

---

## Food Safety and Technology

National Center for Food Safety and Technology  
 IIT Moffett Campus  
 6502 S. Archer Road  
 Summit-Argo, IL 60501  
 708.563.1576  
 708.563.1873 (fax)  
 www.ncfst.iit.edu

**NCFST Director:**  
 Martin Cole

**Graduate Program Director:**  
 Sadhana Ravishankar

The National Center for Food Safety and Technology (NCFST), with IIT faculty, U.S. Food and Drug Administration (FDA) scientists, and food industry scientists, provides a unique training ground for individuals seeking graduate education in food safety and technology and food process engineering. Courses are offered at NCFST with strong support of the following IIT departments: Biological Chemical and Physical Sciences (BCPS) and Chemical and Environmental Engineering (ChEE).

The master's degree programs in Food Safety and Technology are designed to train students with backgrounds in food science to be food safety experts for the private sector and for the federal and state public health

agencies. The master's degree programs in Food Process Engineering are designed as flexible programs to educate engineers and scientists in different aspects of food processing and safety. Students can specialize in food processing operations, packaging, food safety, food biotechnology, and process and quality monitoring and control.

The faculty is drawn from NCFST/IIT faculty and NCFST/FDA scientists, and is augmented by IIT faculty from several departments, other federal scientists, and experts from NCFST member companies. In addition to formal course requirements, students will participate in food safety and technology research projects at the NCFST under the supervision of IIT faculty and FDA scientists. The FDA presence provides a unique opportunity for students to understand the synergy of scientific philosophy and legal issues involved in the regulatory process governing the safety and wholesomeness of the U.S. food supply.

Graduates of the program will be prepared to assume responsible positions in research and development, food safety, compliance and regulatory affairs, quality assurance, and quality control in the food industry. Other career options include positions in federal, state or local health agencies and private public health organizations in policy-making, regulatory or research positions.

---

### Degrees Offered

Master of Science in Food Safety and Technology  
 (Thesis Option)  
 Master of Food Safety and Technology (Professional,  
 Non-Thesis Option)

Master of Science Food Process Engineering  
 (Thesis Option)  
 Master of Food Process Engineering  
 (Professional, Non-Thesis Option)

---

### Certificate Programs

Food Process Engineering  
 Food Safety and Technology

---

### Facilities

The NCFST facilities include a 2,692 square meter modern industrial scale pilot plant. The pilot plant houses state of the art equipment such as a computer-controlled retort, high temperature-short time plate pasteurizer, batch high pressure food processors for pasteurization and sterilization studies, equipment for aseptic processing of particulate foods, pulsed electric field apparatus, ozone processor, UV food processor, homogenizers, and package recycling pilot plant. Biocontainment pilot plant

laboratory (BL3) provides an opportunity to conduct studies of pathogenic microorganisms with pilot plant equipment. Further, microbiological, food engineering, chemical and packaging laboratories support the pilot plant facilities. NCFST's food science and technology library provides both physical and systems access to current and retrospective research and technical publications.

# Food Safety and Technology

---

## Faculty

Martin B. Cole, Research Professor and Director of the National Center for Food Safety and Technology. B.S., Manchester Metropolitan University (UK); Ph.D., University of East Anglia (UK). Control measures for food safety; causes and diagnoses of food spoilage in processed foods; emerging concepts in food safety; development and implementation of control mechanisms for foodborne microorganisms; modeling the growth, survival and death of bacterial pathogens; novel processing technologies, including thermal and non-thermal high pressure processing; detection and control of emerging pathogens.

Tatiana Koutchma, Research Associate Professor of Food Process Engineering, Ph.D., Thermal and non-thermal innovative preservation technologies including ultra high pressure; ultraviolet irradiation; microwave and radio frequency heating and combined treatments for improved food safety, shelf life and product acceptability. Developing protocols for food companies on validating novel technologies in the food safety area using new processing approaches.

Samuel Palumbo, Research Professor of Biology. B.S. Biology, Loyola University; M.S., Ph.D., Food Science, University of Illinois, Urbana-Champaign. Growth of foodborne pathogens at low (refrigeration) temperatures; microbiology of food processing operations; interventions to reduce or eliminate pathogens from red meats and meat products; and laboratory and pilot plant detection and enumeration of various foodborne pathogens such as *Listeria monocytogenes*, *Escherichia coli* O157:H7, *Salmonella*, and *Campylobacter jejuni*.

