

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

Code	33985
Name	Food Chemistry
Cycle	Grade
ECTS Credits	6.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1103 - Degree in Food Science and Technology	Faculty of Pharmacy and Food Sciences	2	Second term

Subject-matter

Degree	Subject-matter	Character
1103 - Degree in Food Science and Technology	12 - Food chemistry	Obligatory

Coordination

Name	Department
GARCIA LLATAS, GUADALUPE	265 - Prev. Medicine, Public Health, Food Sc., Toxic. and For. Med.

SUMMARY

Food Chemistry is a mandatory subject, carrying 6 ECTS in the second year, second semester of the Degree in Food Science and Technology. It is part of Module 2: Food Science, which includes other subjects such as Bromatology and Food Analysis.

To gain insight into the physicochemical changes that can occur in foods and act on them, producing the desired changes, the first thing we need to know are the characteristics of their components. Food Chemistry studies the different substances that can become part of the food, their structure, characteristics, physicochemical properties and reactions that may be involved and their possible interactions with other food components. Therefore, nutrients are studied (water, carbohydrates, lipids, proteins, vitamins and minerals) and other non-nutritional substances for the human organism, such as pigments, flavourings and food additives.



Foods derived from biological systems, i.e. from two main sources, animals and plants, undergo changes along time, in some cases due to their own cellular metabolism. In addition, the transformation undergone during processing and/or storage of foods requires a detailed study for each type of food, as these stages are influenced by their specific characteristics.

In short, the subject of Food Chemistry deals with the study of:

- a) Components of food: structure, physicochemical properties, reactions.
- b) The changes incurred during processing and/or storage of food.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

Subjects of the basic module, essentially, Biochemistry and Chemistry (General and Organic).

OUTCOMES

1103 - Degree in Food Science and Technology

- Develop skills to undertake further study.
- Acquire the knowledge and skill needed to elucidate the causes of organoleptic and/or nutritional modifications of components and/or food.
- Acquire knowledge to design and/or improve food.
- Saber aplicar esos conocimientos al mundo profesional, contribuyendo al desarrollo de los Derechos Humanos, de los principios democráticos, de los principios de igualdad entre mujeres y hombres, de solidaridad, de protección del medio ambiente y de fomento de la cultura de la paz.
- Poseer y comprender los conocimientos en el área de Ciencia y Tecnología de los Alimentos.
- The ability to transmit ideas, problems and solutions within the study area of modern languages and their literatures.
- Be familiar with discipline-specific terminology.
- Capacidad de interpretar datos relevantes.
- Know the physico-chemical properties, chemical reactions and technological functions of the components of food.
- Determine the influence of physical and chemical factors on the components of food.



- Know how to apply the knowledge acquired to the preparation and preservation of food.
- Adquirir capacidad de utilizar adecuadamente las fuentes de información y comunicación disponibles.

LEARNING OUTCOMES

To master the terminology of the subject

- Understand the effects of technological processes in the chemical properties of food components.
- Apply the knowledge acquired in the handling and storage of food.
- Evaluate possible causes of sensory changes and / or nutritional components and / or food.
- Apply the knowledge to design and / or improvement of food
- Know, appraise, manage and apply knowledge leading basic and specialized bibliographic sources and some sources for the dissemination of computer-related issues of food chemistry.
- Acquire the ability to synthesize and organize properly, the information obtained from various sources.
- Be able to adequately express, both orally and in writing, the knowledge gained and relate them with previous ones.
- Know how to apply scientific rigor in the laboratory and in the problems.
- Have the ability to prepare reports of studies related to the subject.

DESCRIPTION OF CONTENTS

1. Main components in foods: structure, physical-chemical properties, reactions in foods

- Item 1. Food Chemistry. Concept. Relationship with other subjects. Literature.
- Item 2. Water. Physical constants and structures of water and pure ice. Water-solute interactions. Water activity and alterations in foods.
- Item 3. Carbohydrates. Classification. Starch and modified starches.
- Item 4. Browning in foods I. Classification. Caramelisation and ascorbic acid degradation.
- Item 5. Browning in foods II. Maillard reaction.
- Item 6. Components of dietary fibre. Prebiotics of interest. Other functional properties of carbohydrates.
- Item 7. Lipids. Physical properties of fatty acids and fats.
- Item 8. Lipid alterations. Classification. Lipid oxidation. Other lipid alterations. Frying process.
- Item 9. Modifications of fats and oils. Functional properties of lipids.
- Item 10. Proteins. Modifications of proteins during processing and storage. Functional properties.
- Item 11. Enzymes. Classification and action in foods. Enzymatic browning.

