



DEGREE CURRICULUM

PLANT FOOD PROCESSING TECHNOLOGY I

Coordination: MARTIN BELLOSO, OLGA

Academic year 2020-21

Subject's general information

Subject name	PLANT FOOD PROCESSING TECHNOLOGY I			
Code	102584			
Semester	1st Q(SEMESTER) CONTINUED EVALUATION			
Typology	Degree	Course	Character	Modality
	Bachelor's Degree in Food Science and Technology	3	COMPULSORY	Attendance-based
	Bachelor's Degree in Agricultural and Food Engineering	3	COMPULSORY	Attendance-based
	Master's Degree in Management and Innovation in the Food Industry		COMPLEMENTARY TRAINING	Attendance-based
Course number of credits (ECTS)	6			
Type of activity, credits, and groups	Activity type	PRALAB	PRAULA	TEORIA
	Number of credits	1	0.4	4.6
	Number of groups	4	3	2
Coordination	MARTIN BELLOSO, OLGA			
Department	FOOD TECHNOLOGY			
Teaching load distribution between lectures and independent student work	On-site hours: 60 Off-site hours: 90			
Important information on data processing	Consult this link for more information.			
Language	Spanish (50%) Catalonian (50%)			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
GARZA GARZA, SALVADOR	salvador.garza@udl.cat	6,5	
IBARZ MARTÍNEZ, RAQUEL	raquel.ibarz@udl.cat	3	
MAGRI TERSA, XAVIER	xavier.magri@udl.cat	2,9	
MARTIN BELLOSO, OLGA	olga.martin@udl.cat	2	

Subject's extra information

It is compulsory to attend all the practical sessions.

For the purposes of the final qualification, in order to pass the subject, it will be necessary to obtain at least 4.0 in each evaluated activity and an average higher than 5.0 points.

It is mandatory for the students to wear the individual protection equipment (PPE) in the practical sessions:

- UdL unisex white lab coat
- Protection glasses
- Chemical / biological protection gloves

If, for health reasons, or other unforeseen circumstances, teaching activities cannot be carried out in the classroom, they will take place remotely.

Learning objectives

BACHELOR IN FOOD SCIENCE AND TECHNOLOGY

The student, after passing the subject, must be able to:

- Differentiate the specific characteristics of the sector and the vegetable processing industries.
- Strengthen the fundamentals of pasteurization and heat sterilization as well as freezing as food preservation techniques.
- Handle the legislation related to this type of industries.
- Specify the characteristics of the raw materials necessary to obtain the required final product.
- Estimate the utilization needs of the different types of packaging, additives and technological aids.
- Select and plan the stages necessary to obtain the different types of canned, juices or frozen vegetables.
- Choose the most suitable equipment for each stage of the corresponding process.
- Apply the appropriate techniques for the manufacture of canned, juices and frozen of the most important vegetables, as well as the Hazard Analysis and Critical Control Points (HACCP) system.
- Make the necessary determinations for the quality control of raw materials, packaging, additives and final product.
- Interpret the results of analytical determinations to improve processes and products.
- Acquire the ability to determine, advise and act on technical problems and product alterations.

BACHELOR IN AGRICULTURAL AND FOOD ENGINEERING

It is intended the student to be capable, at the different food industries studied in this subject, of:

- Describe the fresh conditioning / preservation processes and the transformation processes of plant products (fruits and vegetables).
- Handle and know how to apply the different regulations that affect the fresh packaging and preservation industries and the vegetable products processing industries.
- Outline, in flow diagrams, the fresh conditioning and preservation processes, as well as the processes for preparing and preserving plant products.
- Identify raw materials, ingredients, additives and other materials to be used in the fresh conditioning / preservation industry and in the vegetable products processing industries.
- Assess the influence of the composition and properties of the raw material on the quality of the final product.
- Interpret the physical and chemical changes that occur within the various fresh conditioning / preserving processes and those for transformation processes of plant products.
- Modify fresh conditioning / preservation processes and transformation processes of plant products based on the objectives to be reached.
- Organize the production of fresh conditioning / preservation lines and transformation of plant products.
- Associate composition and defects in the final product with raw materials and applied technologies.
- Select equipment for fresh conditioning / preservation lines and transformation of plant products.
- Sizing production lines and estimating the capacities of fresh conditioning / preservation equipment and transformation of plant products.

