

**COURSE DATA****Data Subject**

<b>Code</b>	34004
<b>Name</b>	Transformation and Conservation
<b>Cycle</b>	Grade
<b>ECTS Credits</b>	12.0
<b>Academic year</b>	2021 - 2022

**Study (s)**

<b>Degree</b>	<b>Center</b>	<b>Acad. year</b>	<b>Period</b>
1103 - Degree in Food Science and Technology	Faculty of Pharmacy and Food Sciences	2	Annual

**Subject-matter**

<b>Degree</b>	<b>Subject-matter</b>	<b>Character</b>
1103 - Degree in Food Science and Technology	16 - Processes of the food industry	Obligatory

**Coordination**

<b>Name</b>	<b>Department</b>
GAMERO LLUNA, MARIA DESAMPARADOS	265 - Prev. Medicine, Public Health, Food Sc.,Toxic. and For. Med.
GANDIA GOMEZ, MONICA	265 - Prev. Medicine, Public Health, Food Sc.,Toxic. and For. Med.

**SUMMARY**

Transformation and Preservation is an obligatory subject in the second year of the Degree in Food Science and Technology, at the Faculty of Pharmacy, University of Valencia. This subject has 12 ECTS credits.

Foods suffer constant changes due to endogenous and exogenous agents that lead to alterations during storage. These alterations are physical (weight loss, odor, flavor or color), biochemical (autolysis, oxidation) or biological (mold or bacterial growth). It is very important to note that alterations are not always harmful. For example, there are alterations produced by the growth of microorganisms that yield food, as in the case of yogurt, cheese or beer. There are also chemical changes that lead to organoleptic changes as the aging of wine. Except these positive cases, and focusing on the negative, there are two interesting concepts. On one hand the preservation and the need to avoid the food spoilage, on the other,



the shelf life of a food as the period of time that food can be consumed without loss of organoleptic and nutritional characteristics. The food industry uses a wide range of preservation processes for extending shelf life of foods and to ensure food security in the best quality.

Nowadays, there is a large number of transformation processes for the manufacturing of food products that involve modifying operations on the size and texture as well as separation of components for further processing or disposal.

This subject addresses major processes of transformation, preservation and packaging applied in the food industry as well as the main emerging technologies.

## PREVIOUS KNOWLEDGE

### Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

### Other requirements

To have completed the subjects Biology, Physics, Chemistry, Biochemistry and Microbiology.

## OUTCOMES

### 1103 - Degree in Food Science and Technology

- Conocer los procesos industriales de transformación y conservación de los alimentos así como las tecnologías de envasado y almacenamiento.  
Conocer los procesos de transformación y conservación particulares de los principales tipos de industrias alimentarias.
- Conocer los mecanismos y parámetros para el control de los procesos y los equipos de la industrial alimentaria. Conocer los sistemas de control y optimización de procesos y productos aplicados a los principales tipos de industrias alimentarias.
- Apply the knowledge of transformation and preservation processes to the development of new processes and products.
- Analizar y evaluar los riesgos alimentarios derivados de los distintos procesos de transformación, conservación y envasado. Conocer los riesgos alimentarios particulares de las principales industrias alimentarias.
- Apply emerging technologies of food processing and preservation to develop new products with improvements in quality, costs and environmental impact.



## LEARNING OUTCOMES

- To know the processes used in the food industry for processing, preservation, packaging, storage and transportation of food.
  - To identify the most appropriate methodologies for the preservation of foods based on food types and degree of quality desired.
  - To know and understand how work the equipments used for preserving and processing of foods.
  - To have a critical attitude with current and future technologies and be able to argue and make reasoned decisions.
- To know how to apply environmental sustainability criteria to the processes applied in the food industry.

## DESCRIPTION OF CONTENTS

### 1. Introduction

TOPIC 1. Introduction to food technology

What is Food Technology? Brief history of Food Technology. Objectives of Food Technology. Basic references. Agro-food sector. Types of food industries. Processes and unitary operations. Flow diagrams: examples.

TOPIC 2. Causes of food spoilage

What is Food spoilage? Main spoilage agents of foods. Food spoilage mechanisms. Shelf life concept. Purpose of Food Preservation.

### 2. Thermal methods of preservation

Topic 3. Introduction to the fundamentals of thermal processing

Description of canned foods. Thermal inactivation kinetics of micro-organisms. Mechanisms of microbial thermal resistance. Effects of heating on enzymes.

TOPIC 4. Calculation and validation of sterilization processes

Determination of the required lethality. Heat temperature-time profiles. Process lethality determination (F value). Process optimisation: effect of heating on food components. Validation of the thermal processes.

