

COURSE OUTLINE

GENERAL

SCHOOL		AGRICULTURAL SCIENCES	
DEPARTMENT		FOOD SCIENCE AND NUTRITION	
EDUCATION LEVEL		Undergraduate	
LECTURE CODE		MK412	SEMESTER 4 th
LECTURE TITLE		NUTRITION AND HUMAN METABOLISM	
		Responsible person: Sandra Martín-Peláez	
SELF-ENDED TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDIT UNITS (ECTS)
LECTURES		4	6
LABORATORY EXERCISES		2	
COURSE TYPE		DEVELOPMENT OF SKILLS	
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:		Greek	
THE COURSE IS OFFERED TO ERASMUS STUDENTS			
COURSE WEBSITE (URL)		https://food.uth.gr/sandra-martin-pelaez/?lang=en	

LEARNING OUTCOMES

Learning outcomes
The course introduces students to the biochemical, cellular, and molecular mechanisms governing the interaction between food components, bioactive ingredients, gut microbiota, and metabolic physiology. It covers the dynamics of digestion, epithelial transport, nutrient sensing, metabolic pathways, and the biotransformations mediated by the gut microbiome. Upon successful completion of the course, the student will be able to: 1. Understand the cellular and molecular mechanisms of digestion, transport, bioaccessibility, and metabolic processing of nutrients and bioactives. 2. Evaluate the enzymatic activities and metabolic pathways of the gut microbiome in substrate biotransformation. 3. Elucidate nutrient-sensing networks and transcriptional regulation in metabolic tissues. 4. Analyze signaling pathways mediated by microbial metabolites via cellular receptors. 5. Apply laboratory protocols (<i>in vitro</i> models, cell culture techniques, chromatographic analysis) and bioinformatic tools to evaluate metabolic processes and functional ingredients.
General Skills
1. Autonomous work 2. Group work 3. Promotion of free, creative and inductive thinking 4. Search, analyze and synthesize data and information, using and necessary technologies

COURSE CONTENT

Theory

Block I: Digestion, Epithelial Transport & Cellular Metabolism

- **Physicochemical Dynamics of Digestion and Bioaccessibility:** Breakdown of food matrices, enzymatic kinetics, and *in vitro* digestion models.
- **Epithelial Transport and Barrier Function:** Mechanisms of cellular transport across the intestinal epithelium and structural regulation of barrier integrity.
- **Nutrient Sensing and Cellular Energetics:** Molecular sensing of energy charge and nutrients and mitochondrial function.
- **Transcriptional and Hormonal Regulation of Metabolism:** Nuclear receptors and hormonal signaling pathways in metabolic tissues.

Block II: Gut Microbiome & Metabolic Signaling

- **Gut Microbiome Ecology and Enzymatic Activity:** Composition and dynamics of the gut microbiota; enzymatic systems for complex substrate degradation.
- **Biosynthesis and Flux of Microbial Metabolites:** Pathways for Short-Chain Fatty Acids (SCFAs), bile acid biotransformations, and tryptophan derivatives.
- **Signaling Mediated by Microbial Metabolites:** Receptor signaling and metabolic cross-talk mediated by microbial products.
- **Epigenetics and Mucosal Physiology:** Epigenetic effects of microbial metabolites, cellular interactions, and mucosal homeostasis.

Block III: Omics & Bioactive Ingredients

- **Nutrigenomics and Epigenetic Mechanisms:** Direct interactions between food components, gene expression, and epigenetic modifications.
- **Metabolomics and Biomarker Analysis:** Analytical platforms (LC-MS, GC-MS, NMR) for metabolic profiling and biomarker identification.
- **Probiotics, Prebiotics, Synbiotics, and Postbiotics:** Selection criteria for probiotic strains, chemical properties of prebiotics, and postbiotic mechanisms.
- **Experimental Evaluation of Bioactive Ingredients:** Methodologies (*in vitro*, *ex vivo*, and *in vivo* models) for characterizing and evaluating functional ingredients.

The laboratory program consists of experimental and computational modules designed to familiarize students with basic methodologies in digestion, microbial metabolism, and bio-evaluation:

- ***In vitro* Digestion and Bioaccessibility Assays:** Standardized protocols simulating gastrointestinal conditions to evaluate the breakdown and bioaccessibility of food components and bioactive ingredients.
- **Microbial Fermentation and Metabolite Analysis:** *In vitro* microbial fermentation techniques and analytical methods (such as chromatography) for quantifying microbial metabolites and bioactives.
- **Microbial Enzymatic Activity Assays:** Biochemical assays to measure microbial enzymatic activity (such as bile salt hydrolase activity) and microbial biotransformations relevant to metabolism.
- **Epithelial Function & Barrier Evaluation:** Biochemical and molecular techniques to evaluate intestinal transport dynamics, barrier integrity, and bioaccessibility.
- **Bioinformatic Analysis of Microbiome & Metabolic Pathways:** Processing of biological/metagenomic datasets and mapping of metabolic pathways using specialized databases and software (e.g., KEGG, HMDB).

TEACHING AND LEARNING METHODS - ASSESSMENT

DELIVERY METHOD	In person		
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	PRESENTATION OF LECTURES THROUGH PPT USE OF COMPUTER DURING THE LECTURES BY THE TEACHER LEARNING PROCESS SUPPORT THROUGH E- CLASS		
TEACHING ORGANIZATION	Activity	Semester workload	
	Lectures	52 (13 weeks × 4 hours)	
	Laboratory Exercises	12 (6 Lab Exercises × 2 hours)	
	Autonomous Study & Course Preparation	38	
	Preparation for Written Examination	48	
	Total Course Workload (25 workload hours per credit unit)	150 (6 ECTS)	
STUDENT EVALUATION	The final grade for the course is determined by 70% from the theoretical part and 30% from the laboratory part. • Theoretical Part Examinations (70%): Include multiple-choice questions and short essay or critical thinking questions. • Laboratory Part Examinations (30%): Include multiple-choice questions and computational exercises / problems. A passing grade (5 out of 10) is required in both the theoretical and the laboratory parts.		

SUGGESTED BIBLIOGRAPHY

-Suggested Bibliography :

- Gropper SS, Smith KL, Groff JL. Διατροφή και Μεταβολισμός, Τόμος 2. Εκδόσεις Πασχαλίδης, 2008, 978- 960-399-575-3.
- Carr T, Gropper S, Smith J. Advanced Nutrition and Human Metabolism. 7th Edition. Cengage Learning, 2017.
- Συντώσης Λ, Σκενδέρη Α. Διατροφή και Μεταβολισμός. Broken Hill Ed, 2016.