Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	**Reaction kinetics in food processing**
Course code	44704
Scientific sector	AGR/15
Degree	Food Sciences for Innovation and Authenticity
Semester	II
Year	I
Academic year	2021/2022
Credits	6
Modular	No

Total lecturing hours	36
Total exercise hours	24
Attendance	Yes
Prerequisites	Use of spreadsheet
Course page	

Specific educational objectives	**Aims** The course aims to describe a methodological approach to study the chemical, physical or biological changes occurring to foods during processing or storage. At this purpose, the course is mainly focused on data analysis and model building. Thanks to the extensive use of spreadsheets, the students will learn how to fit experimental data with the most appropriate kinetic model (zero, first or second) and evaluate the overall effect of the process on food quality. A number of practical problems of great relevance for the food industry will be discussed and analyzed, like storage stability, accelerated shelf-life, fermentations, lipid oxidations and browning reactions. **Educational objectives:** 1) the student knows the principles of reaction kinetic, differential rate laws, elementary reactions and Arrhenius equation (temperature dependence). 2) the student knows the main degradation reactions occurring to foods during storage or processing and can describe the main case studies presented at the lectures. 3) given a time series of a specific storage or processing operation, the student is able to identify the most important reactions that may occur, describing the theory governing those

	reactions and identifying the key element to control them. 4) given a time series, the student is able to derive the best kinetic model, analyze the situation, describe the appropriate procedure to report the solution to the problem, predict the changes occurring to foods.

Lecturer	Matteo Mario Scampicchio
Scientific sector of the lecturer	AGR/15
Teaching language	English
Office hours	
Teaching assistant (if any)	PhD Yubin Ding
Office hours	
List of topics covered	**1) Introduction to reaction kinetic** *Stability and shelf life problems in food processing, practical use of kinetic analysis, theory of reaction rates in solutions, effect of temperature, main mechanisms and rate laws.* **2) Application of reaction kinetics to the study of chemical, biochemical and physical changes in foods** *Maillard reactions, vitamin loss, thermal microbial destruction, fermentation kinetics, enzyme kinetics, autoxidation and radical chain reactions, role of antioxidants.* **3) Modelling of kinetic data** *Estimation of linear models, uncertainty estimation, propagation of errors, numerical methods for non-linear models*
Teaching format	Frontal lectures, exercises, labs, projects

Learning outcomes	The learning outcomes are: **Knowledge and understanding** The student will gain principles and theoretical basis of the main product changes occurring to foods during processing and storage, and their interaction with control factors (pH, temperature, Aw, pO2, etc.) and quality attributes (color, moisture, texture, flavor, etc.). The achievement of a sufficient basic knowledge on kinetic theory will be assessed during the final exam, the recap quiz offered during at the end of the lectures and during the writing of reports at the end of lab activities.

	Applying knowledge and understanding The student will be able to apply theory on practical problems occurring to foods, like, stability, shelf-life, effect of thermal treatments, antioxidants, lipid oxidation, Maillard reaction and fermentation kinetics. The capacity of applying knowledge and understanding will be assessed especially during the lab activities and with the final exam, where the student will have to solve practical problems. **Making judgements** The student will be able to analyze, compare and judge the stability of foods and understand the effects of typical degradation reactions and important factors used to prevent their occurrence. This skill will be assessed in the final exam. A series of quiz will test the student's capacity to make judgements, i.e., comparing food changes during processing, identifying undesired reactions, selecting the best storage conditions, choosing among ingredients, etc. **Communication skills** The student will develop skills to communicate the results from kinetic studies of food products. This skill will be evaluated especially during lab activities, where students will work in small group with the aim to write reports summarizing the results achieved. **Learning skills** During classes, the student will learn the time management necessary to complete class assignments. Regularly, small quiz or short recap exercise will be offered during the lectures. This will force to work in groups and collaborate to achieve the result.

Assessment	The assessment is based on a final written test and laboratory reports
Assessment language	English
Evaluation criteria and criteria for awarding marks	The evaluation will consist of: • 80% Written tests (true/false quiz) • 20% Laboratory reports After the successful completion of the written test and laboratory reports, a further (optional) question is planned for the final award (30L).

Required readings	During the lectures, students will receive slides for the general theories, electronic spreadsheets for the numerical applications and detailed instructions for the lab activities. This material is generally sufficient to be prepared for the exam.

	Earle, R. Earle ,M., *Fundamentals of Food Reaction Technology* (free version online at: www.nzifst.org.nz/foodreactiontechnology/index.htm)
Supplementary readings	Martinus A.J.S. van Boekel, *Kinetic Modeling of Reactions In Foods*, (ISBN 9781574446142)