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MODULE 2: Food Safety and Food Quality Analysis

COURSE TITLE: 2.2 FOOD ANALYSIS

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CREDITS: 5 (3-2-6)

1 credit: 1 h/week (15 h)
(Lecture-Practice-Self learning)
Class (contact hours): 45 H (15 weeks)
Practical work: 90 H -(1 credit: 3 h/week (15 h))
Self-learning (Assignment, Presentation, Case study, Self-study): 90 H (15 Weeks)
TOTAL: 225 H/SEMESTER (15 Weeks)

LANGUAGE OF COURSE DELIVERY:

ENGLISH or FRENCH, and national languages (THAI, VIETNAMESE, KHMER)

WORKLOAD: 225 H

(/25h=12 ECTS): 45 contact hours + **90**h practical work + **90**h self-learning (1 credit=15h)
Semester:

PREREQUISITES: MICROBIOLOGY, CHEMISTRY, FOOD TECHNOLOGY,FOOD LEGISLATION AND STANDARD

COURSE OBJECTIVES

To provide the students with knowledge on the key food safety issues, including the food safety hazards, their methods of detection and the key food quality properties. The course will also deal with the, sampling methods, and tools to conduct statistical analysis.

LEARNING OUTCOMES

Upon completion of this module, students will be able:

LO1: to understand and identify food hazards, adulteration and traceability

LO2: to understand how to validate a method to monitor microbiological and/or chemical hazards in food (according to international guidelines)

LO3: to understand how to perform advanced analysis methods for food hazards, adulteration and traceability

LO4: to implement parts of standard analytical methods to monitor microbiological, chemical and physical hazards in food.

LO5: to perform laboratory analyses for routine microbiological and/or chemical testing, in the framework of an accredited laboratory.

LO6: to implement a sampling plan to monitor chemical and microbiological hazards in food.

LO7: to know how to develop a project proposal

Benchmark LOs				Suggested
	Knowledge	Skills	Competence	EQF levels
LO1	X			6
LO2	X			6
LO3	X			6
LO4		X		7

LO5		X		7
LO6		X		7
LO7			X	7

COURSE OUTLINE

The course includes:

4. Lab analysis for Hazard identification

4.1. Types of common contaminants (short introduction)

- Physical (Insects and spoilage)
- Chemical contaminants (Heavy metals, pesticides, mycotoxins, Veterinary drug residues)
- Biological (Microbial and animal based contaminants)

4.2. Methods for identification of common contaminants

- Physical hazards (glass, metal, hair, stones, rings, insects…)
  - Observations, detection…
- Chemical hazards
  - Heavy metals: atomic adsorption chromatography (AAS)
  - Mycotoxin: GC-MS, LC-MS, Aflatoxin detection kits, ELISA method
  - Pesticides: GC-MS, pesticide test kit
- Biological hazards
  - Conventional methods (microbial plate count: pour plate technique and spread plate technique, MPN method, microscope count, electronic counter method, membrane filtration method,…)
  - Rapid methods (real-time PCR, biosensor, immunological-based methods (ELISA), Rapid detection kits, molecular-based methods)

5. SAMPLING TECHNIQUES

5.1. Sample collection

5.2. Sampling standards and legislation

5.3. Sampling plan

5.4. Sampling techniques/methods

5.5. Sample preparation for analysis

5.6. Effect of sampling on analytical results

5.7. Case study for sampling method

6. Food quality analysis

6.1. Factors determining food quality

- Sensory properties
- Physical properties
- Chemical properties
- Microbiological properties

6.2. Analytical methods for food quality

6.3. Proximate analysis (Methods for analysis of moisture, fat, protein, starch and crude fiber)

6.4. Sensory analysis

- Sensory analysis standards
- Sensory analysis management

6.5. Tests or analysis used to authenticate food products/GMO products

6.6. Case studies:

- Methods used to identify adulterated food
- Implementation of traceability along the food chain

7. Statistical analysis

7.1. Statistical regression

- Data, information, models, data types, analytical representation of data
- Calibration and regression, Introduction to Statistics
- Media & Variance
- The Normal distribution, theory of measurement errors, the central limit theorem and the theorem of Gauss
- Maximum likelihood, method of least squares, Generalization of the method of least squares
- Polynomial regression, non-linear regression, the $\chi 2$ method

