- Chemistry and Biochemistry of Primary Production

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***Text under revision. Not yet approved by academic staff.***

COURSE AIMS AND INTENDED LEARNING OUTCOMES

The course aims to provide a more in-depth knowledge of the chemical composition of foods, with particular attention to the substances of nutraceutical and functional interest. Provide an understanding of the chemical-physical phenomena of certain chemical and biochemical phenomena and transformations that take place during the collection, preservation and transformation of food. Expand biochemical knowledge of the regulation of cellular communication processes and of the sensory perception of food. At the end of the course, students shall be able, for any given food, to discuss its composition, know the substances formed through the transformation of its nutritional ingredients, describe the substances responsible for its organoleptic characteristics and analyse their interactions with the sensory organs. The knowledge acquired must be communicated appropriately and applied to real cases, such as the preparation of industrial or artisanal foodstuff, all the characteristics of which the students must be able to appropriately discuss in a scientific language and with the specific vocabulary in both oral and written form. Another acquired competence they will have to demonstrate, is knowledge of the biochemical mechanisms activated by interaction with food intake.

COURSE CONTENT

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|  | ECTS |
| Carbohydrates: prebiotic oligosaccharides and saccharides, starch, exopolysaccharides, galactomannans, structural polysaccharides, pectins, agar, alginates, carrageenans. Colloidal systems in food, surface tension, emulsions and emulsifiers, foams and gels. | 1 |
| Amino acids and proteins. Functional properties of proteins and their changes during transformations, bioavailability, allergies and main allergens, gluten. Peptides conjugated to sugars (proteoglycans and glycoproteins) and lipids (proteolipids and lipopeptides). | 1 |
| Lipid- and water-soluble vitamins, vitamin C. Prostaglandins, CLA. Secondary metabolism of plants. Terpenes, sterols, carotenoids. Polyphenols, flavonoids, tannins. Alkaloids. Other secondary plant metabolites. | 1 |
| Alterations in food. Biochemistry of vegetable product maturation. Softening. Enzymatic browning, enzymatic oxidation. Formation of volatile compounds. Food colours, haem group pigments, isoprenoid derivatives, polyphenols and melanoidins. Non-enzymatic browning. Lipid transformations. | 1 |
| Compounds with antioxidant activity and their activity. Oxidative stress. Communications within the organism. Types, origin and transmission of cellular signals. Signal molecules and various receptors. G proteins and second messengers. Nerve signal transmission, synaptic junctions, neurotransmitters. | 1 |
| The biochemical mechanisms that regulate food intake. Biochemistry in sensory analysis. Sense organs, sensory receptors, CNG and TRP ion channels. Taste and smell and their perception. Chemesthesis. | 1 |
| 12 practical classes of 3 hours each. At the end of each practical, students will have to write a report in a special notebook, which will be assessed in terms of presentation completeness and information reported.  The scheduled practicals, which may undergo changes, are:   1. Simple, fractional and steam distillation. 2. Surface tension CMC measurement of surfactant and commercial shampoo solutions. 3. Emulsions and foams: Classic mayonnaise, with egg white, with lecithin, meringue, whipped cream/butter. 4. Carbohydrates: starch, starch and gluten, starch and lipids. Starch gelation, leavened-unleavened bread, focaccia dough, seitan (gluten determination in dough), bechamel (with and without gluten). 5. Denaturation of soy (tofu) and milk (ricotta, clarified butter and casein) proteins. 6. Egg proteins: egg curd, basic egg, marinated egg, sour egg, egg texture, “the perfect egg”. 7. Molecular cuisine: alginates. Molecular caviar, agar noodles, juice balls, instant noodles, yoghurt mozzarella, orange jellies. 8. Carotenoids. Lycopene extraction. 9. Molecular cuisine: liquid nitrogen, thickeners and emulsifiers. Liquid nitrogen ice cream, cream for ice cream, soy lecithin fresh pasta, lemon air, flax seed muffins, soy lecithin shortcrust pastry. 10. Maillard reaction. Non-enzymatic browning. 11. Enzymatic browning, polyphenols. Antioxidant power assays. 12. Molecular Cuisine: Sugars: glucose frying, glucose vitrification, sucrose vitrification, salted caramel, flavoured powders, sweet charcoal. Corn and popcorn. | 3 |

READING LIST

P. Cappelli & V. Vannucchi,  *Principi di chimica degli alimenti,* Zanichelli, 2016.

J. McMurry-T. Begley, *Chimica bio-organica,* Zanichelli, 2007.

T. COULTATE, *La chimica degli alimenti*, Zanichelli, 2005

P. CABRAS, A. MARTELLI, *Chimica degli alimenti*, Piccin, Padua, 2004.

P. Walstra, *Physical Chemistry of Foods,* Marcel Dekker Inc., New York, 2003.

G. GALAVERNA, C. DALL'ASTA, *Le molecole del gusto, ovvero la chimica dei sapori*, Monte Università Parma, 2018

TEACHING METHOD

Lectures and laboratory practicals. In addition, in-depth seminars will be organised with experts. All the material presented during lectures will be available to students, after every lecture, on Blackboard.

ASSESSMENT METHOD AND CRITERIA

An oral assessment. Students will have to prepare a presentation on a currently marketed transformed food or on a recipe of their choice, and discuss it in depth within a maximum time of 30 minutes. The presentation must necessarily cover at least one of the primary productions involved, at least 3 classes of ingredients present in the product, one transformation/process that takes place during the preparation of the food, and one biochemical interaction with the organism, including those covered by the course. If necessary, questions will be asked about the topics covered in the course during the discussion. 80% of the final assessment will be based on the quality of the presentation (in-depth knowledge, scientific rigour, analytical and organisational skills displayed in the work) and by the critical and in-depth skills demonstrated during the presentation, and 20% will be based on the assessment of the laboratory activities.

NOTES AND PREREQUISITES

Participation in the laboratory activities is strongly recommended. To follow the course, students should possess a basic knowledge of organic chemistry and biochemistry.

Should the health situation relating to the Covid-19 pandemic not allow face-to-face teaching, remote teaching in synchronous or asynchronous mode will be guaranteed; this will be communicated in good time to students.

Information on office hours available on the teacher's personal page at http://docenti.unicatt.it/.