Competences

GRAU EN CIENCIA I TECNOLOGIA D'ALIMENTS

Competències generals

- CG2: Que els estudiants sàpiguen aplicar els seus coneixements al seu treball o vocació d'una forma professional i posseeixin les competències que es demostren per mitjà de l'elaboració i defensa d'arguments i la resolució de problemes dins la seva àrea d'estudi
- CG3: Que els estudiants tinguin la capacitat de reunir i interpretar dades rellevants per emetre judicis que incloguin una reflexió sobre temes rellevants d'índole social, científica o ètica.
- CG4: Que els estudiants puguin transmetre informació, idees, problemes i solucions a un públic tant especialitzat com no especialitzat
- CG6: Analitzar situacions concretes, definir problemes, prendre decisions i implementar plans d'actuació en la recerca de solucions.
- CG7: Interpretar estudis, informes, dades i analitzar numèricament.
- CG8: Seleccionar i manejar les fonts d'informació escrites i informatitzades disponibles relacionades amb l'activitat professional.
- CG9: Utilitzar les eines informàtiques i de la comunicació existents com a suport per al desenvolupament de la seva activitat professional (competència estratègica UdL)
- CG10: Treballar sol i en equip multidisciplinari.
- CG11: Entendre i expressar-se amb la terminologia adequada.
- CG12: Presentar correctament informació de forma oral i escrita (competència estratègica UdL)
- CG18: Tenir un esperit crític i innovador.
- CG19: Analitzar i valorar les implicacions mediambientals en la seva activitat professional.

Competències específiques

Tecnologia dels aliments

- CE20. Avaluar les característiques de les principals varietats vegetals i la seva aptitud per als diferents processos de transformació.
- CE22. Conèixer els equips de processament d'aliments i saber utilitzar-los.
- CE23. Esquematzar, sobre la base de diagrames de flux, els processos d'elaboració i conservació d'aliments.
- CE24. Identificar i avaluar matèries primeres, ingredients, additius i coadjuvants tecnològics d'ús en la indústria agroalimentària.
- CE25. Conèixer la funció dels ingredients i dels additius alimentaris.
- CE26. Aplicar els coneixements bàsics sobre matèries primeres, ingredients i additius a la formulació d'aliments.
- CE27. Interpretar els canvis físics i químics que es produeixen durant els diferents processos d'elaboració d'aliments.
- CE28. Modificar els processos d'elaboració d'un aliment sobre la base d'un objectius.
- CE29. Seleccionar equipament i organitzar les línies d'elaboració i envasat d'aliments.
- CE30. Desenvolupar nous processos i productes.
- CE31. Identificar i valorar les diverses parts d'un projecte d'una indústria agroalimentària.