TOPIC 5. Installations for heat processing and applications

Pasteurization and sterilization equipment for in batch processing of foods. Continuous processing and aseptic packaging. New heating technologies. Applications of heat in the food industry.



### **3. Food preservation by low temperatures**

TOPIC 6. Food refrigeration systems and applications

Fundamentals of food refrigeration. Effects of low temperatures on microorganisms. Chilling systems. Shelf life of refrigerated food and safety and quality issues. Other applications in the food industry.

TOPIC 7. Food preservation by freezing

The freezing process in biological materials. Mode of preserving action. Effects of freezing and frozen storage on the quality of foods. Thawing process.

TOPIC 8. Food freezing methods

Industrial Freezing Production. Equipment and methodology for freezing foods. Description of Storage Cameras for refrigerated and frozen foods.

### **4. Preservation by low water activity**

TOPIC 9. Basics of water activity

Water in foods. Terminology: Water activity, Sorption Isotherms, Hysteresis Phenomenon. Influence of water activity on the safety and the quality of foods.

TOPIC 10. Food drying

Food drying basics. Psychrometric notions. Effects of moisture on solid properties. Thermal drying process.

TOPIC 11. Equipments and methods for drying

Principal characteristics of drying equipments. Classification of Drying Methods. Freeze-Drying Technique. Osmotic dehydration.

TOPIC 12. Food concentration

Fundamentals of food concentration. Vacuum system for food concentration. Principal compounds of evaporators for food concentration. Multi-effect plate evaporators. Different types of evaporators used in the food industry. Freeze concentration. Food concentration by reverse osmosis.

### **5. Biological preservation methods**

Descripción de contenidos (English):

TOPIC 13. Microorganisms involved in food preservation processes

Yeasts, lactic and acetic acid bacteria, filamentous fungi. Types and characteristics.

TOPIC 14. Types of food fermentations

Alcoholic, lactic, acetic and other fermentations.

TOPIC 15. Biopreservation of food

Lactic acid bacteria, bacteriocins and other metabolites. Bacteriophages.

### **6. Emerging technologies for food preservation**

TOPIC 16. Food preservation by modified-atmosphere packaging

Types of packages: Modified-Atmospheres Packaging, Controlled-Atmosphere packaging. Important parameters in package design. Recommended Modified-Atmosphere to produce. Minimally Processed Fresh Vegetables. Future outlook.

TOPIC 17. Food preservation by irradiation





Food irradiation process. Action of ionization irradiation. Effects of irradiation on microorganisms and food components. Sources and equipments of ionizing irradiation. Applications of irradiation in foods. Technological problems and limitations of irradiation.

**TOPIC 18. High hydrostatic pressures**

Fundamentals of high hydrostatic pressures. Microbial and enzymatic inactivation by high pressures. Effects on food constituents. Facilities and current uses of high pressures in the food industry.

**TOPIC 19. Pulse electric fields processing.**

Fundamentals of pulse electric fields processing. Effects on microorganisms and enzymes. Commercial applications

**TOPIC 20. Other emerging food preservation technologies**

Ohmic heating. Light pulses. Ultrasound. Combined processes.

## **7. Food packaging**

**TOPIC 21. Filling and packaging systems for food**

The concept of packaging. Types of packaging. Essential requirements for the packaging operation. Packaging systems. Closure systems. Handling of containers. Interactions between the container and the food.

**TOPIC 22. Active packaging**

Active packaging and intelligent packaging: definition and types. Packaging absorbers. Moisture absorbers. Preservative releasers.

## **8. Processes of food transformation**

**TOPIC 23. Raw materials pre-treatment operations**

Raw materials: reception, classification, selection, washing, blanching. transport system in food industry. packaging, storage and distribution.

**TOPIC 24. Food size modification. Food mixture operation. Emulsification**

Size reduction for solid and liquid foods. Flocculation and agglomeration. Homogenization. Mixture. Moulded operation. Emulsification.

**TOPIC 25. Separation operations**

Sedimentation and centrifugation. Sieving and pressing. Filtration. Separation in membranes. Extraction. Crystallization. Equipments and application in food industry.

**TOPIC 26. Texture modification system**

Introduction. Gel formation. Texturization. Extrusion. Effects of texture modification on food quality. Applications in food industry.

## **9. Culinary technology**

**TOPIC 27. Baking and roasting processes**

Cooking methodologies used in food industry. Baking and roasting: concept, process, equipment and their influence on the food properties.

**TOPIC 28: Frying and grilling processes**

Frying: batter techniques, frying process, types of oils for frying, equipment and the effect of frying on foods. Grilling: fundamentals and applications.