7.2. Design of Experiments

- Basic design of experiments and analysis of the resulting data
- Analysis of variance, blocking and nuisance variables
- Factorial designs
- Fractional factorial designs
- Response surface methods and designs
- Applications of designed experiments from various fields of food science

7.3. Data Matrices and sensor arrays

- Correlation
- Principal component analysis (PCA)
- Partial least squares regression (PLS)

LABORATORY SESSION: 90 HOURS

Course 4 :0 hours Course 5 : 15 hours Course 6 : 15 hours, Course 7 : 15 hours

- 2 laboratory exercises would be conducted:
  a) Validation of simple chemical method to practice regression
  b) Sensory analysis and physical properties to practice sensory methods like focus groups,… and design of experiments (apply and evaluate simple factorial design) and statistics like ANOVA (calculating e.g. error of analysis. Error of sampling, multiple comparison of different products), PCA (comparison sensory and physical properties,),

Learning Outcomes (LOs)- Course Content Matrix

	4	5	6	7
LO1	X			
LO2		X		X
LO3	X		X	X
LO4	X		X	
LO5	X	X	X	X
LO6		X		X
LO7	X	X	X	X

Skills Development Matrix

Skills (Discipline specific)	
Food-related hazards	I
Hazard analysis	IP
Hygienic practices	IPA
Cleaning and Disinfection design	IPA
Water and waste handling	IP
Preservation methods	IP
Transferable Skills	
Independent learning	P
Time management	P
Oral communication	PA
Written Communication	PA
Co-operative learning	P
Leadership	P

Outcome-Method Table

Intellectual Outcomes

Intellectual outcomes	**Teaching methods or activities**
Students will be better able to:	
1. Identify, investigate and critically evaluate current issues in food safety and preventive strategy to identify hazards	Classroom lecture, case studies, webinar, lab practical work, on-line tutorial
2. Identify and critically evaluate food analysis method and technic to ensure quality control	Classroom lecture, case studies, webinar, lab practical work, on-line tutorial

Skills Outcome

Skills outcome	**Teaching methods or activities**
Students will demonstrate the ability to:	
1. Apply and implement Food quality and Food Safety analysis	Classroom lecture, case studies, webinar, lab practical work, on-line tutorial
2. Use and adapt new techniques in lab according to legislation and context	Classroom lecture, case studies, webinar, lab practical work, on-line tutorial

Attitudinal Outcome

Attitudinal outcomes	**Teaching methods or activities**
Students will increasingly be able to:	
1.systemically search, select and evaluate the literature and other relevant materials on food safety and food quality analysis	Case studies, lab practical work, on-line directed self learning, Group study
2. Plan and manage to do the research and identify issues related to food safety and food quality in laboratory	Case studies, lab practical work, on-line directed self-learning, Group study
3. organise the control and the monitoring of the quality of raw materials and finished products	Case studies, lab practical work, on-line directed self-learning,

Learning Resources:

Textbooks: No designated textbook, but class notes and handouts will be provided.

Reference Books:

1. Rui M. S. Cruz, Igor Khmelinskii, Margarida Vieira, (2014) Methods in Food Analysis, CRC Press
2. Leo M.L. Nollet, Fidel Toldra (2015) Handbook of Food Analysis, Third Edition - Two Volume Set CRC Press
3. V Ravishankar Rai, Jamuna A Bai (2017) Food Safety and Protection, CRC Press
4. Leo M.L. Nollet, Fidel Toldra (2017) Safety Analysis of Foods of Animal Origin, CRC Press
5. Ignacio Arana (2016) Physical Properties of Foods: Novel Measurement Techniques and Applications, CRC Press

Journals and Magazines:

1. Food Control, Elsevier
2. Food Policy, Elsevier
3. Food Research International, Elsevier
4. Innovative Food Sciences and Emerging Technologies, Elsevier
5. Trends in Food Science and Technology, Elsevier
6. Journal of Food Safety, John Wiley & Sons

TEACHING AND LEARNING METHODS

The course is delivered via lectures, webinars, reading materials including the recent literatures and practical problem solving in food safety issues. . Additional online and recent information will be provided to enhance self-learning experiences. Active learning is encouraged and students' understanding of each modules or subtopics is evaluated via featured examples, practical questions, relevant case studies, homework and presentation. .