GRAU EN ENGINYERIA AGRARIA I ALIMENTARIA

Competències generals

- CB1. Que els estudiants hagin demostrat posseir i comprendre coneixements en una àrea d'estudi que parteix de la base de l'educació secundària general, i se sol trobar a un nivell que, si bé es recolza en llibres de text avançats, inclou també alguns aspectes que impliquen coneixements procedents de l'avantguarda del seu camp d'estudi.
- CB2. Que els estudiants sàpiguen aplicar els seus coneixements al seu treball o vocació d'una forma professional i posseixin les competències que solen demostrar-se per mitjà de l'elaboració i defensa d'arguments i la resolució de problemes dins de la seva àrea d'estudi.
- CB3. Que els estudiants tinguin la capacitat de reunir i interpretar dades rellevants (normalment dins la seva àrea d'estudi) per emetre judicis que incloguin una reflexió sobre temes rellevants d'indole social, científica o ètica.
- CB4. Que els estudiants puguin transmetre informació, idees, problemes i solucions a un públic tant especialitzat com no especialitzat.
- CB5. Que els estudiants hagin desenvolupat aquelles habilitats d'aprenentatge necessàries per emprendre estudis posteriors amb un alt grau d'autonomia.
- CG1. Capacitat per a la preparació prèvia, concepció de projectes que tinguin per objecte la construcció que per la seva naturalesa i característiques quedin compresos en la indústria agroalimentària
- CG6. Capacitat per a la direcció i gestió de tota classe d'indústries agroalimentàries, amb coneixement de les noves tecnologies, els processos de qualitat,
- CG8. Capacitat de resolució de problemes amb creativitat, iniciativa, metodologia i raonament crític.
- CG10. Capacitat per a la recerca i utilització de la normativa i reglamentació relativa al seu àmbit d'actuació.
- CG12. Capacitat per al treball en equips multidisciplinaris i multiculturals.
- CG13. Correcció en l'expressió oral i escrita

Competències específiques

- CEMC8. La gestió i aprofitament de subproductes agroindustrials.
- CEMC9. Presa de decisions mitjançant l'ús dels recursos disponibles per al treball en grups multidisciplinaris.
- CEIAA1. Enginyeria i tecnologia dels aliments: Tecnologia d'aliments. Processos en les indústries agroalimentàries.

Subject contents

BACHELOR IN FOOD SCIENCE AND TECHNOLOGY

Set of topics

Chapter I. INTRODUCTION TO THE TRANSFORMATION OF VEGETABLES

- Unit 1. Food preservation systems. Foundations and relative importance of pasteurization and heat sterilization and freezing.
- Unit 2. Current situation and prospects of the fruit and vegetable processing sector. Installation and organization of vegetable processing industries.

Chapter II. LEGISLATION

- Unit 3. European and Spanish legislation that affects the installation and operation of canned, juices and frozen vegetable industries, as well as the obtained products.

Chapter III. AUXILIARY MATERIALS IN THE CANNING INDUSTRY

- Unit 4. Packaging of canned vegetables. Packaging characteristics and handling metal and glass containers. Corrosion of metal containers. Frozen vegetable packaging.
- Unit 5. Additives and technological aids. Function and need for use.
- Unit 6. Labeling of canned and frozen vegetables.

Chapter IV. TRANSFORMATION OF CANNED VEGETABLES

- Unit 7. Sterilization process parameters. Factors that influence vegetables canning sterilization. Microbial thermo-resistance and heat penetration into the containers.
- Unit 8. Quality, alterations and shelf life of canned vegetables.
- Unit 9. General process for preparing canned vegetables. HACCP system application.
- Unit 10. Technology for manufacturing low-acid vegetables.
- Unit 11. Manufacturing technology for medium acid vegetables.
- Unit 12. Manufacturing technology for high acid vegetables.

Chapter V. FROZEN VEGETABLES

Unit 13. Quality and shelf life of frozen vegetables.

Unit 14. Elaboration of frozen vegetables. General manufacturing process. Application of HACCP system.

Unit 15. Processing technology for frozen vegetables. Freezing vegetables. Freezing fruit.

CHAPTER VI. FRUIT JUICES, FRUITS AND DERIVATIVES

Unit 16.- Composition, properties and nutritional value of citrus juices. Morphology of citrus fruits. Components and technological and nutritional importance. Chemical composition: Sugars. Acids. Suspended solids. Vitamins. Lipids. Minerals. Pigments. Aromas.

Unit 17.- Composition, properties and nutritional value of sweet fruit and grape juices. Sweet fruit morphology. Components and technological and nutritional importance. Chemical composition: Sugars. Acids. Suspended solids. Vitamins. Lipids. Minerals. Pigments. Aromas. Components and technological and nutritional importance of the grape.

