

Food Science (FDSC)

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Department of Food Science website (<http://food-science.uark.edu>)

Degrees Conferred:
 M.S., Ph.D. (FDSC)

Program Description: The M.S. and Ph.D. programs in Food Science provide students with graduate education and research experience, both fundamental and applied, aimed at enhancing production and processing techniques, assuring food safety, utilizing co-products of food processing, improving the sensory and nutritional quality of food and understanding the role of nutrition in health and disease. Interdisciplinary faculty with comprehensive expertise in the food and food-related sciences, along with state-of-the-art facilities, are capable of addressing the most complex fundamental and applied research problems.

Primary Areas of Faculty Research: Food systems engineering; food system sustainability and resilience; food chemistry and functionality; food microbiology and safety, retail food safety, ready-to-eat and low-moisture food safety, virology, and enology; sensory and consumer science, consumer testing, behavior and food neuropsychophysiology; food for health; post-harvest technologies; new value-added products and process development; methodology and assessment of quality attributes of raw and processed foods; food processing and packaging; lipid, protein, and carbohydrate chemistry; functional foods; nutraceuticals; human nutrition and chronic diseases.

M.S. in Food Science

Admission to Master of Science Degree Program: The student must have a B.S. degree from an accredited institution with a grade-point average of no less than 3.00, minimum GRE score percentiles of 30 for verbal, 25 for quantitative and a score of at least 3.0 for writing, suitable preparation in food science or related areas, and be acceptable to the department. International students must also have a minimum TOEFL score 79 internet-based/550 paper-based, 6.5 IELTS, and 3.9 iTEP.

Requirements for the Master of Science Degree: A minimum of 24 semester hours of course work and 6 semester hours of thesis are required for the M.S. degree. At least 14 course credits of the 24 credits required must be from 5000-level or higher courses. Students are required to complete FDSC 5001 Seminar twice — one proposal seminar and one final seminar. Course deficiencies, if any, will be identified at the time of acceptance. In addition to coursework, the student will be required to conduct research and prepare an acceptable thesis. Upon admission to

this program the candidate will be assigned to a thesis director, who in consultation with the department head will select a graduate committee. This committee will assist with developing a suitable program for the candidate and will serve as the examination committee.

The student must maintain a grade-point average of 3.00 or higher.

Students should also be aware of Graduate School requirements with regard to master's degrees (<http://catalog.uark.edu/graduatecatalog/degreerequirements/#mastersdegreestext>).

Ph.D. in Food Science

Admission to Doctor of Philosophy Degree Program: Applicants for acceptance into the interdepartmental doctoral program in food science must meet all of the requirements for admission to the Graduate School and the Department of Food Science. Students with a B.S. or M.S. degree in Food Science or related sciences from an accredited institution should have a GPA of no less than 3.0. All applicants to the Ph.D. program (B.S. and M.S.) should have a minimum GRE percentile of 30 for verbal, 25 for quantitative and a minimum score of 3.0 for writing, suitable preparation for the food science graduate program, and be acceptable to the department. International students must also have a minimum TOEFL score of 79 internet-based/550 paper-based and 6.5 IELTS.

Requirements for the Doctor of Philosophy Degree: Upon acceptance to this program, the student will be assigned to a dissertation director from the department representing the student's selected area of research. The dissertation director in consultation with the student and with the department head will select at least two suitable graduate faculty members from outside the student's own department to complete a committee of five members. The doctoral advisory committee chaired by the dissertation director will be responsible for supervision of the student's program development, and will serve as the examination committee for candidacy and final examinations. The student's course work and dissertation topic will be supervised by the doctoral advisory committee.

For students holding an M.S. degree in a science discipline, a minimum of 24 semester hours of course credit and a minimum of 18 semester hours of Ph.D. dissertation research credit will be required. At least 18 course credits of the 24 credits required must be from 5000-level or higher courses. Students are required to complete FDSC 5001 Seminar twice — one proposal seminar and one final seminar. Course deficiencies, if any, will be identified at the time of acceptance.

