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[6650] - SHELF-LIFE CALCULATION AND ESTIMATION

Module of [6649] - FOOD TECHNOLOGY II

General information

Course	FOOD SCIENCE AND TECHNOLOGY
Course type	Master's Degree
Academic year	2025/2026
Year	2
Training activity type	Compulsory subjects, characteristic of the class
Scope	Food Technologies
Language	INGLESE
CFU	5 CFU
Didactic Activity Type	Lezione
Exam type	Oral exam
Evaluation	Voto Finale
Teaching period	Annuale (from 23/09/2025 to 29/05/2026)
Teaching type	Obbligatorio
Holders	SACCHETTI GIAMPIERO - Main teacher
Length	40 hours (40 hours Lezione)
Frequency	Not mandatory
Subject area	AGR/15
Location	TERAMO

Module's Goals

The training objective of the course is to induce the student to integrate, organize and use the knowledge of food technologies, food chemistry, biochemistry and food microbiology acquired in four years of study for the calculation of the shelf life of a stabilized food product and to understand the limits of applicability of the result.

The objective will be achieved by stimulating students to develop different cognitive processes related to learning defined by the Dublin descriptors:

Knowledge and understanding:
The student will be able to:
• define the basic principles at the basis of shelf-life calculation;
• describe the factors affecting shelf-life and their possible interactions;
• explain the different approaches which are used to study the shelf-life of foods;
• describe the methodologies used to perform shelf-life calculations.

Applying knowledge and understanding:
Students will have to:
• integrate previous knowledge of food chemistry, food technology, and food microbiology in order to perform a shelf-life evaluation (group project);
• carry out a shelf-life test by using analytical data collected on literature or in laboratory experience and calculate the results (group project);

Making judgements:
Students should be spurred to:
• demonstrate judgement skill in discussing the advantages and limitations of shelf-life testing;
• demonstrate judgement skill in discussing their own results of shelf-life calculations in comparison with literature data;

Communication skills:
Students will have to:
• Make a shelf-life calculation report (team work project)
• Make a computer aided presentation of their team work project

Learning skills:
Students will be supplied with new tools to learn:
• How to calculate shelf-life solving n-order and mixed order kinetic models.
The tool Solver which is available in the Excel (Open access, Windows or Mac) sheets is used to this purpose and, eventually, a specific add-in (SolverAid) will be supplied by the teacher to students.

Module's Required skills

Consolidated knowledge of the following subjects:
Unit operations and processes of food technologies, food microbiology, food biochemistry, mathematics and statistics.

Module's Subjects

Unit 1. Shelf-life definition. Quality loss and choice of quality indices. The main chemical and biochemical responsible for food spoilage and quality decay. Intrinsic and extrinsic factors affecting the rate of food quality decay. The role of temperature and mobility.

Unit 2. Shelf-life calculation: product-dependent approach. The kinetics of food quality decay (zero, first, second a n-order). Effect of temperature on reactions rate: the Arrhenius equations. Linearization and modifications of the Arrhenius equation: advantages and disadvantages.
Shelf-life tests and accelerated shelf-life tests (ASLT) in isothermal conditions. Examples of calculations.

Unit 3. Shelf-life tests and accelerated shelf-life tests (ASLT) in non-isothermal conditions. The calculation for discreet-time intervals. The calculation of the most probable exposure temperature. The use of time temperature indicators (TTI). Validation of a TTI.

Unit 4. Degradative phenomena following mixed order kinetics. Enzymatic reactions, diffusion kinetics, microbial growth kinetics. Probabilistic quality loss equations. Phase transitions, texture changes and the use of probabilistic quality loss equations.

Unit 5. Reactions kinetics in concentrated food systems: the polymeric approach to food stability. Phase transition and state changes in food. Phase transition and the WLF equation.
Phase transition and WLF-like quality loss kinetics. Phase transitions, texture changes and the use of probabilistic equations for quality loss modelling. Integration of Arrhenius dependent approach and polymeric approach to calculate the shelf-life. Study cases on modified Arrhenius equations.

Unit 6. Role of packaging in shelf-life extension. Water and oxygen transmission rate of packaging materials. Calculation of shelf-life using a packaging dependent approach.

Class exercises

1. Use of the Solver and Solver aid for xls. Determination of the order of a quality loss kinetic.

2. Shelf-life calculation using an n-order kinetic. Calculation of an Arrhenius plot (linearized and non-linearized) and time-temperature modified Arrhenius plot.

3. Shelf-life calculation using a pseudo-diffusion kinetic. Calculation of a time-temperature modified Arrhenius.

4. Shelf-life calculation using a probabilistic approach. Calculation of a time-temperature modified Arrhenius plot. Comparison of results with those obtained in exercise 3.

5. Shelf-life calculation using the Gompertz equation. Calculation of a time-temperature modified Arrhenius plot.

6. Shelf-life calculation of a frozen food. Application of a modified Arrhenius equation that considers concentration and viscosity changes.

Module's Books

- Nicoli C. Shelf Life Assessment of Food (Food Preservation Technology Series). CRC Press: Boca Raton, FL (2012).
- Steele R. Understanding and measuring the shelf-life of food. CRC Press: Boca Raton, FL (2004).
- Kilcast D., Subramaniam P. The stability and shelf-life of food. Woodhead Publishing Ltd: Cambridge, UK (2000)
- Man D., Jones A. Shelf-life evaluation of foods. Aspen Publishers Inc.: Gaithersburg, Maryland, US (2000).