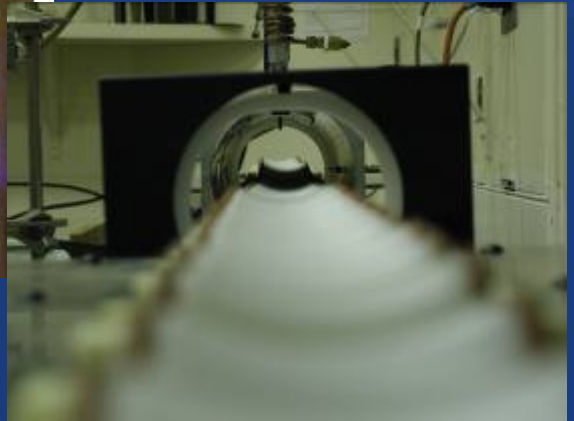
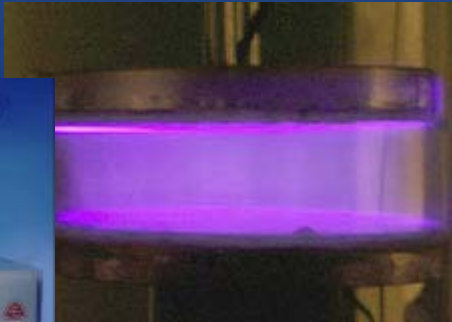


# Food Processing and Packaging Platform



# Science Platform: *Food Processing/Packaging*

Investigate physical/microbial effects that processing and packaging have on preventing potential public health hazards in food products

## Pasteurized Foods

USDA Chilled Foods

## Extended Shelf-life Foods

C. bot Boundary Conditions

## Sterilized Foods

LACF enzyme validation

## Packaging

Solids/Fats - Pasteurization of *Coxiella burnetii*

Microwave Pasteurization of In-Shell Eggs

Decontamination of Dry Ingredients

Solid Particles/UV inactivation of *E. coli* K12

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Migration Models for indirect Food Additives



Platform



Program



Projects

# Pasteurized Foods

# Thermal Resistance of *Coxiella burnetii* in Dairy Products with Differing Levels of Solids and Fat Contents

- Objective:
  - Study the thermal resistance of *Coxiella burnetii* in milk and dairy products with differing levels of solids and fat contents
- Rank: 42 (continuing)
- Team: Schlessner
- Benefits to Stakeholders: better understanding of thermal resistance of *Coxiella burnetii* and minimum pasteurization requirements for dairy products with differing levels of solids and fat contents

# Validation of Microwave-based Pasteurization Processes for In-Shell Eggs

- Objective:
  - To develop a means for measuring the degree of microbiological inactivation and quality retention in shell eggs pasteurized by microwave energy.
- Rank: 44 (continuing)
- Team: Fleischman
- Benefits to Stakeholders: eliminate the microbial (bacteria and viral) hazards for in-shell eggs, currently estimated at 2,000,000 eggs per year.

# Decontamination of Dry Ingredients

- Objective:
  - Evaluate the effectiveness of cold plasma and pulsed UV-light technologies for microbial destruction of vegetative cells attached to surfaces of low moisture foods (e.g., almonds, infant formula, sprout seeds).
- Rank: 5 (continuing)
- Team: Anderson, Krishnamurthy
- Benefits to Stakeholders: proactive project to achieve a better understanding of various approaches to powder and solid decontamination, which is at present not well known

# Effect of Solid Particles on Ultraviolet Disinfection *E. coli* K12

- Objective:
  - Investigate effect of particle presence, size, and concentration, and Reynolds number on the inactivation efficiency of UV-light for reduction of *E. coli* K12
- Rank: 41 (new)
- Team: Krishnamurthy, Rodriguez
- Benefits to Stakeholders: Be able to optimize UV systems treating products with particles for inactivation efficiency of *E. coli*

# Analysis of Microwave Heating of Food Systems

- Objective:
  - Determine the expected temperature distribution in food items composing a complex food system and how changes in food system content, placement and geometry affect this distribution
- Rank: 26 (continuing)
- Team: Fleischman
- Benefits to Stakeholders: Be able to potentially identify how the constituents of a not-ready-to-eat food product effect its heating in a microwave heated. Will be able to direct focus on the most important elements of heating in a microwave.