For students holding a B.S. degree in a science discipline, a minimum of 48 semester hours of course credit, a minimum of 18 semester hours of Ph.D. dissertation research credit, and a total of 72 semester hours of credit will be required. At least 32 course credits of the 48 credits required must be 5000-level or higher courses. Students are required to complete FDSC 5001 Seminar twice — one proposal seminar and one final seminar. Course deficiencies, if any, will be identified at the time of acceptance.

The student must maintain a grade-point average of 3.00 or higher. General requirements pertaining to the declaration of intent, admission to candidacy and residency are in accordance with the requirements set forth by the Graduate School of the University of Arkansas.

Students should also be aware of Graduate School requirements with regard to doctoral degrees (<http://catalog.uark.edu/graduatecatalog/degreerequirements/#phdandeddddegreestext>).

Requirements for Ph.D. in AFLS with Human Nutrition Concentration

Prerequisites to Degree Program: A Master of Science degree is desirable. A student with a Bachelor of Science and an exceptional record in academics and/or research may be approved for admission to the Ph.D. program in Agricultural, Food and Life Sciences if the Graduate Student Concentration Admissions Committee of the desired concentration deems them qualified and approval is granted by the AFLSPH Steering Committee. A student admitted to the University of Arkansas, pursuing an M.S. and in good academic standing may apply to be admitted to the doctoral program and forgo completing the M.S. degree if so approved by the AFLSPH Steering Committee and the AFLSPH Graduate Concentration Admissions Committee. A minimum grade point average of 3.00 (on a 4.00 scale) on previous college-level course work is required.

Admission Requirements for Entry: To be considered for admission, a student must submit a letter of intent, along with the application for admission indicating the desired degree concentration, areas of interest and career goals. Official transcripts of all previous college-level course work must be submitted. Three letters of recommendation are required. These letters should address the character and academic capability of the applicant. Applications will first be reviewed by the AFLSPH Steering Committee which will assign the student to the appropriate Graduate Student Concentration Admissions Committee for review. The Concentration Admissions Committee will make the final determination of admittance into the AFLSPH program and the concentration.

Requirements for Doctor of Philosophy Degree: The Ph.D. program in Agricultural, Food and Life Sciences requires a minimum of 72 credit hours after a Bachelor of Science or Bachelor of Arts degree or a minimum of 42 hours after a Master of Science or Master of Arts degree.

General course requirements for each degree candidate are arranged on an individual basis by the Faculty Adviser, the Graduate Advisory Committee and the candidate in accordance with guidelines of their concentration. Alternate courses may be selected at the discretion of the committee.

All students must complete 6 hours of elective course hours and 2 hours of seminar. One seminar must be a research proposal presentation and the other must be an exit seminar presenting the dissertation research results. All students must complete 18 hours of doctoral dissertation hours. Students entering the doctoral program with only a B.S. or B.A. must also complete an additional 30 hours (to reach the 72 hour post B.S./B.A. requirement). Students must satisfactorily pass written and oral candidacy examinations covering their discipline and supporting areas. These examinations must be completed at least one year before completion of the Ph.D. degree program in Agricultural, Food and Life Sciences. Each candidate must complete a doctoral dissertation on an important research topic in the concentration field. The specific problem and subject of the dissertation is determined by the faculty adviser, the student and the Graduate Advisory Committee. A dissertation title must be submitted to the dean of the Graduate School at least one year before the dissertation defense. Provisional approval of the dissertation must be given by all members of the Graduate Advisory Committee prior to the dissertation defense. Students must pass the oral defense and examination of the dissertation given by the Graduate Advisory Committee. A student cannot be approved for conferral of the doctoral degree until after completion of all coursework, written and oral candidacy exams, the defense passed and dissertation accepted by the

Graduate School and an application for the degree has been filed with the Registrar's Office and the fee paid.

