:

- Factors influencing the severity of poisoning,
- Mechanisms of toxin activation and deactivation,
- Distribution models within the body and their impact on specific organs.

Finally, the course includes case studies to help students understand the practical application of these concepts in real-world scenarios.

Semester: 6
Core Educational Unit 1 (UEF 3.2.1)

Subject 2: Analytical Techniques

Credits: 6
Coefficient: 3

Course Objectives:

This course aims to develop students' understanding of the concepts related to **automated analytical methods** used in **food quality control**. The course is structured around three main areas:

1. A concise overview of analytical methods' principles,
2. Description and operation of analytical instruments,
3. Interpretation of results.

Due to the wide variety of automated analytical methods, this course will focus on those most commonly used in the food industry.

Recommended Prerequisite Knowledge:

Chemistry, physics and optics, analytical instruments, etc.

Course Content:

Chapter 1: Review of Basic Concepts

1. **General information on good laboratory practices (GLP):**
    - 1.1. Organizational measures
    - 1.2. Equipment
    - 1.3. Chemicals (hazard information, risks, storage, and waste management)
    - 1.4. Classical operations
    - 1.5. Facilities (premises/laboratories)
    - 1.6. Laboratory behavior
2. **General information on solutions:**
    - 2.1. Definitions (solute, solvent, concentrations)
    - 2.2. Units of concentration
3. **Solution preparation methods:**
    - 3.1. Gravimetric method (by weight)
    - 3.2. Dilution method
    - 3.3. Cross method (methode de la croix)

Chapter 2: Chemical and Physicochemical Analysis Methods

1. **Chemical analysis methods:**
    - 1.1. Gravimetric analysis (Gravimetry)
    - 1.2. Volumetric analysis (Volumetry)
2. **Physicochemical methods:**
    - 2.1. pH measurement (pH-metry)
    - 2.2. Electrical conductivity (Conductimetry)
    - 2.3. Polarography

Chapter 3: Physical Analysis Methods

1. **Spectroscopic methods:**
    - UV-Visible spectroscopy
2. **Chromatographic methods:**
    - Thin-layer chromatography (TLC)
    - Gas chromatography (GC)
    - High-performance liquid chromatography (HPLC)
3. **Other analytical techniques:**
    - Polarimetry
    - Refractometry
    - Flame emission and atomic absorption spectroscopy
    - Electrophoresis

This content equips students with comprehensive theoretical and practical knowledge of various analytical techniques critical for ensuring food safety and quality in modern laboratories.

(UEF 3.2.2) 2

Subject: Agro-Food Industries Technology 2

Credits: 6
Coefficient: 3

Learning Objectives:

This course aims to equip students with a solid command of the techniques and processes used in the **processing of cereals, fruits and vegetables, meat, and fish**.

Recommended Prerequisite Knowledge:

Chemistry, biochemistry, microbiology, physics, thermodynamics, energetics, etc.

Course Content:

Part I: Cereal Technology

Introduction – Classification – Cereal chains – Global cereal usage

I. Cereal Grains:

- General structure
- Tissue structure
- Chemical composition
    - Intermediate composition
    - Distribution of components within the grain

II. Wheat:

- Properties of wheat proteins
- Primary processing: cleaning, preparation, milling
- Industrial processing:
    - Bread making
    - Pasta production
    - Couscous production

III. Wheat Quality Evaluation:

- Soft wheat: baking value, bread test
- Durum wheat: semolina value, pasta value, couscous value

IV. Corn Industry:

- General information
- Corn processing

V. Rice:

- General information
- Primary processing (hulling)
- Secondary processing
- Cooking quality

Practical Work: Visit to a flour mill and semolina factory

Part II: Fruit and Vegetable Technology

Introduction – Importance of preservation techniques – Spoilage factors – Ripening

I. Pre-preservation treatments:

- Washing, sorting, blanching

II. Thermal preservation:

- Commercial sterilization (Appertization)
- Filling, stuffing, sealing
- Preheating

III. Sterilization:

- General overview
- Sterilization of acidic and non-acidic products
- Sterilization equipment
- Sterilization defects
- Use of sterilized products
- Microwave processing

IV. Canning Techniques:

- Vegetables
- Fruits

V. Cold preservation:

- General overview
- Pre-cooling, cooling, modified atmosphere storage
- Freezing, rapid freezing

VI. Drying:

- Introduction
- Relationship between drying characteristics and food properties
- Storage of dried foods
- Drying equipment and methods
- Freeze-drying (Lyophilization)

VII. Chemical treatments:

- Treatments that do not alter sensory characteristics
- Treatments that alter sensory characteristics

- Fermentation

VIII. Ionizing radiation processing:

- General overview
- Basic effects on foods
- Applications

Part III: Meat and Fish Technology

- **Challenges in the meat sector:** Presentation of production chain issues and challenges
- **Meat composition and structure:** Components and physical structure
- **Primary processing:** Slaughtering techniques for cattle, sheep, and poultry
- **Slaughter by-products:** Valorization of the “fifth quarter” (skins, offal, etc.)
- **Fish:** Composition and characteristics
- **Cold processing:** Refrigeration, freezing, rapid freezing of meat and fish
- **Tertiary processing of meat:** Cooking, mincing, salting, preparation of sausages and pâté
- **Canned fish products:** e.g., sardines and tuna

This comprehensive course gives students technical and practical insight into industrial processing techniques for plant- and animal-based raw materials, emphasizing both product quality and preservation.