Sadhana Ravishankar, Research Associate Professor of Food Safety and Director of Educational Programs. B.S., M.S., Tamilnadu Agricultural University, (India); Ph.D., University of Georgia. Stress tolerance responses of foodborne pathogens, mechanisms of stress response in bacteria, control of foodborne pathogens by non-thermal technology, bacterial attachment, biofilm formation and control, bacterial spoilage detection in food packages by novel methods, bacterial pathogen surrogate evaluation, control of foodborne pathogens in processed foods by multiple hurdle approach, natural antimicrobials.

Peter J. Slade, Research Associate Professor and Director of Research. B.S., University of Leeds (England); Ph.D., University of Guelph (Canada). Investigations of antimicrobial

treatments applied to seeds and vegetable sprouts, and ready-to-eat meat products; studies on resistance and injury in food borne pathogens to novel processing technologies, with understanding of underlying mechanisms; development and application of novel rapid methods for the detection of food borne pathogens; development of food safety programs such as hazard analysis critical control points (HACCP); hygienic design of food processing facilities and equipment.

Cynthia M. Stewart, Principal Microbiologist and Assistant Research Professor of Biology. B.S., and M.S., University of Delaware; Ph.D., Rutgers University. High pressure processing and other non-thermal processing technologies, bacterial spore inactivation (including mechanisms of inactivation), predictive microbial modeling, food defense (biosecurity), process validation, food polymer science approach to understanding product safety and stability.

Peter Varelis, Principle Research Chemist, M.S. and Ph.D. University of Western Australia. Application of isotope dilution mass spectrometric techniques to measuring contaminants in food and understanding their fate during food processing.

Darsh Wasan, Professor of Chemical Engineering, Vice President for International Affairs, and Motorola Chair. Ph.D, University of California, Berkeley. Interfacial colloidal phenomena, foams, emulsions and dispersions, and food and environmental technologies.

Wei Zhang, Assistant Professor of Biology, B.En., M.S., Huazhong Agricultural University, (China); Ph.D., Pennsylvania State University. Microbial food safety and security; PCR detection and molecular tracking of foodborne pathogens; comparative genomics; study of bacterial pathogenesis, epidemiology, evolution and emergence of new pathotypes; identification of novel bacterial virulence factors; DNA microarray analysis of global gene expressions of foodborne pathogens under environmental or food processing stresses; MALDI-TOF mass spectrometry analysis of bacterial proteomes; applications of DNA fingerprinting technology; development of high-throughput SNP genotyping for foodborne disease surveillance and bioterrorism investigations.

---

## Adjunct Faculty

Upasana Abbott, Adjunct Professor, Food Analysis. B.S. Home Science, M.S., Ph.D. Food Technology, Punjab Agricultural University (India). Single and multiple laboratory validation of analytical methods, detection of pesticide residues, microbial and environmental toxins in foods, and food product development to promote health and longevity.

Eric F. Greenberg, Adjunct Professor of Food Law and Regulations. B.A., Northwestern University; J.D., Cornell Law School. Partner in the law firm of Ungaretti & Harris, which is concentrated in food and drug law, packaging law, and commercial litigation. Work has included regulatory counseling, new product development, negotiation with the U.S. Food and Drug Administration on

numerous levels, handling recalls, and defending enforcement actions.

Alfredo C. Rodriguez, Adjunct Professor, Advanced Food Process Engineering. B.S. and M.S., National Polytechnic Institute (Mexico); Ph.D., University of Florida. Dr. Rodriguez is the Engineering Specialist, Sterilization Science Center, at Baxter Healthcare Corporation, Round Lake, IL. Kinetics, transport phenomena, statistics and system analysis as applied to sterilization process engineering. Applied research interests correspond to the use of high pressure, radiation, moist-heat; and ethylene oxide and other disinfectants to sterilize pharmaceutical and biological products.

## Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0  
 GRE score minimum: 1400 (combined score, for tests taken prior to Oct. 1, 2002); 900 (quantitative + verbal) and 2.5 (analytical writing, for tests taken on or after Oct. 1, 2002).  
 TOEFL minimum: 550/213\*

Meeting the minimum GPA and test score requirements does not guarantee admission. GPA and test scores are just two of several important factors considered. Admission to graduate study in food safety and technology requires the completion of a program leading to a bachelor's degree in food science and technology, agricultural engineering, chemical engineering or related disciplines from an accredited institution. The applicant must have a minimum cumulative undergraduate grade point average of 3.0/4.0. Prerequisites for the program are food processing, chemistry, microbiology, calculus and statistics. Students without appropriate prerequisites are expected to take deficiency courses suggested by their

academic advisers. For admission requirements in the Food Process Engineering program, please refer to the Department of Chemical and Environmental Engineering section.