Additional Concentration Requirements

In addition to the general requirements for the Ph.D. program in Agricultural, Food and Life Sciences, students in the Human Nutrition Concentration must also complete:

NUTR 5113	Advanced Nutrition I	3
NUTR 5233	Advanced Nutrition II	3
NUTR 5103	Nutrition Research Design and Methodology	3
CHEM 5843	Biochemistry II	3
	Graduate-level Statistics	6
	Choose three (3) hours from the following:	3
FDSC 6443	Metabolism of Xenobiotics	
FDSC 602V	Special Topics (ST: Metabolism and Chronic Disease)	

Total Hours **21**

Completion of the AFLS Ph.D. with a concentration in Human Nutrition does not meet the eligibility requirements to become a registered dietitian nutritionist (RDN). The Commission on Dietetic Registration requires a minimum of a master's degree plus the completion of supervised practice hours. The commission requires that individuals complete the supervised practice hours in programs accredited by the Accreditation Council for Education in Nutrition and Dietetics (ACEND) for this purpose. This is not provided by the University of Arkansas.

In addition to the prerequisites to the AFLS Ph.D. program, applicants are required to have earned credit in the following:

- Introductory Biology (3 credits)
- Physiology (human; 3 credits)
- Biochemistry (3 credits)
- Nutrition (human; 3 credits)
- Statistics (3 credits)

Students entering the graduate program who do not have an undergraduate degree in nutrition or closely related field with training and experience will be required to take the following additional courses:

- CHEM 5813 Biochemistry I
- NUTR 5223 Nutrition During the Life Cycle

Graduate Faculty

Acuff, Jennifer C., Ph.D. (Virginia Tech), M.S. (Kansas State University), B.S. (Abilene Christian University), Assistant Professor, 2020.

Atungulu, Griffiths Odhiambo, Ph.D., M.S. (Iwate University, Japan), B.S. (Jomo Kenyatta University of Agriculture and Technology, Kenya), Associate Professor, 2013, 2019.

Baum, Jamie I., Ph.D., B.S. (University of Illinois-Urbana-Champaign), Associate Professor, 2011, 2018.

Crandall, Philip G., Ph.D., M.S. (Purdue University), B.S. (Kansas State University), Professor, 1989, 1997.

Gibson, Kristen Elizabeth, Ph.D. (Johns Hopkins University), B.S. (University of Central Florida), Associate Professor, 2012, 2017.

Hettiarachchy, Navam S., Ph.D. (University of Hull, England), M.S. (Edinburgh University, Scotland), B.S. (University of Madras, India), University Professor, 1992, 2006.

Howard, Luke R., Ph.D., M.S. (University of Arkansas), B.S. (Purdue University), Professor, 2002.

Lee, Sun-Ok, Ph.D., M.S. (Iowa State University), M.S., B.S. (Dongduk Women's University, South Korea), Associate Professor, 2008, 2016.

Morawicki, Ruben O., Ph.D. (Pennsylvania State University), M.Eng. (State University of New York-Buffalo), B.S. (Universidad Nacional de Misiones, Argentina), Associate Professor, 2006, 2016.

Seo, Han-Seok, Dr.rer.Medic. (Technische Universität Dresden, Germany), Ph.D., M.Sc. (Seoul National University, South Korea), B.S. (Korea University, Seoul, South Korea), Associate Professor, 2012, 2017.

Subbiah, Jeyamkondan, Ph.D. (Oklahoma State University), M.S. (University of Manitoba, Canada), B.E. (Tamil Nadu Agricultural University, India), Professor, 2019.

Ubeyitogullari, Ali, Ph.D. (University of Nebraska-Lincoln), M.S., B.S. (Middle East Technical University, Turkey), Assistant Professor, 2021.

Wang, Ya-Jane, Ph.D. (Iowa State University), M.S. (University of Minnesota-Twin Cities), B.S. (National Taiwan University), Professor, 1999, 2009.

Courses

FDSC 5001. Seminar. 1 Hour.