TIME DISTRIBUTION AND STUDY LOAD:

1. Lecture: 45 hours
2. Assignments: 15 h
3. Case study and presentation: 40 h
4. Self-study: 35 hours

Course /Chapter	Lecture hour	Lab practices	Presentation	Self-study/Assignment
4	10	20	0	15
5	10	25	15	10
6	10	45	10	10
7	**15**	**0**	**15**	**15**
Total	**45**	**90**	**40**	**50**

EVALUATION SCHEME

The final grade will be based on the following weight distribution: Assignments (15%), Case studies and presentation (35%) mid semester exam (20%) and final exam (30%)

An “A” would be awarded if a student can show the ability having elaborative knowledge on; elaborate, formulate and solve problems related to this module. A “B” would be awarded if a student shows an overall understanding of the topics covered, a “C” would be given if a student meets below expectation on both knowledge acquired and analysis. A “D” would be given if a student does not meet basic expectations of the topics presented in the course.

Assessment Specification Grid

Activities	LO1	LO2	LO3	LO4	LO5	LO6	LO7	Total
2.2.4	**x**		**x**	**x**	**x**		**x**	
Quizzes	2		1					**3**
Mid Term Exam	1		1	2	1		1	**6**
Final Exam	3		3	2	2		2	**12**
Assignment4				3	3		3	**9**
2.2.5						**x**	**x**	
Final Exam						6	4	**10**
Assignment 5						5		**5**
Presentation						2	3	**5**
2.2.6			**x**	**x**	**x**		**x**	**0**
Practical report			2	2	2		2	**8**
Presentation			2	2	2		1	**7**
Exam			4	4	4		3	**15**
2.2.7		**x**			**x**	**x**	**x**	**0**
Quizzes		1			1	2		**4**
Assignment7		1			1	2	1	**5**
Presentation		1			1	2	1	**5**
Exam		1			1	2	2	**6**
Examination								**0**
Total 2.2	**6**	**4**	**13**	**15**	**18**	**21**	**23**	**100**

Assessment of Case study and Assignments:

- Understanding the concept and topics properly
- Demonstrate the specifically sound of the evident-based case analysis
- Concise reviewing the relevant literature on relevant topics
- Interpret the acquired data and analyse scientifically
- Describe the results comprehensively and writing skills in the report
- Clear oral presentation

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ALIGNMENT MATRIX OF MODULE LEARNING OUTCOMES

Corresponding EQAS LO	Module LO	Units developing the LO	Extent of alignment with EQAS LO (maximum total for an EQAS LO 100%)
Learning Outcomes for Food Safety and Microbiology			
Describe the properties of common food spoilage organisms. Experimentally determine their presence and numbers. Demonstrate a critical understanding of instances of food spoilage, causation and prevention.	LO1: to understand and identify food hazards, adulteration and traceability	2.2-4, 2.2-6	
Describe the properties of common food poisoning organisms, their toxins and means of detection. Experimentally determine the presence of food poisoning organisms. Demonstrate a working knowledge of food-borne infections/intoxications, evaluating causation and prevention.	LO1: to understand and identify food hazards, adulteration and traceability	2.2-4, 2.2-5, 2.2-6	
	LO2: to understand how to validate a method to monitor microbiological and/or chemical hazards in food (according to international guidelines)	2.2-4, 2.2-5, 2.2-6	
	LO3: to understand how to perform advanced analysis methods for food hazards, adulteration and traceability	2.2-4, 2.2-5, 2.2-6	
	LO4: to implement parts of standard analytical methods to monitor microbiological, chemical and physical hazards in food	2.2-4, 2.2-5, 2.2-6	
Learning Outcomes for Food Chemistry and Analysis			
Demonstrate understanding of the basic concepts of organic chemistry, physical chemistry and biochemistry related to food. Demonstrate an understanding of the structure and function of major food components. Describe the physical and chemical properties of foods in production and supply chains. Demonstrate a comprehensive understanding of the structure, function and interactions of major and minor food components, vitamins, flavours, taste and colour.	LO2: to understand how to validate a method to monitor microbiological and/or chemical hazards in food (according to international guidelines)	2.2-4, 2.2-6	
	LO3: to understand how to perform advanced analysis methods for food hazards, adulteration and traceability	2.2-4, 2.2-6	
Demonstrate a practical understanding of health and safety in the laboratory. Demonstrate the application of the principles of GLP, health and safety in the context of a food laboratory.	LO5: to perform laboratory analyses for routine microbiological and/or chemical testing, in the framework of an accredited laboratory		