A limited number of supported graduate half-dean's scholarships are available. Consideration is given based on the quality of previous academic work, evidence of research ability and intellectual capacity. These are awarded on a competitive basis to qualified students who have submitted completed applications by January 30 for admission in the fall semester or by September 1 for admission in spring semester. Graduate Research Assistantship will be available depending on grants received by the faculty. Assistantship appointments are in general for one year and renewed upon satisfactory research progress and funding availability. Additional information is available from NCFST.

\* Paper-based test score/computer-based test score.

## Program Descriptions

Students in Food Safety and Technology programs should consult with their faculty adviser to plan a program of study best suited to their background and interests. The Food Safety and Technology program is directed toward students with backgrounds in food science and related fields. The Food Process Engineering (FPE) programs are directed toward students with background and career objectives in engineering-related disciplines. Students enrolled in FST Master of Science programs must register for six to eight credit hours of research. This work will usually be done at the Moffett Campus; research topics will be selected

from food safety, food process engineering, food biotechnology, or related topics. Attendance will also be required in a graduate seminar where students are expected to actively participate and present reports on their research. Students enrolled in Master of Food Safety and Technology and Master of Food Process Engineering are strongly encouraged to do an independent project up to four credit hours. Details on food process engineering program requirements are in the section on the Department of Chemical and Environmental Engineering.

## Master of Science in Food Safety and Technology

32 credit hours  
 Thesis

Candidates are required to take a total of 32 credit hours, 14 credits of which must be selected from the core food safety and technology courses listed below, and six to eight credit hours must be in research and thesis work.

### Core courses

FST 505	Food Microbiology
FST 506	Food Microbiology Laboratory
FST 507	Food Analysis
FST 521	Food Process Engineering
FST 541	Principles of Food Packaging
FST 524	Fundamentals of Food Science and Technology (For Students with Non-Food Background)
FST 541	Principles of Food Packaging

### Electives

FST 504	Food Biotechnology
FST 511	Food Law and Regulation
FST 531	HACCP Planning and Implementation
FST 507	Food Analysis

The student must have a minimum grade point average of 3.0/4.0 in the core courses. In addition to the core courses required of all students, further courses may be selected with the approval of the adviser to fit the background and needs of the individual student.

Research for the thesis must be carried out under the direct supervision of a participating faculty member. Based on the requirements of the research project, thesis committee members may be chosen from IIT faculty members from various departments, NCFST/FDA scientists and the food industry scientists. The final thesis examination consists of submission of a written thesis report followed by an oral presentation open to all NCFST staff and the university community. As a part of the thesis, the student is expected to contribute to one or more high quality peer-reviewed journal article(s). The student is also encouraged to present the research at a national professional society meeting.

# Food Safety and Technology

---

## Master of Science in Food Process Engineering Master of Food Process Engineering

32 credit hours

Thesis (for Master of Science program)

Project Option (for Master of Food Process Engineering)

Students should refer to the section on the Department of Chemical and Environmental Engineering for details on food process engineering program requirements.

---

### Certificate Programs

12 credits

Certificate programs provide a student with post baccalaureate knowledge of food safety and technology and its applications in the food industry, and in federal and state public health agencies. Certificate programs typically require a set of three to four courses that must be

completed in three years with minimum GPA of 3.0/4.0. Students who are admitted to master's degree programs may apply coursework previously taken in a certificate program towards the requirements for the master's degree.

---

#### Food Process Engineering (FPE)

Provides an introduction to the field of food engineering with application of chemical engineering to food manufacturing and food safety (four courses, 12 credits). Offered in collaboration with Chemical and Environmental

Engineering program. Students should refer to the Department of Chemical and Environmental Engineering section for additional details.

---

#### Food Safety and Technology (FST)

The following is a list of suggested courses students may choose for the certificate program in Food Safety and Technology.

The certificate requires four courses (12 credits).