Presentation and discussion of graduate student research. Prerequisite: Graduate standing. (Typically offered: Fall, Spring and Summer) May be repeated for up to 2 hours of degree credit.

FDSC 509V. Special Problems Research. 1-6 Hour.

Original investigation on assigned problems in food science. Prerequisite: Graduate standing. (Typically offered: Fall, Spring and Summer) May be repeated for up to 6 hours of degree credit.

FDSC 5111L. Food Analysis Lab. 1 Hour.

Laboratory exercises providing students with experience of analytical techniques and instrumentation used in food analysis. Laboratory 3 hours per week. Graduate degree credit will not be given for both FDSC 4111L and FDSC 5111L. Corequisite: FDSC 4113 or FDSC 5113 (formerly FDSC 4113). Prerequisite: FDSC 4304 or FDSC 5304 (formerly FDSC 4304) and CHEM 1123 and CHEM 1121L and CHEM 2613 and CHEM 2611L or (CHEM 3603 and CHEM 3601L). (Typically offered: Spring)

FDSC 5113. Food Analysis. 3 Hours.

Methods of analysis, instrumentation, and laboratory techniques for measuring the chemical composition of raw and value-added products. Lecture 3 hours. Graduate degree credit will not be given for both FDSC 4113 and FDSC 5113. Corequisite: FDSC 4111L or FDSC 5111L (formerly FDSC 4111L). Prerequisite: FDSC 4304 or FDSC 5304 (formerly FDSC 4304) and CHEM 1123 and CHEM 1121L and CHEM 2613 and CHEM 2611L or (CHEM 3603 and CHEM 3601L). (Typically offered: Spring)

FDSC 5121L. Food Microbiology Lab. 1 Hour.

A hands-on laboratory course designed to teach students microbiological techniques and certain enumeration and plating techniques of specific food spoilage and pathogenic bacteria. Graduate degree credit will not be given for both FDSC 4121L and FDSC 5121L. Prerequisite: BIOL 2013 and BIOL 2011L. Pre- or Corequisite: FDSC 4122 or FDSC 5122 (formerly FDSC 4122). (Typically offered: Fall)

FDSC 5122. Food Microbiology. 2 Hours.

The study of food microbiology including classification/ taxonomy, contamination, preservation and spoilage of different kinds of foods, pathogenic microorganisms, food poisoning, sanitation, control and inspection and beneficial uses of microorganisms. Graduate degree credit will not be given for both FDSC 4122 and FDSC 5122. Prerequisite: BIOL 2013 and BIOL 2011L or BIOL 2533. (Typically offered: Fall)

FDSC 5223. Food Biosecurity. 3 Hours.

This course is the study of the security of agricultural products and the protection of our food supply from intentional and accidental, domestic and international contamination. Prerequisite: Graduate standing. (Typically offered: Fall Even Years)

FDSC 5304. Food Chemistry. 4 Hours.

Water, carbohydrates, lipids, proteins, vitamins, and minerals in foods; biochemical and functional properties, enzymes, food additives (emulsifiers, pigments, colors, flavors, preservatives, and sweeteners) and texture as related to properties in food systems and during processing. Lecture 3 hours, laboratory 3 hours per week. Graduate degree credit will not be given for both FDSC 4304 and FDSC 5304. Corequisite: Lab component. Prerequisite: CHEM 1123 and CHEM 1121L and CHEM 2613 and CHEM 2611L or (CHEM 3603 and CHEM 3601L). (Typically offered: Fall)

FDSC 5311. Food Science Internship. 1 Hour.

The Food Science Internship is a supervised practical work experience with a food industry, research program or governmental agency to gain professional experience and insight into career opportunities. Graduate degree credit will not be given for both FDSC 4311 and FDSC 5311. Prerequisite: Completion of first year of graduate studies and instructor consent. (Typically offered: Fall, Spring and Summer) May be repeated for up to 2 hours of degree credit.

FDSC 5413. Sensory Evaluation of Food. 3 Hours.