**TOPIC 29. Microwave cooking**

Microwave cooking: principles of heat radiation, action mechanisms, industrial equipments and applications in food industry.

**10. Laboratory work**

Practice 1. Steam systems.

Practice 2. Cooling systems.

Practice 3. Extraction and pasteurization of juices.

Practice 4. Preservation by dehydration: Spray-drying and lyophilization.

Practice 5. The sterilization of canned food.

Practice 6. Concentration of juices.

Practice 7. Metal cans.

**WORKLOAD**

ACTIVITY	Hours	% To be attended
Theory classes	82,00	100
Laboratory practices	25,00	100
Seminars	4,00	100
Tutorials	4,00	100
Development of group work	20,00	0
Development of individual work	10,00	0
Study and independent work	35,00	0
Readings supplementary material	10,00	0
Preparation of evaluation activities	40,00	0
Preparing lectures	30,00	0
Preparation of practical classes and problem	20,00	0
Resolution of case studies	15,00	0
<b>TOTAL</b>	<b>295,00</b>	

**TEACHING METHODOLOGY**

Teaching is based on the individual study of the topics that will be reinforced with the organization of **tutoring**. Prior to the date of tutoring, the student must have prepared the proposed activities to reinforce the learning of specific aspects of the program. **Classes** are taught using audio-visual equipment. The student will have this material available in the virtual classroom.

The **laboratory work** will favor the relationship between knowledge and its application to practice. Prior



to visit the lab, be provided a booklet with the procedures, as well as a number of issues and problems that students must solve and return to the teacher within a certain time.

The **seminars** are team work that will include the delivery of a report on a working topic that relates the Sustainable Development Goals (SDGs) to the contents of the course and a public presentation in the classroom. Examples of the applications of the subject content in relation to the SDGs will be given, thus providing students with the knowledge, skills and motivation to understand and address the SDGs, while promoting reflection and critique.

## EVALUATION

a) (10%) Producing, presentation and defense of works related to the contents explained and discussed in the classroom related to one of the subjects studied during the semester (**coordinated seminars**). Written work will be evaluated as well as the level of understanding of the content and skills to their exposure, advocacy and discussion.

b) (60%) Make a **written test** to ensure knowledge and understanding of theoretical minimum content established for the subject. A mid-term exam will be held in January with the material taught in the first term. A grade equal or higher than 4 out of 10 is required to eliminate this part. The subject taught in the second term will be evaluated in the first exam, in the same way as the first midterm was evaluated (minimum of 4 points out of 10). The first midterm may be repeated in this call in the case of not having taken it or not having reached the minimum score required. On the other hand, those students who wish to raise the grade of the first midterm must communicate it previously (at least 48 hours in advance) and waive the previous grade.

In the second call, students will be able to take the exam of the part or parts in which they have not reached the minimum required score (4 points out of 10). The theory will be passed by achieving an average score between the two mid-term exams equal to or higher than 5 out of 10 points.

c) (20%) Evaluation of the practical contents by means of a written test based on the **practical classes** and the ability to solve the experimental problems raised, being able, optionally, to assess the ability to make well-detailed and organized reports of the experimental results.

d) (10%) Evaluation of the work during the **tutorials** and the ability to solve the proposed activities.

5 points out of 10 must be obtained on the written theoretical test and 5 out of 10 in the total of the evaluable activities to pass the subject.

Attendance at practices is obligatory for passing the subject except for those students that have undertaken these classes previously. Unjustified non-attendance to tutorials and coordinated seminars imply zero points in the corresponding evaluation section except for those students that have undertaken these classes in previous years.



## REFERENCES

### Basic

- Brennan, J.G., Butters, J.R., Cowell, N.D., Lilley, A.E.V. (1980). Las Operaciones de la Ingeniería de los Alimentos. Ed. Acribia, Zaragoza.
- Casp, A., Abril, J. (1999). Procesos de Conservación de Alimentos. Ed. AMV y Mundi-Prensa, Madrid.
- Cheftel, J.C., Cheftel, H., Besancon, P. (1989). Introducción a la bioquímica y tecnología de los alimentos. Vols. 1 y 2. Ed. Acribia, Zaragoza.
- Fellows, P. (1994). Tecnología del procesado de alimentos: principios y prácticas. Ed. Acribia, Zaragoza.
- Ordoñez, J.A., Cambero, I., Fernández, L., García, M.L., de la Hoz, L., Selgas, M.D. (1998). Tecnología de los alimentos. Volumen I. Componentes de los alimentos y procesos. Ed. Síntesis S.A., Madrid.
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- Potter, N.N., Hotchkiss, J.H. (1999). Ciencia de los alimentos. Ed. Acribia, Zaragoza