Unit 18.- Preliminary and complementary operations. Influence of raw material. Preliminary operations. Complementary operations: Sieving, Deaeration, Centrifugation, Decantation.

Unit 19.- Juice extraction technology. Extraction of citrus juices. FMC extractor. Sweet fruit extraction systems. Types press. Hydraulic presses.

Unit 20.- Enzymatic applications in the juice industry. Enzymes in the juice industry. Enzymatic clarification. Enzymatic maceration of the pulp. Enzymatic liquefaction. Enzymatic applications in citrus processing.

Unit 21.- Juice clarification. Non-enzymatic clarification. Turbidity formation mechanisms. Process controls clarification. Clarifying agents. Filtration. Ultrafiltration.

Unit 22.- Juice concentration by evaporation. Concentration by evaporation. Multiple effect evaporators. Plate evaporators. Design of evaporation plants.

Practical activities

Classroom practices

1. Interpretation of technical information obtained from commercial catalogs
2. Interpretation of the information collected in regulations and scientific articles
3. Calculation of ingredients and proportions to be used in the manufacture of canned vegetables specific.
4. Evaluation of the information offered on the labels of canned, juices and frozen vegetables and their compliance with legislation.

Laboratory practices

1. Quality control of fruit juices
2. Quality control of frozen vegetables.
3. Elaboration of a fruit nectar.
4. Determination of essential oils in citrus juices.
5. Sensory analysis of fruit juices.

It is MANDATORY that students wear the following personal protective equipment (PPE) during the laboratory practices.

- UDL unisex white lab coat
- Safety glasses
- Chemical / biological protection gloves

Directed activities: Preparation of a bibliographic work:

1. Guidance for carrying out a directed bibliographic work on the characteristics and technology for the process of making canned, juice or frozen vegetables.
2. Selection of a certain fruit or vegetable and establish its general process of canned, juice or frozen.
3. Monitoring of the performance of the work.
4. Public presentation of the work.

BACHELOR IN AGRICULTURAL AND FOOD ENGINEERING

Set of topics

CONDITIONING AND PRESERVATION OF FRESH FRUITS AND VEGETABLES

Unit 1. Fundamentals of the post-harvest of fruits and vegetables

Types and structure of fruits and vegetables.- Chemical composition of fruits and vegetables.- Physiological processes in postharvest of fruits and vegetables.- Postharvest factors that influence the quality and deterioration of fruits and vegetables.- Pre-harvest factors that influence the quality and deterioration of fruits and vegetables.

Unit 2. Aspects of fruit and vegetable storage plants

Purposes of the processing in fruit and vegetable plants.- Types of plants.- Process diagrams.- Typical sections in plants: constructive aspects.- Aspects of facilities in plants: cold rooms and facilities.

Unit 3. Treatments prior to conservation or commercialization

Fruit and vegetable treatments: purpose and methods of application.- Sprout inhibitor treatments.- Curing.- Disinfection.- Treatments to delay ripening and senescence.- Waxing and other coatings.- Control of microbial disorders.- Control of physiological disorders.- Desastringent treatments.

Unit 4. Accelerated maturation and greening

Purpose and benefits.- Physiological basis.- Early ripening in pre-harvest.- Accelerated ripening. Parameters.- Facilities for accelerated maturation.- Greening. Parameters.- Facilities for greening.

Unit 5. Fruit and vegetable cooling

Purpose and benefits of cooling.- Cooling kinetics. Parameters.- Types of cooling methods.- Air cooling: foundation and equipment.- Water cooling: foundation and equipment.- Vacuum cooling: foundation and equipment.- Comparison between cooling methods.