2. Minor components in foods: structure, physical-chemical properties, reactions in foods

- Item 12. Minerals and anti-nutritional factors. Modification of mineral content during food processing. Anti-nutritional factors: nature, mechanism of action and mitigation.
- Item 13. Hydrosoluble vitamins. Structure and stability.
- Item 14. Liposoluble vitamins. Structures and stability.
- Item 15. Pigments and aroma compounds in foods. Pigments: structures and stability. Aroma compounds: concept, impact compounds and aroma compounds generated in enzymatic and non-enzymatic reactions. Off-flavours. Food flavouring.



Item 16. Food additives. Concept and classification. Description of additives.

3. Food of animal and plant origin: changes undergone during processing and/or storage

Item 17. Meat. Post-mortem changes. Effects of thermal treatment. Meat products.

Item 18. Fish. Post-mortem changes. Changes during processing.

Item 19. Egg and egg products. Functional properties. Changes during storage. Changes during processing.

Item 20. Milk. Effects of thermal treatment. Dairy products. Changes during their elaboration.

Item 21. Cereals. Changes during storage of grain and flour. Changes during baking and storage of bread.

Item 22. Fruits and vegetable. Changes during ripening, storage and processing.

Item 23. Fermented beverages. Changes during their elaboration. Alterations.

4. Laboratory sessions

Lab sessions are conducted to:

- a) identify or quantify the content of a component in food
- b) assess the modification of food by processing and/or storage
- c) observe the effect of certain properties of food components

These include:

- Modification of the myoglobin colour of meat.
- Assessment of water retention capacity in meat.
- Evaluation of the effect of heating on soluble proteins in dairy products.
- Evaluation of fermentation in dairy products:
 - a) Determination of lactose
 - b) Determination of acidity
- Assessment of frying oil quality:
 - a) Colorimetric assay
 - b) Measurement of capacitance
- Evaluation of flour strength. Pelshenke index. Effect of glutathione.
- Determination of Brix degrees in juices.
- Evaluation of fruit maturity index.
- Determination of hydroxymethylfurfural in honey.
- Determination of tartrazine in a commercialized food colouring.

**WORKLOAD**

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Laboratory practices	15,00	100
Seminars	2,00	100
Tutorials	2,00	100
Development of group work	10,00	0
Development of individual work	4,00	0
Study and independent work	60,00	0
Readings supplementary material	2,00	0
Preparation of evaluation activities	10,00	0
Resolution of case studies	4,00	0
TOTAL	147,00	

TEACHING METHODOLOGY

Lectures: explanatory sessions and/or demonstration of contents, with a total of 38 hours/term. Classes are taught using audio-visual technical equipment and materials available on the online platform beforehand. At the end of each item, ICT tools might be used by the teacher in order to reinforce the most relevant aspects. Additionally, throughout the semester, students will be provided of activities and resources in order to facilitate the study of the subject available in open-access educative platforms.

Seminars: students gain insight through interaction and activities. Two coordinated seminars will take place on topics provided by the teacher and related to the course, and must follow the guidelines on coordinated seminars available at the website of the faculty.

The development of the seminar will be monitored through tutorials, to be agreed upon between the teacher and the students. The seminars will be presented in writing and explained orally by the students. After the oral presentation, discussion will take place with the other students, chaired by the teacher.

Practical lessons (laboratory): there will be four hands-on lab sessions, i.e. three of four hours and one of three hours. Practice exercises will be done in pairs. At the beginning of each lab session, students should complete individually a test through a Moodle questionnaire and/or an scheme of the experimental procedure related to the assays to be performed during the session. At the end of the lab sessions, students must fill in, individually, the report available on the online platform, and it must be delivered daily through this platform. Additionally, students will be provided of links to open-access multimedia resources (i.e. videos recorded by the faculty, ITC tools, etc.) related to the practical lessons in order to facilitate the study and understanding



Tutorials: students can attend tutorials either individually or in a group. Two tutorials of one hour each will take place. Several activities, short questions and/or problems previously solved and individually delivered on the online platform by the students, will be dealt with. Additionally, students' queries about the subject will be discussed and solved, and subject concepts and terminology will be reinforced through activities available in open-access educative platforms.

Continuous assessment activities: there will be a total of 5 continuous assessment activities that will be distributed throughout the semester. The topics of these activities raised by the teachers will be part of the contents of the subject. In this sense, students will be provided with the basic bibliography and necessary resources to work on the knowledge they are intended to acquire.

Individual or group work and study: individual and in-group learning capacity will be developed.

During the activities, both theoretical and practical, examples of the applications of the subject's contents in relation to the Sustainable Development Goals (SDG) will be indicated. By doing this, it is intended to provide knowledge, skills and motivation to the students in order to understand and address these SDGs, while promoting reflection and criticism.

EVALUATION

The acquisition of knowledge, competence and skills will be assessed continuously throughout the semester.