Principles and procedures for sensory evaluation of food. Appropriate uses of specific tests are discussed, along with physiological, psychological, and environmental factors affecting sensory verdicts. Lecture 2 hours, laboratory 2 hours per week. Graduate degree credit will not be given for both FDSC 4413 and FDSC 5413. Corequisite: Lab component. Prerequisite: STAT 2303 or BUSI 1033 or AGST 5023 or STAT 2823 or PSYC 2013. (Typically offered: Fall)

FDSC 5423. Foodborne Diseases. 3 Hours.

This course will introduce students to the major pathogens associated with foodborne diseases, their epidemiology, and approaches to outbreak investigation and control of foodborne illness. An emphasis will be placed on understanding the relationships between the host, the etiologic agent, and the environment as they relate to disease causation. The student will gain knowledge through lectures, case studies, readings, and an individual project. An understanding of basic biology principles is expected for this course. (Typically offered: Summer Odd Years)

FDSC 5503. Safety and Sanitation for the Food Industry. 3 Hours.

This web-based course will provide an appreciation of the need for sanitation in food processing and increase the students' knowledge of sanitary techniques. Topics will include contamination sources, plant and equipment design, cleaners and sanitizers, HACCP, and food biosecurity. Also covered will be considerations in selecting, establishing and maintaining a sanitation program. An understanding of general microbiology and chemistry principles is expected for this course. (Typically offered: Summer Even Years)

FDSC 5513. Cereal Processing Technology. 3 Hours.

Fundamental concepts of heat and mass transport in grains; cereal/grain structure, property and composition; cereal/grain processing systems and technology; cereal/grain co-product processing technology and value recovery; cereal/grain quality metrics, grading standards and food safety assurance. Prerequisite: FDSC 3103 or FDSC 4754 or instructor permission. (Typically offered: Spring Odd Years)

FDSC 5713. Product Innovation for the Food Scientist. 3 Hours.

This is a capstone course integrating knowledge developed in Food Science to the development of new food products. This course will take an integrated multidisciplinary approach to developing innovative food products and will provide learning experiences in new product development and Research & Development. Topics include product formulation, ingredient interactions, sensory analysis, packaging, labeling, food safety and food law. Graduate degree credit will not be given for both FDSC 4713 and FDSC 5713. Corequisite: Lab component. Pre- or Corequisite: FDSC 4113 or FDSC 5113 (formerly FDSC 4113) and FDSC 4111L or FDSC 5111L (formerly FDSC 4111L). Prerequisite: FDSC 4304 or FDSC 5304 (formerly FDSC 4304), FDSC 3103, and FDSC 4413 or FDSC 5413 (formerly FDSC 4413). (Typically offered: Spring)

FDSC 5754. Engineering Principles of Food Processing. 4 Hours.

Basic mechanics of refrigeration, temperature controls, materials handling and mechanical problems as applied to foods and food processing. Lecture 3 hours, laboratory 3 hours per week. Graduate degree credit will not be given for both FDSC 4754 and FDSC 5754. Corequisite: Lab component. Prerequisite: MATH 1213, PHYS 2013, and PHYS 2011L. (Typically offered: Spring Even Years)

FDSC 5823. Principles of Food Microbiology. 3 Hours.

This web-based course is a study of the fundamentals of food microbiology to include its history, classifications, spores and their importance, and the most common and serious pathogenic food microorganisms. Fermentation, spoilage microorganisms and control methodology are also discussed. (Typically offered: Fall Even Years)

FDSC 5993. Global Horticulture and Human Nutrition to Enhance Community Resilience and Food Security. 3 Hours.

This course covers three broad areas (Global Horticulture, Sustainable International Development, Human Health and Nutrition) and experts on three campuses created the instruction. The course is intended to be multi-disciplinary, and students should use their contextual knowledge to add to weekly discussions. Prerequisite: Graduate standing. (Typically offered: Spring Even Years)

This course is cross-listed with AGED 5993, HORT 5993.

FDSC 600V. Master's Thesis. 1-6 Hour.