FST 504	Food Biotechnology
FST 505	Food Microbiology
FST 506	Food Microbiological Laboratory
FST 507	Food Analysis

FST 521	Food Process Engineering
FST 523	Food Engineering Laboratory
FST 524	Fundamentals of Food Science and Technology (For students with a (Non-Food background))
FST 531	HACCP Planning and Implementation
FST 541	Principles of Food Packaging

Numbers in parentheses after course descriptions indicate weekly class, lab and total credit hours, respectively.

## Course Descriptions

### FST 504

#### Food Biotechnology

Introduction of biotechnology in the food industry including genetic engineering of microorganisms.

Fundamentals of microbial genomics and proteomics. Practice of a variety of software and bioinformatics tools including database search, sequence alignment, phylogenetic and cluster analyses, gene prediction, genomic map construction, structural and functional prediction of proteins.

Applications of DNA fingerprinting techniques in food safety and public health. Prerequisite: Biology or Microbiology. (3-0-3)

### FST 505

#### Food Microbiology

Microorganisms of importance to food safety, spoilage and food fermentations. Principles of occurrence and control. Importance of sanitation and prevention of public health problems. Microbiological contaminants and methods for their detection. Mechanisms of microbial inactivation. Prerequisites: Introductory Microbiology, Food Science and Biochemistry. (3-0-3)

### FST 506

#### Food Microbiological Laboratory

Basic microbiological techniques and safe laboratory practices. Introductory Food Microbiology. Isolation of pathogenic bacteria. Spoilage microorganisms. Fermentation. Environmental Monitoring. Rapid Identification tests. Sporeformers. Prerequisites: Introductory Microbiology and Biochemistry. (0-3-3)

### FST 507

#### Food Analysis

Techniques for analyzing food toxins, food constituents of public health concern, intentional and unintentional food additives, modern separation and analytic techniques. Prerequisites: chemistry, analytic chemistry. (3-0-3)

### FST 511

#### Food Law and Regulation

Legal and scientific issues in regulating the nation's food supply and nutritional status. Rules of regulatory agencies; Federal Food, Drug and Cosmetic Act; definitions and standards for food and adulterated foods. Manufacturing processed foods in compliance with regulations. (3-0-3)

### FST 521

#### Food Process Engineering

Food engineering fundamentals, heat transfer in food processing, food rheology, freezing of foods, food dehydration, kinetics of chemical reactions in foods, refrigeration and thermal process calculations, alternative methods of food processing. (3-0-3)

### FST 522

#### Advanced Food Process Engineering

Process calculations for food processing methods such as canning, aseptic processing, ohmic heating, microwave processing and pulsed energy processing. Extrusion techniques in food processing. Discussion of new food processing techniques and safety implications. Prerequisite: FST 521 or permission of the instructor. (3-0-3)

### FST 524

#### Fundamentals of Food Science and Technology

This course will cover the central food science issues encountered with storage and processing of all major American food commodities including meats, grains, confections, vegetables, eggs, dairy. It will also review the relevant chemistry, physics and engineering required to understand common food-related unit operations such as drying, freezing, sterilization and radiation treatment of foods. An introduction to microbial and chemical issues of food quality and safety will also be covered. (3-0-3)

### FST 531

#### HACCP Planning and Implementation

Examination of the hazard analysis and critical control point (HACCP) principles; microbiological and process overviews; generic HACCP models, good manufacturing practices; monitoring of critical control points, process control and implementation. (3-0-3)

### FST 541

#### Principles of Food Packaging

Type and application of packaging materials. Migration Theories. Food Package interaction. Package testing to ensure safety. Special design considerations. Recycling of package materials. (3-0-3)

### FST 591

#### Research and Thesis

Students conduct their research on a particular topic and write a thesis. Students are also required to write manuscripts from his/her thesis work for publication. (Credit: Variable 1-10 hours)

### FST 593

#### Seminar on Food Safety and Technology

Students attend seminars offered during the semester. Each student is also required to give a 30 minute presentation on a topic of his/her interest or a research project on which she/he has worked. (Credit: 1 Hour)

### FST 594

#### Special Projects

Advanced projects involving analysis of food safety processing, packaging and biotechnology systems. (Credit: 1-6 hours)

### FST 597

#### Special Problems

Independent study focusing on current problems, issues of professional relevance. Topics selected from food process engineering, food safety, packaging, biotechnology. Repeatable to a maximum of six credit hours. (Credit: 1-6)