Unit 6. Cold storage

Product maturity at harvest.- Harvesting method.- Preparation of chambers.- Disinfection of chambers and containers.- Product loading in chamber: stowage, density of load and incompatibility between products.- Storage parameters in chamber.- Temperature.- Relative humidity.- Recirculation and air renewal.- Monitoring of product conservation.- Recommended conservation conditions for fruits and vegetables.

Unit 7. Conservation in controlled atmosphere chambers

Fundamentals of the controlled atmosphere technique.- Benefits of conservation in CA.- Maturity of the product at harvest.- Preparation of chambers. Tightness.- Loading and sealing of chambers.- Setting and maintenance of the atmosphere. Equipment and facilities.-Chamber conservation parameters. Temperature, relative humidity, air recirculation, O₂ and CO₂ concentration.- Product handling in chambers.- Special techniques: CA-low ethylene, CA-dynamic.- Recommended conditions for CA storage of fruits and vegetables.

Unit 8. Conditioning and preparation of the product for the market

Purpose of fruit and vegetable conditioning.- Cleaning and washing.- Selection.- Classification.- Packaging.- Labeling.- Conditioning lines. Equipment.- Environmental conditions in the conditioning zone.- Hygiene and occupational safety aspects.- Transport of fruits and vegetables.

Unit 9. Quality of fruits and vegetables.

Definition and meanings of the concept of quality.- Physicochemical quality parameters. Analysis methods.- Sensory attributes. Analysis methods.- Quality standards.- Quality management.

Unit 10. Post-harvest alterations in fruits and vegetables

Types and causes of alterations.- Damage due to wilting.- Mechanical damages.- Microbial alterations. Rot.- Physiological alterations: due to low temperatures, due to mineral deficiencies, due to gaseous composition, due to other causes.- Chemical phytotoxicities.

TRANSFORMATION OF FRUITS AND VEGETABLES

Unit 11. Situation of the vegetable processing sector

Current situation and prospects of the fruit and vegetable processing sector. Installation and organization of vegetable processing industries.

Unit 12. Legislation

European and Spanish legislation that affects the installation and operation of the canned, juices and frozen vegetable industries, as well as the products obtained.

Unit 13. Auxiliary materials in the canning industry.

Canned vegetable packaging. Characteristics and handling of metal and glass containers. Frozen vegetable packaging. Additives and technological aids. Function and need for use. Labelling.

Unit 14. Transformation of canned vegetables

Sterilization process parameters. Factors that influence the sterilization of canned vegetables. Quality, alterations and shelf life of canned vegetables. General process of preparing canned vegetables. Application of the HACCP system. Technology for the manufacture of vegetables with low acidity, medium acidity and high acidity.

Unit 15. Frozen vegetables

Quality and shelf life of frozen vegetables. Manufacture of frozen vegetables. General manufacturing process. HACCP system application. Frozen vegetable processing technology. Freezing vegetables. Freezing fruit.

Unit 16.- Composition, properties and nutritional value of juices.

Fruit morphology. Components and technological and nutritional importance. Chemical composition: Sugars. Acids. Suspended solids. Vitamins. Lipids. Minerals. Pigments. Aromas.

Unit 17.- Preliminary and complementary operations.

Influence of raw material. Preliminary operations. Complementary operations: Sieving, Deaeration, Centrifugation, Decantation.

Unit 18- Juice extraction technology.

Extraction of citrus juices. FMC extractor. Sweet fruit extraction systems. Types of press. Hydraulic presses.

Unit 19.- Enzymatic applications in the juice industry.

Enzymes in the juice industry. Enzymatic clarification. Enzymatic maceration of the pulp. Enzymatic liquefaction. Enzymatic applications in citrus processing.

Unit 20.- Juice clarification.

Non-enzymatic clarification. Turbidity formation mechanisms. Controls of the clarification process. Clarifying agents. Filtration. Ultrafiltration.

Unit 21.- Juice concentration by evaporation.

Concentration by evaporation. Recovery of aromas. Multiple effect evaporators. Plate evaporators. Design of evaporation plants.