Corresponding EQAS LO	Module LO	Units developing the LO	Extent of alignment with EQAS LO (maximum total for an EQAS LO 100%)
Carry out an analysis of the proximate composition of foods and of basic sensory properties. Undertake an extended analysis of the chemical, physical and sensory properties of foods, critically analyse and interpret the results.	LO2: to understand how to validate a method to monitor microbiological and/or chemical hazards in food (according to international guidelines)	2.2-4, 2.2-5, 2.2-6, 2.2-7	
	LO3: to understand how to perform advanced analysis methods for food hazards, adulteration and traceability	2.2-4, 2.2-5, 2.2-6, 2.2-7	
	LO4: to implement parts of standard analytical methods to monitor microbiological, chemical and physical hazards in food	2.2-4, 2.2-5, 2.2-6, 2.2-7	
	LO5: to perform laboratory analyses for routine microbiological and/or chemical testing, in the framework of an accredited laboratory	2.2-4, 2.2-5, 2.2-6, 2.2-7	
Quality Management and the Law			
Demonstrate a critical understanding of the role of food provenance in maintaining food quality. Undertake an analysis demonstrating how a food product can be authenticated.	LO1: to understand and identify food hazards, adulteration and traceability	2.2-5, 2.2-6, 2.2-7	
	LO3: to understand how to perform advanced analysis methods for food hazards, adulteration and traceability	2.2-5, 2.2-6, 2.2-7	
Generic Competences Communication abilities, ethics and personal skills			
Able to plan and carry out an experimental investigation under supervision and write a scientific report following standard conventions.	LO1: to understand and identify food hazards, adulteration and traceability	2.2-5, 2.2-6, 2.2-7	
	LO2: to understand how to validate a method to monitor microbiological and/or chemical hazards in food (according to international guidelines)	2.2-5, 2.2-6, 2.2-7	
	LO4: to implement parts of standard analytical methods to monitor microbiological, chemical and physical hazards in food	2.2-5, 2.2-6, 2.2-7	
	LO6: to implement a sampling plan to monitor chemical and microbiological hazards in food	2.2-5, 2.2-6, 2.2-7	
Communicate scientific ideas through written, oral and visual means in English. Able to discuss these ideas at a higher level.	LO4: to implement parts of standard analytical methods to monitor microbiological, chemical and physical hazards in food	2.2-5, 2.2-6, 2.2-7	
	LO6: to implement a sampling plan to monitor chemical and microbiological hazards in	2.2-5	

Corresponding EQAS LO	Module LO	Units developing the LO	Extent of alignment with EQAS LO (maximum total for an EQAS LO 100%)
	food		
	LO7: to know how to develop a project proposal	2.2-6	
Evaluating their own achievement by developing a capacity for self-reflection and that of others by participating in peer-review.	LO4: to implement parts of standard analytical methods to monitor microbiological, chemical and physical hazards in food	2.2-5, 2.2-6, 2.2-7	
	LO6: to implement a sampling plan to monitor chemical and microbiological hazards in food	2.2-5	
Demonstrate autonomy, self-direction, initiative and effective decision making in complex and unpredictable situations.	LO2: to understand how to validate a method to monitor microbiological and/or chemical hazards in food (according to international guidelines)	2.2-5, 2.2-6, 2.2-7	
	LO6: to implement a sampling plan to monitor chemical and microbiological hazards in food	2.2-5	
Use statistical programs for experimental design and analysis of experimental data and interpret the results.	LO2: to understand how to validate a method to monitor microbiological and/or chemical hazards in food (according to international guidelines)	2.2-5, 2.2-6, 2.2-7	
	LO3: to understand how to perform advanced analysis methods for food hazards, adulteration and traceability	2.2-5, 2.2-6, 2.2-7	
	LO4: to implement parts of standard analytical methods to monitor microbiological, chemical and physical hazards in food	2.2-5, 2.2-6, 2.2-7	
	LO5: to perform laboratory analyses for routine microbiological and/or chemical testing, in the framework of an accredited laboratory	2.2-5, 2.2-6, 2.2-7	
	LO6: to implement a sampling plan to monitor chemical and microbiological hazards in food	2.2-5	