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
  i. 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
  ii. Bioactive Food Components and Biological Potential (Lecture 2)
     Macro and micro nutrients vs. Phytochemicals
     Population needs for genetically active nutrients
  iii. 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
  i. Overview of Disease and Nutrition (Lecture 1)
     Disease associated with nutrient deficiency
     Examples of nutrient-gene interaction resulting in disease
  ii. Bioactive/Functional Foods and Nutrition Security (Lecture 2)
     Disease Implications-Development
     Microbiome and metabolism
     Survey of phytochemicals and biological activity
  iii. 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
  i. 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
  ii. 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