

PHYSICOCHEMICAL PROCESSES OF INTEREST IN FOODS

Academic Course 2020-2021

(Last updated: 29/06/2020)

(Approved by Department Council: 30/06/2020)

MODULE	SUBJECT	COURSE	SEMESTER	CREDITS	TYPE
Complementary training	PHYSICOCHEMICAL PROCESSES OF INTEREST IN FOODS	3º	1º	6	Optional
PROFESSOR			TUTORING CONTACT INFORMATION		
<ul style="list-style-type: none"> Bartolomé Quintero Osso 			Physical-Chemistry Department. 2 nd Floor Faculty of Pharmacy. Campus Universitario de Cartuja. 18071-Granada. Office: 195 Phone: 0034-958-249071. bqosso@ugr.es		
			TUTORING HOURS		
			Tuesday: 10'00-13'00 (Department) Thursday: 10'00-13'30 h (Department)		
DEGREE IN WHICH THE SUBJECT IS TAUGHT			OTHER DEGREES IN WHICH THE SUBJECT COULD BE TAUGHT		
Food Science and Technology					
PREREQUISITES AND RECOMENDATIONS (IF THEY APPLY)					
<ul style="list-style-type: none"> Basic knowledges in Mathematics, Statistics, General Chemistry, General Physic and Physical Chemistry are strongly recommended 					
BRIEF ACCOUNT OF THE SUBJECT PROGRAMME					
<ul style="list-style-type: none"> Physical chemistry foundations on preservation and processing of foods Adsorption processes Kinetic mechanisms related to the food wastage Energy transfer in steady and non-steady processes Colloidal state. Rheology 					
BASIC, GENERAL, TRANSVERSAL AND SPECIFIC COMPETENCES					
Detailed information about this ítem can be found in the Spanish version					



OBJECTIVES (EXPRESSED IN TERMS OF EXPECTED RESULTS OF THE TEACHING PROGRAMME)

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DETAILED SYLLABUS OF THE SUBJECT

THEORETICAL SYLLABUS:

- **UNIT 1. Introduction:** Food technology. Brief review of the concept, history and objectives. The role of Physical Chemistry in food technology. Fresh and processed foods. Deterioration of fresh foods. (1 hour)
- **UNIT 2. Water:** General aspects. The water in the human body and foods. Chemical and structural aspects. Water in nature. Water aggregation states. Water phase diagram. (2 hours)
- **UNIT 3. Air-water system.** Humidity: Transitions involving water vapor equilibrium: evaporation and sublimation. Phase equilibria for the system formed by pure water and for air-water systems. Absolute humidity. Saturation pressure. Relative humidity. Dew point. Hygrometer. (2 hours)
- **UNIT 4. Food thermodynamics.** Basic concepts of classical thermodynamics. Food as a thermodynamic system. Water in food. Vapor-liquid equilibrium. Thermodynamic activity concept. Water activity in aqueous solutions related to relative humidity. Water activity in food. Water content measurement in food. Indirect, direct and complementary procedures. (3 hours)
- **UNIT5. Adsorption:** Solid adsorption phenomena: Fundamentals. Adsorption isotherms. B.E.T adsorption isotherm. Limitations of the B.E.T isotherm. G.A.B Isotherm. Other empirical adsorption isotherms. Using the adsorption isotherms: relative humidity isotherms. State of water in foods. Differentiated zones in the activity water vs. relative humidity diagram. Hysteresis cycle in the food adsorption isotherms. Influence of temperature on the adsorption isotherms. (3 hours)
- **UNIT 6. Heat.** Basic concepts. Specific heats. Latent heat. Specific heat in food. Measures of specific heats: Differential Scanning Calorimetry. Thermochemical. Combustion heat. Constant-volume adiabatic calorimeter (2 hours)
- **UNIT 7. Energy Transfer:** Transport phenomena. Thermal conductivity. Fourier law. Steady and non-steady processes. Steady-state thermal conductivity. Other energy transfer mechanisms: convection from a fluid. Heat transfer by conduction-convection. Heat transfer by radiation. Heat transfer in unsteady state. Convection heat transfer in laminar fluid. (3 hours)
- **UNIT 8. Food stability:** Principles of chemical kinetics. General processes affecting food stability. Chemical and biochemical alterations. Food stability and water activity. Non-enzymatic browning. Free Radicals. Basic mechanisms and kinetic treatment of lipid peroxidation. (4 hours)
- **UNIT 9. Sterilization:** Thermal Processing. Sterilization. Pasteurization. Other physical methods. Kinetic sterilization treatment. Thermal death time. Temperature dependence of decimal lifetime. Heat death in non-isothermal conditions. Weibullian model. (3 hours)
- **UNIT 10. Freezing.** Freezing food. Kinetic freezing of pure water. Cooling curves. Supercooled and glassy state for pure water. The glassy state transitions. General characteristics of the glassy state. Change in the thermodynamic properties at the glass transition. Influence of freezing in food quality. (4 hours)
- **UNIT 11.-Evaporation.** Theory. Mass and energy transfer. Factors affecting heat transfer. Effects on foods. Dehydration. Dehydration stages. Drying curves. Effects of dehydration. Lyophilization. Effects of lyophilization. (2 hours)
- **UNIT 12. Mechanical properties.** Macroscopic motion of fluids. Viscosity. Laminar and turbulent flows. General rheology. Newtonian and non-Newtonian fluids. Time dependent behavior: thixotropy. (2 hours)
- **UNIT 13. Surfaces.** Interfaces: surface and interfacial tension. Adsorption in solution. Gibbs isotherm. Surfactants: Classification. (1 hour)
- **UNIT 14. Colloidal state.** Definition and classification. Colloidal stability. Emulsifiers and stabilizers. Food colloids. Foams. Emulsions. Formulation of emulsions. Food emulsions. Gels (2 hours)
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PRACTICAL SYLLABUS:

Workshop: preparation of a laboratory experiment

- Preparation and development of an experimental work suitable to the didactics of the subject

Lab practices

PRACTICE 1. DETERMINATION OF WATER ACTIVITY IN FOODS.

PRACTICE 2. DETERMINATION OF WATER CONTENT IN YOGURT USING FTMIR-ATR SPECTROSCOPY.

PRACTICE 3. POTENTIOMETRIC DETERMINATION OF pH AND TOTAL ACIDITY OF BEER.

PRACTICE 4. SPECTROFLUORIMETRIC APPLICATION TO THE DETERMINATION OF CAFFEINE IN BLACK TEA

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BIBLIOGRAPHY

FUNDAMENTAL BIBLIOGRAPHY::

- 1.- "Propiedades Físicas de los Alimentos Procesados y de los Sistemas procesados". Lewis, M.J. Editorial Acribia S.A. 1993
- 2.- "Termodinámica y cinética de sistemas alimento entorno". Martínez Navarrete, N.; Andrés Grau, A.M.; Chiralt Boix, A.; Fito Maupoey, P. Universidad Politécnica de Valencia. 1999
- 3.- "Introducción a la Bioquímica y Tecnología de los Alimentos". Cheftel, J.C. y Cheftel, H. Editorial Acribia, S.A. (1999)
- 4.- "Ciencia de los Alimentos". Potter, N y Hotchkiss, J. Editorial Acribia S.A. (1999)
- 5.- "Deshidratación de Alimentos". Barbosa-Cánovas, G y Vega-Machado, H. Editorial Acribia S.A. (2000)
- 6.- "Ciencia y Tecnología de los Alimentos" Geoffrey Campbell-Platt Ed. Editorial Acribia (2009)

COMPLEMENTARY BIBLIOGRAPHY:

- "Introduction to the Physical Chemistry of Foods". Christos Ritzoulis. CRC Press. 2013.
- "Physical Chemistry of Foods" Pieter Walstra. Marcel Dekker, Inc. New York. USA. 2003
- "Physical Chemistry of Food Processes, Volume I: Fundamental Aspects". Ion C. Baianu Ed. Chapman and Hall. England. 1992
- "Fisicoquímica". Levine I.N. 5ª Ed. Mac Graw Hill/Interamericana España. 2004. Madrid.
- "Química Física". Atkins y de Paula. Ed. Panamericana. 8ª Ed. 2006

TEACHING METHODOLOGY

Detailed information about this ítem can be found in the Spanish version

SYSTEM FOR ASSESSING THE ACQUISITION OF THE COMPETENCES AND KNOWLEDGE

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ADDITIONAL INFORMATION

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