Subject: Sensory Analysis

Credits: 4
Coefficient: 2

Course Objectives:

To enable the student to:

- Link the sensory quality of a product to other factors that may cause its deterioration (e.g., microbiological quality).
- Select the appropriate test to evaluate the sensory quality of a product.

Required Prerequisite Knowledge:

- Familiarity with biostatistics
- Knowledge of food composition and quality
- Understanding of factors influencing sensory characteristics (taste, odor, texture, etc.)

Course Content:

I. Basic Concepts in Sensory Physiology

- Study of the senses and their role in evaluating food properties.

II. Sensory Analysis

- Conditions related to:
    - The environment
    - The panelists

    - The samples
- Organization of the tasting panel:
    - Selection
    - Training
    - Monitoring
    - Guidelines
- Types of tests:
    - Discriminative tests
    - Descriptive tests

III. Sensory Analysis Tests

- **Triangle test**
- **Duo–trio test**
- **A/Not-A test**
- **Two-out-of-five test**
- **Ranking and scoring tests**

IV. Instrumental Methods

- Instrumental evaluation of:
    - **Color and odor**
    - **Texture (structure/consistency)**

V. Evaluation Panels

- Types of panels:
  - **Hedonic panels (preference-based)**
  - **Analytical panels**
  - **Quantitative panels**
- Preparation of sensory analysis reports

VI. Statistical Models

- Use of statistics to analyze and interpret sensory data.

This course is designed to provide students with the theoretical foundation and practical tools needed for effective sensory evaluation of food products, integrating both human perception and instrumental techniques.

Discovery Educational Unit 1 (UED 1)

Subject: Molecular Biology

Credits: 4
Coefficient: 2

Course Objectives:

This course aims to introduce the basics of:

- **Molecular biology**
- **Genetic engineering**
- **An introduction to bioinformatics** (genomic databases)

Main Goals:

1. Understand the **structure and organization of the genome**, along with complex processes such as **transcription, translation, replication, and repair**.
2. Handle DNA: **gene transfer**, **mutagenesis** (mutation techniques).
3. Get acquainted with **molecular biology tools and techniques**, such as **PCR** and **DNA sequencing**.

Recommended Prerequisite Knowledge:

Part I: Molecular Biology

- **Genetic information expression**:
  - **Protein synthesis** (transcription and translation)
- **Regulation of gene expression**:
  - Control at the **transcriptional and translational levels**
- **Basic techniques**:
  - **Nucleic acid preparation** (extraction and purification)
  - **Nucleic acid separation** (agarose gel electrophoresis, pulsed-field gel electrophoresis)
  - **Detection and characterization** (blotting, labeling, hybridization)
  - **DNA sequencing**
  - **Nucleic acid amplification** (PCR, RT-PCR)

This course provides students with the theoretical foundations and practical tools needed to understand the molecular mechanisms of life and equips them to apply modern molecular biology techniques in research or biotechnology contexts.

Subject: Industrial Microbiology

Credits: 4
Coefficient: 2

Course Objective:

To introduce students to the use of **microorganisms in industry**, their **impact on product quality**, and their **role in food preservation**.

Prerequisites:

A solid understanding of:

- **General microbiology**
- **Food microbiology**
- **Food industry technology**

Course Content:

1. **Main categories** of fermentation-derived products
2. **Steps** of the fermentation process
3. **Growth media** for industrial fermentation processes
4. **Design and construction** of **bioreactors (fermenters)**
5. **Microbial growth dynamics**
6. **Techniques** for evaluating **microbial counts** and **growth curves**
7. **Dynamics of metabolite production** (secondary products)
8. **Use of microorganisms** in the **food industry**

This course provides the theoretical and practical basis for understanding how microorganisms are harnessed in industrial processes, especially in the production and preservation of food products.

Transversal Educational Unit: Free and Open-Source Software

Subject: Free Software
Credits: 1
Coefficient: 1

Objectives:

- To deepen the use of **free software** in **scientific research** in **natural and life sciences (SNV)**.
- To develop **advanced skills** in **data management and analysis**.
- To design **open science projects** in **biology and environmental sciences**.
- To train students in the use of **open and collaborative scientific tools**.

Course Content:

Part 1: Open Science and Advanced Data Management

- Definition and importance of **open science**
- **Reproducibility principles** in scientific research
- **Open data formats** and interoperability
- **Collaborative work** using **Git** and **GitHub**

Part 2: Advanced Programming and Automation (6.5 hours)

- Advanced **Bash scripting** for automation

- Advanced **statistical analysis** using **R** and **Python**
- Creating **interactive dashboards** with **Shiny** and **Jupyter Notebook**

Part 3: GIS and Modeling (5 hours)

- Advanced **spatial analysis** using **QGIS** and **GRASS GIS**
- **Species distribution modeling** using **MaxEnt**

Part 4: Bioinformatics and Environmental Applications (5 hours)

- **Gene sequence analysis** using **BioPython** and **MEGA**
- Using **TensorFlow** for analyzing **biological images**
- **Case studies** in **environmental science** and **bioinformatics**

Practical Work (TPs):

- **TP1:** Collaborative development of an **open science research project** using **Git/GitHub** and **Jupyter Notebook**
- **TP2: Spatial analysis** of a **nature reserve** using **QGIS** and **biological data analysis** using **R/Python**
- **TP3: Open science project** in **biology or environmental science**, including **report writing** and **interactive presentation**

Personal Work:

- Writing a **summary report** explaining the results of each practical exercise