Measurable parameters considered are:

- Written test which will assess the degree of general knowledge of theoretical and practical concepts and procedures presented for each item.
- Implementation of individual reports and/or group exercises related to activities performed in the classroom and laboratory.
- Attitude of the student (valued on the basis of individual and in group tutorials, theoretical and practical lessons and seminars).

The assessment will take place as follows:

1. Acquisition of theoretical/practical concepts and their expression through written tests (65%).

The exam matters will include the topics covered in the theoretical and practical sessions. There will be a written test with two calls with prior notice (2 h length) including open questions with short answers, true-false responses with justifications, multiple-choice questions, identification of chemical structures of relevant compounds, and short questions concerning the laboratory sessions (basics, purpose of used



reagents, etc.). In the possible case of penalizing wrong answers, it will be indicated. The correct expression of concepts (including spelling) as well as the correct use of the terminology will be taken into account for the mark. **Students must reach 5 out of 10** to be added up with the rest of marks obtained and thus pass the subject.

2.Resolution of a practical case related to the lab sessions (7%) (0.7 out of 10) and the student's attitude and participation in the lab sessions as well as previous preparation of practical classes (4%) (0.4 out of 10).

La resolución del caso se realizará durante la última hora de la cuarta sesión de prácticas. La actitud del estudiante, entendida como preparación previa de las prácticas y participación en las mismas, se evaluará mediante prueba tipo test a través de cuestionario Moodle y/o la entrega de esquema del procedimiento experimental al inicio de cada sesión de laboratorio.

Assessment criteria:

- Attitude and participation during the lab sessions: Aspects like previous preparation of practical classes, active intervention in issues raised in the laboratory, the cooperative attitude, teamwork and the care and management of material will be considered.
- Application of acquired knowledge to resolve proposed questions and/or problems raised in the practical case.
- In the practical case, solving of calculations and interpretation of the data obtained will be assessed.

Attendance of the lab sessions and the daily delivery of the results' report are compulsory to pass the subject.

3.Tutorials (4%): the resolution of questions proposed by the teacher through the online platform for each session will be assessed and they will have to be delivered by means of it. The evaluation will be carried out through a Moodle questionnaire (0.2 points/session) composed by test questions; erroneous responses will be penalized.

Attendance of tutorials is compulsory in the first year of enrolment in order to pass the subject.

4. Seminars (10%):

written work, presentation, defence and proposed activities will be taken into account for their assessment. The level of understanding of the contents as well as the skills for its presentation and discussion, aspects agreed and detailed in the corresponding regulations for seminars (which are available on the website of the faculty), will be assessed.

Attendance of seminars is compulsory in the first year of enrolment in order to pass the subject.



5. Continuous assessment activities (10%): the realization of the tasks proposed by the teacher in each of the continuous assessment activities related to the contents of the subject will be assessed. The evaluation will be done through a Moodle questionnaire (0.2 points/activity) with test-type questions; erroneous responses will be penalized.

Notes:

(i) Attendance of laboratory sessions, seminars and tutorials is compulsory to pass the subject.

(ii) The daily delivery of the results' report is compulsory to pass the subject.

(iii) Students who in the first call do not pass the written test, will keep their marks corresponding to seminars, tutorials and report from lab sessions until the second call of the same year.

(iv) Students retaking the subject will keep their marks corresponding to seminars and tutorials. Marks corresponding to the laboratory sessions will be kept for the following two years after their completion. After this period, lab sessions will have to be retaken.

(v) Although, numerically the sum of the marks corresponding to seminars, tutorials and lab sessions will make up 50%, the subject will not be considered as passed if the mark corresponding to the written theoretical/practical test does not reached the established minimum.

REFERENCES

Basic

- BADUI, S.: Química de los Alimentos. 5ª ed., Ed. Pearson. México, 2013. (Disponible también e-book).
- BELITZ H.D., GROSCH W.: Química de los Alimentos. 3ª ed., Ed. Acribia S.A., Zaragoza, 2012.
- CHEFTEL, J.C., CHEFTEL, H.: Introducción a la Bioquímica y Tecnología de los Alimentos. Ed. Acribia. Zaragoza, 2000.
- COULTATE, T.P.: Manual de Química y Bioquímica de los Alimentos. Ed. Acribia S.A. Zaragoza, 2007.
- FENNEMA, O.R.: Química de los Alimentos. 3ª (y 4ª) ed., Ed. Acribia. Zaragoza, 2010 (2019).
- JEANTET, R. et al. Ciencia de los Alimentos. Vol 1 y 2. Ed. Acribia. Zaragoza. 2010.
- LINDEN, G., LORIENT, D.: Bioquímica Agroindustrial. 2ª ed. Ed. Acribia. Zaragoza, 1996
- ORDOÑEZ (ed.): Tecnología de los Alimentos. Vol. 1. Componentes de los Alimentos y Procesos. Ed. Síntesis. Madrid, 1998.
- PRIMO YUFERA, E.: "Química de los Alimentos". Ed. Síntesis. Madrid, 1998.
- VANACLOCHA, A. Tecnología de los alimentos de origen vegetal. Vol 1 y 2. Ed. Síntesis. Madrid, 2014.
- WONG, D.W.S.: Química de los Alimentos. Mecanismos y Teoría. Ed. Acribia. Zaragoza, 1994.