Practical activities

Classroom practices

1. Exercise on the dimensioning of cold rooms for fruits storage. Design and selection of equipment in plants.
2. Preparation of a study on the post-harvest handling of fresh vegetables.
3. Viewing of symptoms of alterations and quality aspects in fruits and vegetables.
4. Interpretation of technical information obtained from commercial catalogs
5. Interpretation of the information collected in regulations and scientific articles
6. Calculation of ingredients and proportions to be used in the manufacture of specific canned vegetables.
7. Evaluation of the information offered on the labels of canned, juices and frozen vegetables and their compliance with the legislation.

Laboratory practices

1. Analysis of parameters of maturity and quality in fruits and vegetables.
2. Preparation of a canned vegetable.
3. Control of container closures.
4. Quality control of a commercial canned vegetable.

Methodology

BACHELOR IN FOOD SCIENCE AND TECHNOLOGY

Kind of activity	Description	On-site activity		Autonomous activity		Evaluation	Total time	
		Objectives	Hours	Student's work	Hours	Hours	Hours	ECTS
Lecture	Lecture	Explanation of the main concepts	32	Study: Learn, understand and synthesized knowledge.	44	4	80	3.2
Interactive lectura	Interactive lectura	Solving problems and case studies	4	Problems resolution and case discussion	10		14	0.6
Seminar	Participative lectura	Activities for discussion and knowledge application	4	Case discussion	6		10	0.4
Laboratory	Laboratory practice	Practice development	10	Study and prepare the practical report	10		20	0.8
Supervised activities	Monographic exercise (individual or group)	Student orientation	6	Bibliographic search and preparation of a presentation	20		26	1.0
Others								
Total			56		90	4	150	6.0

BACHELOR IN AGRICULTURAL AND FOOD ENGINEERING

Kind of activity	Description	On-site activity		Autonomous activity		Evaluation	Total time	
		Objectives	Hours	Student's work	Hours	Hours	Hours	ECTS
Lecture	Lecture	Explanation of the main concepts	40	Study: Learn, understand and synthesized knowledge.	64	3	107	4.3
Interactive lectura	Interactive lecture	Solving problems and case studies	6	Problems resolution and case discussion	10	1	17	0.7
Seminar	Participative lecture	Activities for discussion and knowledge application	4	Case discussion	4		8	0.3
Laboratory	Laboratory practice	Practice development	6	Study and prepare the practical report	12		18	0.7
Total			56		90	4	150	6

Evaluation

Bachelor in Food Science and Technology

Type of activity	Assesment type		Weight mark
	Procedure	Number	(%)
Lecture	Written test	2	60
Interactive lecture	Written test	2	7
Seminar	Delivering report. Written or oral test	1	6
Laboratory	Delivering report. Written or oral test	2	15
Supervised activities	Delivering report and oral presentation	1	12
Others			
Total			100

Note: If for health reasons, or other unforeseen circumstances, it is not possible to carry out face-to-face tests, these will take place remotely.

Bachelor in Agricultural and Food Engineering

Type of activity	Assesment type		Weight mark
	Procedure	Number	(%)
Lecture	Written test	3	65
Interactive lecture	Written test	2	15
Seminar	Delivering report. Written or oral test	1	5
Laboratory	Delivering report. Written or oral test	2	15
Others			

Total		100
-------	--	-----

Note: If for health reasons, or other unforeseen circumstances, it is not possible to carry out face-to-face tests, these will take place remotely.

Bibliography

BACHELOR IN FOOD SCIENCE AND TECHNOLOGY

The bibliography of technological subjects requires continuous review. However, some manuals that despite having been written in some cases more than one decade ago, their content is suitable for a first contact with the processes in food industries.

