



Nutrigenomics and Nutrition Security (0466.4015)

INSTRUCTOR:

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COURSE DESCRIPTION:

By understanding the interaction of nutrients or bioactive food compounds with genes (nutrigenomics), there exists a great potential to optimize nutrition security and improve human health at an individual or population level. While nutrigenomics on a molecular level explores how food components affect homeostasis in the body, the agricultural application of nutrigenomics in food systems allows for widespread benefits to enhance the quality of food in different regions and climates. Students who study food security and safety must possess a basic understanding of the implications of genetic interactions with food. This course will provide a contemporary overview of nutritional genomics, the effects of the “climate-food-health nexus” on food quality, the role of functional foods; and is designed for students of all educational backgrounds.

PRE-REQUISITES & INTENDED AUDIENCE:

No pre-requisites. The course is intended for Master’s and PhD level students or above.

TEXTBOOK REQUIREMENTS:

Journal Papers

COURSE OBJECTIVES:

Students will develop a general understanding of nutritional genomics and its relation to food security and public health. The role of the climate/environment, earth microbiome and fertilization practices on food nutritional value will also be explored.

COURSE OUTCOMES:

Students will be able to:

- Understand the role and importance of nutrient-gene interaction in food production and agriculture
- Discern the important role of micronutrients in nutrient-induced gene interactions
- Delineate the important differences between food and nutrition security, macronutrients and micronutrients; phytochemicals and vitamins; ect
- Describe the effect of climate and environment on food micronutrient content
- Understand the relationship of agricultural practices on health outcomes
- Recognize the importance of nutrigenomics from a public health perspective
- Complete practical exercises examining nutrigenomic-based approaches in agriculture



- Apply scientific methods for validating functional foods
- Identify the appropriateness of studies and techniques in this field by understanding methodologies and scientific inquiry

SCHEDULE OVERVIEW:

Journal Papers for Discussion

This course will use critical analysis of a series of cutting-edge papers from leading journals. Student participation is essential.

Day 1 Introduction to Nutrigenomics

- Overview of Nutrigenomics (Lecture 1)**
 - Introduction to the broader concept of nutrigenomics
 - Nutrigenomics vs. Nutrigenetics
 - Development of Nutrigenomics as a field of study (Next Generation Sequencing and Big Data)
 - Importance of genetic interface with nutrients
 - Functional foods
- Bioactive Food Components and Biological Potential (Lecture 2)**
 - Macro and micro nutrients vs. Phytochemicals
 - Population needs for genetically active nutrients
- Bioactives and Importance in Human Health (Lecture 3)**
 - Function of phytochemicals in development
 - Need for comprehensive nutrition in human health
 - Growing food to optimize health

Day 2. Nutrition, Disease, and Associated Target Genes

- Overview of Disease and Nutrition (Lecture 1)**
 - Disease associated with nutrient deficiency
 - Examples of nutrient-gene interaction resulting in disease
- Bioactive/Functional Foods and Nutrition Security (Lecture 2)**
 - Disease Implications-Development
 - Microbiome and metabolism
 - Survey of phytochemicals and biological activity
- Nutrigenomics from a Public Health Perspective (Lecture 3)**
 - Population genetics and nutritional requirements
 - Optimizing agricultural practices
 - Growing food for populations based on genetics

Day 3. Agricultural Practices on Nutrition Content

- Climate-Food-Health Nexus (Lecture 1)**
 - Effect of Climate on agricultural practices
 - Food as a vector for Pesticides and other chemicals
 - Changes in food content
- Earth Microbiome (Lecture 2)**
 - Effect of microbes on soil quality



- Effect of microbes on plant nutrient content
- Effect of fertilization on food nutrient content
- iii. **Agricultural Applications: Populations and Nutrition Security (Lecture 3)**
 - Difference in genes affect nutritional needs
 - What foods should be grown based on population genetics

Day 4. Scientific Validation

- i. **Methods for Validation (Lecture 1)**
 - Scientific methods to evaluate food studies
 - Pharmacy vs Nutrition studies
 - Growth, storage, preparation and matrix effect on evaluation
- ii. **Models (Lecture 2)**
 - Cellular studies
 - Animal models
 - Clinical studies
- ii. **Applications (Lecture 3)**
 - Next Generation Sequencing
 - Big Data
 - Precision Agriculture
 - Artificial Intelligence

Day 5. Case Studies

- i. **Presentation of Case Studies (Lecture 1)**
 - Selection of articles that reinforce concepts
- ii. **Discussion of Case Studies (Lecture 2 and 3)**
 - Group discussion of articles

Day 6. Exam