Master's Thesis. Prerequisite: Graduate standing. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

FDSC 602V. Special Topics. 1-3 Hour.

Discussions focused on selected topics of particular fields of raw product physiology and food processing. chemistry, physiology, microbiology, evaluation, sensory analysis and preservation. Prerequisite: Graduate standing. (Typically offered: Irregular) May be repeated for degree credit.

FDSC 6033. Food Biochemistry. 3 Hours.

Biochemical characteristics, functions, regulation and impact of components in raw and processed foods of plant origin. Lecture/discussion 3 hours per week. Prerequisite: CHEM 3813. (Typically offered: Fall Odd Years)

FDSC 6143. Advanced Food Processing and Packaging and their Environmental Impact. 3 Hours.

The course is directed to graduate students in food science and related fields. Students will learn advanced food processing technologies and packaging as well as the environmental issues associated to food production, processing, and distribution. An understanding of basic food processing/food engineering principles and knowledge of food processing operations is expected for this course. (Typically offered: Spring Even Years)

FDSC 6323. Nutraceuticals and Functional Foods. 3 Hours.

Course will include past, present and future of nutraceuticals and functional foods, chemistry, mechanism, novel technologies, nutrigenomics, processing, healthy lifestyle, regulation, safety, marketing, international aspects, and industry project. Prerequisite: CHEM 2613 (or CHEM 3603) and CHEM 3813 and FDSC 4304 or instructor consent. (Typically offered: Spring Even Years)

FDSC 6343. Vitamin Nutrition and Metabolism. 3 Hours.

The vitamins required for humans and domestic animals for a healthy life with emphasis on absorption, transport, metabolism, biopotency, mechanism of action, tissue retention and turnover. Prerequisite: CHEM 3813. (Typically offered: Fall Odd Years)

This course is cross-listed with ANSC 6343, POSC 6343.

FDSC 6403. Epidemiologic Principles in Food Safety and Public Health. 3 Hours.

This course will provide an introduction to epidemiologic methods used in foodborne disease outbreak investigations. The importance of surveillance systems in detecting outbreaks and in the development of effective disease prevention and control strategies will also be presented. An emphasis will be placed on understanding the relationships between the host, the etiologic agent, and the environment as they relate to disease causation. In addition, molecular methods utilized for the identification of etiologic agents will be discussed. Selected important foodborne diseases will be discussed in detail to clarify the role of epidemiology in understanding the pathogenesis of infectious processes in individuals and communities. Prerequisite: FDSC 4122 or FDSC 5122 (formerly FDSC 4122) or equivalent. (Typically offered: Fall Even Years)

FDSC 6443. Metabolism of Xenobiotics. 3 Hours.

This course is designed to provide in-depth knowledge of the integration of molecular, cellular, and physiologic aspects of xenobiotics (e.g phytochemicals)/ micronutrients and metabolism. This course will also discuss the current understanding of the mechanism and regulation of gene expression by xenobiotics/ micronutrients. Examination of current research literature to understand how xenobiotics/micronutrients and physiological states metabolize and influence gene expression, as well as the research methodology used to address these relations. Prerequisite: CHEM 3813. (Typically offered: Fall Even Years)

FDSC 6603. Chemosensory Perception and Measurement. 3 Hours.

This course is designed to address advanced techniques and current issues in sensory and consumer sciences, with a focus on chemosensory perception. This course consists of two main modules: I) anatomy and physiology of the chemosensory senses and II) measurement/analysis of chemosensory responses. This course includes both individual and group projects with an emphasis of four aspects of "C": "Concept," "Creativity," "Critical thinking skills," and "Communication." Prerequisite: FDSC 4413 or FDSC 5413. (Typically offered: Fall Odd Years)

FDSC 700V. Doctoral Dissertation. 1-18 Hour.

The doctoral program in food science is an interdepartmental program offered by the departments of Food Science, Animal and Poultry Sciences, and Human Environmental Sciences. Prerequisite: Graduate standing. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.