Basic bibliography

1. Casp, A. (coord.), 2014. Tecnología de alimentos de origen vegetal. Vol 1 y 2. Editorial Síntesis, Madrid.
2. Arthey, D.; Ashurst, P. R. Fruit processing. Ed. Blackie Academic and Professional. London. United Kingdom. (1996)
3. Ashurst, P.R. Producción y envasado de zumos y bebidas de frutas sin gas. Acribia, Zaragoza. (1998)
4. Cox, P.M. Ultracongelación de alimentos. Ed. Acribia, Zaragoza (1987)
5. Southgate, D. Conservación de frutas y hortalizas. Ed. Acribia, Zaragoza (1992)
6. Varnam, A. H. y Sutherland, J. P. Bebidas. Tecnología, química y microbiología. Ed. Acribia. Zaragoza. (1996)

Complementary bibliography

1. AIJN. Code of practice for evaluation of fruit and vegetables juices. Association of the Industry of Juices and Nectars from Fruits and Vegetables of the European Economic Community (AIJN). Avenue de Cortenbergh 172, 1040 Brussels, Belgium. (1993)
2. Gould, G.W. Food preservation. Ed. Chapman & Hall, New York (1995)
3. Kadoya, T. Food Packaging. Academic Press Inc, New York (1990)
4. Sielaff, H. Tecnología de la fabricación de conservas. Ed. Acribia, Zaragoza (2000)
5. Woodroof, J. G. y Philips. Beverages: Carbonated and non-carbonated. Ed. AVI Publishing, Co, Inc. Westport. Connecticut. USA.: (1974)

Journals:

Fruit processing (Available in the UdL Library since January 1996)

BACHELOR IN AGRICULTURAL AND FOOD ENGINEERING

The bibliography of technological subjects requires continuous review. However, some manuals that despite having been written in some cases more than one decade ago, their content is suitable for a first contact with the processes in food industries.

Basic bibliography

1. Casp, A. (coord.), 2014. Tecnología de alimentos de origen vegetal. Vol 1 y 2. Editorial Síntesis, Madrid.
2. Arthey, D.; Ashurst, P. R. Fruit processing. Ed. Blackie Academic and Professional. London. United Kingdom. (1996)
3. Ashurst, P.R. Producción y envasado de zumos y bebidas de frutas sin gas. Acribia, Zaragoza. (1998)
4. Cox, P.M. Ultracongelación de alimentos. Ed. Acribia, Zaragoza (1987)
5. Namesny, A., 1993. Postrecolección de hortalizas. Vol. 1,2,3. Ediciones de Horticultura, Reus.
6. Southgate, D. Conservación de frutas y hortalizas. Ed. Acribia, Zaragoza (1992)
7. Varnam, A. H. y Sutherland, J. P. Bebidas. Tecnología, química y microbiología. Ed. Acribia. Zaragoza. (1996)
8. Wills, R.H.H., McGlasson, B., Graham, D., Joyce, D., 1998. Introducción a la fisiología y manipulación poscosecha de frutas, hortalizas, plantas ornamentales. 2 ed, Acribia, Zaragoza, 240 pp.

Complementary bibliography

1. AIJN. Code of practice for evaluation of fruit and vegetables juices. Association of the Industry of Juices and Nectars from Fruits and Vegetables of the European Economic Community (AIJN). Avenue de Cortenbergh 172, 1040 Brussels, Belgium. (1993)
2. Gould, G.W. Food preservation. Ed. Chapman & Hall, New York (1995)
3. Kadoya, T. Food Packaging. Academic Press Inc, New York (1990)
4. Kader, A., 2002. Postharvest Technology of Horticultural Crops. University of California.
5. Sielaff, H. Tecnología de la fabricación de conservas. Ed. Acribia, Zaragoza (2000)
6. Woodroof, J. G. y Philips. Beverages: Carbonated and non-carbonated. Ed. AVI Publishing, Co, Inc. Westport. Connecticut. USA.: (1974)

Journals:

Fruit processing (Available in the UdL Library since January 1996)