Additional

- COULTATE, T.: Food: The Chemistry of its Components. Ed. RSC. Reino Unido, 2015.
- DAMODARAN, S. y PARKIN, K.: Fennemas Food Chemistry. 5ª ed., Ed. CRC Press, Estados Unidos de América, 2017.
- PÉREZ-CASTIÑEIRA, J.: Chemistry and Biochemistry of Food. 1ª ed., De Gruyter, Alemania, 2020.
- RUAN, D.: The Maillard Reaction in Food Chemistry. Ed. Springer. Suiza, 2018. (Disponible también como e-book).
- WEAVER, C.M., DANIEL, J.R. The Food Chemistry Laboratory, 2ª ed. CRC Press, Estados Unidos de América, 2003.
- WANG, D.: Food chemistry, 1ª ed. Nova Science Publishers, Estados Unidos de América, 2012 (Disponible como e-book).
- WONG, D.W.S.: Mechanism and Theory in Food Chemistry. 2º Ed. Springer, 2018.

<http://milksci.unizar.es/bioquimica/uso.html>

<http://www.cyberlipid.org/>

https://www.aesan.gob.es/AECOSAN/web/home/aecosan_inicio.htm

<http://www.efsa.europa.eu/>

<http://www.eufic.org/index/es/>

Revistas: Alimentaria (a través de las BBDD de la UV)

Revistas: Revista española de nutrición humana y dietética <https://www.renhyd.org/index.php/renhyd>

ADDENDUM COVID-19

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

1. Contents

- The contents initially included in the teaching guide are maintained.

2. Volume of work and temporary planning of teaching

- The teaching planning of the different activities in number of ECTS and schedule is maintained, but the methodology of the activities changes with respect to the conventional teaching guide, due to the current situation that makes necessary to adopt a hybrid teaching model.



3. Teaching methodology

Theoretical classes: explanatory sessions and/or demonstration of contents through BbCU videoconference. The students will have visual material (Power point file in pdf format) available on the online platform beforehand.

Coordinated seminars: The development of the seminar will be carried out on line. Requirements on the realization of a written report, working diary and the power point presentation file, or similar, are maintained. The seminars will be presented and explained orally by the students through a BbCU videoconference.

Ruled tutorials: proposed and evaluable activities will be uploaded to the virtual classroom, to be delivered through the "Task" option (setting the delivery time), with resolution of doubts through a forum enabled in the virtual classroom. Discussion and correction and realization of a face-to-face Moodle questionnaire will be carried out in the classroom at its established schedule. If the health situation does not allow the realization of face-to-face tutorials, they will be taught through a BbCU videoconference. In that, case, the Moodle questionnaire will be carried out on-line during the tutorial established schedule.

Practical lessons (laboratory): 50% of the practices will be face-to-face and the other 50% not face-to-face. For non-face-to-face practices, one of the following methodologies will be used: synchronous BbCU videoconferences, viewing of didactic videos and/or exercises proposed through the "Task" option of the Virtual Classroom. If the health situation did not allow the realization of the laboratory practices in person, they would all be adapted to their virtual format.

Continuous assessment activities: the activities will be uploaded to the virtual classroom, to be delivered through the "Task" option (setting the delivery time), with resolution of doubts through a forum enabled in the virtual classroom. They will be evaluated by completing a Moodle questionnaire.

Non-ruled tutorials: forums would be enabled in the virtual classroom, organized by thematic blocks, for the raising and answering of doubts (debate type) and students would be provided with a schedule of synchronous videoconference tutoring, with voluntary assistance.

4. Assessment

The evaluation criteria and their percentage value expressed in the Course Guide are maintained:

- a) Acquisition of theoretical / practical concepts through written tests (65%). If the health situation does not allow the written exam, the evaluation will be adapted to its virtual format through the Moodle platform.
- b) Report of the practical sessions (8%) (0.8 points out of 10) and the student's attitude and participation in their development (3%) (0.3 points out of 10). The report will contain the details of those practices carried out in person together with the resolution of the exercises proposed for non-face-to-face practices. The test to evaluate the attitude and participation of the students in the development of the practices will contain questions only from the face-to-face part. If the health situation does not allow the realization of the face-to-face practices, all the content of the same would be adapted to a non-face-to-face format and for the evaluation only the report presented would be taken into consideration, which would have a value of 11% of the final grade of the subject.



- c) Tutorial lessons (4%).
- d) Seminars (10%).
- e) Continuous assessment activities (10%)

