Syllabus

Descrizione corso

Titolo insegnamento	Reaction kinetics in food processing
Codice insegnamento	44740
Titolo aggiuntivo	
Settore Scientifico-Disciplinare	AGRI-07/A
Lingua	Inglese
Corso di Studio	Corso di laurea magistrale in Scienze degli alimenti per l'innovazione e l'autenticità
Altri Corsi di Studio (mutuati)	
Docenti	prof. Matteo Mario Scampicchio, matteo.scampicchio@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/30226
Assistente	
Semestre	Secondo semestre
Anno/i di corso	1st
CFU	6
Ore didattica frontale	36
Ore di laboratorio	24
Ore di studio individuale	90
Ore di ricevimento previste	18
Sintesi contenuti	Reaction kinetics provides quantitative tools to describe, interpret, and predict chemical, biochemical, and microbiological changes in foods during processing and storage. The course covers the development of mechanistic thinking, from rate laws to process design decisions, with a focus on stability and shelf-life issues. Concepts are applied through computational exercises and case studies using food-relevant quality indices.
Argomenti	1. Fundamentals of reaction kinetics in food.

dell'insegnamento	2. Effect of temperature on reaction rates. 3. Apparent kinetics of complex processes (i.e., lipid oxidation). 4. Conditional kinetics of processes dependent on water activity and pH. 5. Kinetics in structured and multiphase foods. 6. Shelf-life prediction.
Parole chiave	Reaction kinetics; Food stability; Shelf life; Arrhenius modelling; Lipid oxidation; Food processing
Prerequisiti	- Basic knowledge of food chemistry and food processing. - Basic concepts of physical chemistry: concentration, equilibrium, pH, water activity. - Elementary mathematics: algebra, logarithms, exponential functions, derivatives, and simple finite integrals. - Basic statistics and regression (this should be covered by the Course Computer Applications in Food Sciences). - Basic use of spreadsheets and R for data analysis and graphical representation (this should be covered by the Course Computer Applications in Food Sciences).
Insegnamenti propedeutici	None
Modalità di insegnamento	- Teaching delivered entirely in person. - Asynchronous lecture recordings available for revision and consolidation. - Laboratory and computational exercise sessions at NOI Techpark. - At least one industrial excursion to observe large-scale processing, process control, and quality-control practices. - Collaborative problem solving based on food-industry kinetic scenarios. - Structured and transparent use of artificial intelligence tools to support analysis, critique, and problem solving.
Obbligo di frequenza	No
Obiettivi formativi specifici e risultati di apprendimento attesi	Knowledge and understanding: Deep understanding of the technological, microbiological, biochemical, chemical, and physical principles underlying food transformation processes and responsible for food product degradation, ensuring their stability and prolonging their shelf life. These knowledge areas will be developed through an educational program that integrates theoretical teaching activities with classroom tutorials, including examples, practical applications,

	individual and group work, and assessments aimed at encouraging active participation and independent solution development. These knowledge areas will be developed through an educational program that integrates theoretical teaching activities with practical activities, such as laboratory exercises, computer simulations, simulations of food processes using pilot plants, and company visits. Ability to apply knowledge and understanding: Ability to manage the technological, microbiological, biochemical, chemical, and physical processes that drive food transformation and the main issues related to the stability and shelf life of food products. Making judgements: Independent judgement is developed through a training programme designed to stimulate critical analysis in students. This includes the use of case studies, simulations using spreadsheets and videos, the reading and critical discussion of scientific articles, as well as specialist seminars held by experts in the food sector. The assessment of the independent judgement acquired by students is entrusted to the individual teachers responsible for the training activities, who will assess it through oral and/or written reports on specific topics and/or through exams. Communication skills: Use of the English language, both written and spoken, at a B2 level, with a command of technical and scientific vocabulary related to food science. Structure and draft scientific and technical documentation describing project activities. Interact and collaborate in the design and development of products and processes with peers and industry experts. The degree course provides graduates with the cognitive skills, logical tools and familiarity with new information technologies necessary to ensure continuous updating of knowledge, both in their specific professional field and in the field of scientific research.
Obiettivi formativi specifici e risultati di apprendimento	- Select and apply suitable kinetic models to experimental data. - Quantify the effects of temperature, oxygen, water activity, pH,

attesi (ulteriori info.)	and food structure on reaction rates. - Predict quality changes during processing and storage, including non-isothermal conditions. - Evaluate model assumptions, uncertainty, validation, and extrapolation limits. - Use kinetic predictions to support decisions on processing, formulation, packaging, storage, and shelf life.
Modalità di esame	- Continuous mid-term assessment: 70% of the final grade (21 points out of 30). It may include in-class multiple-choice and true/false tests, short open questions, interviews, small-group discussions, and problem-based learning activities. - Final written examination: 30% of the final grade (9 points out of 30). For students who successfully complete the mid-term assessment, the examination consists of one integrated food stability and shelf-life problem. The problem requires to model kinetic data, interpret kinetic parameters, express quantitative results, and estimate shelf-life. For Students who do not attend the course and/or do not successfully complete the mid-term assessment, a comprehensive final examination must be undertaken. This includes quiz-style questions, open questions, and an integrated stability and shelf-life problem. 30 cum laude is awarded to Students demonstrating exceptional independence, depth of reasoning, critical insight, and ability to integrate kinetics, uncertainty, model limitations, and industrial constraints in complex or even unfamiliar food systems.
Criteri di valutazione	- Correct understanding of kinetic concepts and terminology. - Ability to formulate a food-processing or shelf-life problem in quantitative terms. - Correct selection and application of kinetic models and equations. - Accuracy of calculations and interpretation of kinetic parameters. - Ability to analyse experimental data and assess model assumptions and limitations. - Ability to justify conclusions and propose technically sound food-industry decisions.

	- Clarity, precision, and appropriate use of scientific and technical language.
Bibliografia obbligatoria	• Lecture slides, datasets, spreadsheets, R scripts, and exercise notes provided by the lecturer. • Earle, R. L., & Earle, M. D. *Fundamentals of Food Reaction Technology*. Royal Society of Chemistry. • Selected scientific articles and technical documents provided during the course.
Bibliografia facoltativa	• van Boekel, M. A. J. S. *Kinetic Modeling of Reactions in Foods*. CRC Press. • Fellows, P. J. *Food Processing Technology: Principles and Practice*. Elsevier. • Heldman, D. R., Lund, D. B., & Sabliov, C. M. (eds.). *Handbook of Food Engineering*. CRC Press. • Selected review articles on food reaction kinetics, lipid oxidation, Maillard reactions, emulsion stability, and shelf-life modelling.
Altre informazioni	Lecture slides, datasets, spreadsheets, R scripts, exercise notes, and other course materials provided by the lecturer are available through the course Microsoft Teams channel. Additional scientific articles, technical documents, and supporting materials may be provided during the course through the same platform.
Obiettivi di Sviluppo Sostenibile (SDGs)	Sconfiggere la fame, Buona salute, Lotta contro il cambiamento climatico, Utilizzo responsabile delle risorse, Innovazione e infrastrutture