### Additional

- Madrid, A. (2010). Nuevo Manual de Industrias Alimentarias. AMV Ediciones. Madrid.
- Bartholomai, A. (2001). Fábricas de alimentos: Procesos, equipamientos, costos. Ed. Acribia, S.A. Zaragoza
- Varnam, A.H., Sutherland, J.P. (1998). Carne y productos cárnicos. Ed. Acribia S.A., Zaragoza.
- Walstra, P., Geurts, T.J., Normen, A., Jellema, A., van Boekel, M.A.J.S. (2001). Ciencia de la leche y tecnología de los productos lácteos. Ed. Acribia S.A. Zaragoza
- Satin, M. (1997). La irradiación de alimentos. Ed. Acribia. Zaragoza.
- Brody, A.L. (1996). Envasado de alimentos en atmósferas controladas, modificadas y a vacío. Ed. Acribia S.A., Zaragoza.
- Thompson, A.K. (2003). Almacenamiento en atmósferas controladas de frutas y hortalizas. Ed. Acribia S.A., Zaragoza.
- Richardson, P. (2005). Tecnologías térmicas para el procesado de alimentos. Ed. Acribia S.A. Zaragoza.

## ADDENDUM COVID-19

**This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council**

### ADENDA 2º SEMESTRE





### **3. Teaching methodology**

Theory: professor will teach in face-to-face modality and the classes will also be broadcasted in streaming. 50% of the students will physically go to the class whereas the remaining 50% will enjoy streaming classes through *Blackboard Collaborate* (BBC). Both groups of students will enjoy the two types of teaching methodology in every other week.

Slides used by the professor during theory classes will be uploaded to Virtual Classroom.

Continuous assessment: diverse activities will be settled during the quarter, tasks/questionnaires with deadlines or participation in debates/discussion forums through Virtual Classroom. These activities will be commented during theory classes.

Practices: provided public health conditions are favourable, it will be done in face-to-face modality.

Tutorials: provided public health conditions are favourable, it will be done in face-to-face modality.

Seminars: provided public health conditions are favourable, it will be done in face-to-face modality.

Tutorials for doubts resolution: they will be carried out in face-to-face modality, through e-mail (attention in maximum 48 h working days) or BBC video conferences.

### **4. Evaluation**

The theory exam ponderation over final mark is reduced, changing from 60% to 50%.

A specific evaluation parameter called “continuous assessment” is created, with a 10% ponderation over final mark. This parameter includes marks correspondent to the assessment of proposed tasks and questionnaires and participation in debates/discussion forums during the quarter.

The remaining assessment parameters kept their ponderations indicated in the Teaching Guide. The subject's evaluation criteria remained the same as in the Teaching Guide.

Exams (theory and practices) will be carried out in face-to-face modality, except public health conditions forces to on-line evaluation. In this case, questionnaires will be done (test, short questions, practical cases) through Virtual Classroom. If any student does not have the means to establish this connection, he/she will have to contact the professor as soon as this option is announced.

## **ADENDA 1er SEMESTRE**

### **3. Teaching methodology**

Theory: an on-line teaching methodology is proposed in the first quarter with video conferences using the tool *Blackboard Collaborate* (BBC). These video conferences will be mainly carried out in synchronous modality according to subject schedule.

Slides used by the professor during theory classes will be uploaded to Virtual Classroom.



Continuous assessment: diverse activities will be settled during the quarter, tasks/questionnaires with deadlines or participation in debates/discussion forums through Virtual Classroom. These activities will be commented during theory classes.

Practices: provided public health conditions are favourable, it will be done in face-to-face modality.

Tutorials: provided public health conditions are favourable, it will be done in face-to-face modality.

Seminars: they will be carried out through BBC video conferences. The monitoring of the development of reports corresponding to the subject will be done by the professor through e-mail and BBC video conferences.

Tutorials for doubts resolution: they will be carried out through e-mail (attention in maximum 48 h working days) or BBC video conferences.

#### **4. Evaluation**

The theory exam ponderation over final mark is reduced, changing from 60% to 50%.

A specific evaluation parameter called “continuous assesment” is created, with a 10% ponderation over final mark. This parameter includes marks correspondent to the assesment of proposed tasks and questionnaires and participation in debates/discussion forums during the quarter.

The remaining assesment parameters kept their ponderations indicated in the Teaching Guide. The subject’s evaluation criteria remained the same as in the Teaching Guide.

Partial and final exams (theory and practices) will be carried out in face-to-face modality, except public health conditions forces to on-line evaluation. In this case, questionnaires will be done (test, short questions, practical cases) through Virtual Classroom. If any student does not have the means to establish this connection, he/she will have to contact the professor as soon as this option is announced.