# Basic Exploratory Study of The Main Engineering Factors of The Microbial Contamination of Foods

- Objective:
  - Development of mathematical models that predict microbial contamination of foods
- Rank: 24 (new)
- Team: Rodriguez
- Benefits to Stakeholders: improved engineering capabilities to predict food microbial contamination by pathogens. Models generated may be used to enhance our understanding of the contamination process, and our capability to control the corresponding threats to food safety

# Nation-wide Survey of Raw Milk for the Presence of Four Significant Food Pathogens

- Objective:
  - Determine the distribution and levels of *E. coli* O157, *Listeria*, *B cereus* and *Salmonella* in the nation's raw milk supply.
- Rank: 37 (continuing)
- Team: R. Reddy and Schlessner
- Benefits to Stakeholders: Knowledge of  $H_0$  in raw milk. Ability to determination of effectiveness of alternative processes for dairy products.

# Effects of Thermal Pasteurization on the Macro- and Micro-Nutrients in Bovine Milk

- Objective:
  - To determine effects current pasteurization conditions have on the nutritive qualities in pasteurized milk
- Rank: 43 (new)
- Team: Schlessner, Burton-Freeman
- Benefits to Stakeholders: Both industry and regulators will benefit from information obtained from this project, which will provide the data on the nutritive qualities of pasteurized milk

## An Interagency Project: Determination, Analysis, and Validation Of Cooling Procedures and Options for Food Service Items Within the USDA National School Lunch Program in Order to Meet the Food Code Recommended Practices.

- Objective:
  - Determination, analysis, and validation of cooling procedures and options for food service items within the USDA national school lunch program in order to meet the food code recommended practices
- Rank: 32 (continuing)
- Team: Bialka, Rodriguez
- Benefits to Stakeholders: Better understanding of the characteristics and critical elements of the systems and procedures used for cooling as they affect the safety of the school lunches.

# **Extended Shelf-Life Foods**

# Effects of Sanitizers and Processes on Viral and Bacterial Pathogens

- Objective:
  - To determine combination effects of chemicals and physical processes, e.g., sanitizers and ultrasonic washing, on hepatitis A and norovirus inactivation
- Rank: 20 (continuing)
- Team: Grove and Lee
- Benefits to Stakeholders: Increased understanding of ways to inactivate viruses and bacteria in foods and on food contact surfaces

# Effect of Solids Levels on the Thermal Resistance of *Listeria* Species

- Objective:
  - To determine D and z values of *Listeria* species as influenced by 18-50% Milk Solids NonFat (MSNF) and sugars
- Rank: 28 (continuing)
- Team: Keller
- Benefits to Stakeholders: Effect of solids levels on thermal resistance of *Listeria monocytogenes* will be established, allowing for better design of thermal treatments of foods with high solids

# Framework for Setting and Validation of Extended Shelf-Life (ESL) Refrigerated Foods

- Objectives:
  - To demonstrate the utilization of the Food Safety Objective (FSO) method for safely manufacturing an Extended Shelf-Life (ESL) Refrigerated Food
  - The model for the FSO calculation will be developed based on the NCFST FSO committee approach
- Rank: 4 (continuing)
- Team: Anderson, Skinner, Larkin, Cole
- Benefits to Stakeholders: establishment of steps to manufacture ESL refrigerated foods that will result in safe high quality products

# Inhibitory Growth Boundary Conditions for *Clostridium botulinum*

- Objectives:
  - Determine the probability of proteolytic *C. botulinum* toxin formation as a function of inoculum at various boundary conditions of inhibition. This data will be useful in FSO determinations
- Rank: 9 (new)
- Team: N. Reddy, Skinner
- Benefits to Stakeholders: Gain insight into the ability of *C. botulinum* to produce toxin in foods under conditions of pH, aw or NaCl that are almost inhibitory. Provide data for utilization in the FSO approach to food safety by helping to model the  $\Sigma I$ , or probability of growth or recontamination

# **Sterilized Foods**

# Thermal Characterization of Botulinum Neurotoxin using Differential Scanning Calorimetry

- Objective:
  - Determine if BoNT thermal events as measured by DSC can be linked to results of the mouse bioassay
- Rank: 38 (continuing)
- Team: Fleischman
- Benefits to Stakeholders: better understanding of the degree to which thermal processing succeeds in deactivating the toxin

# Inactivation of *Clostridium botulinum* Spores Using High Pressure Processing

- Objective:
  - To measure the high pressure/temperature resistance of *Clostridium botulinum* spores for use in setting the food safety objective (FSO) for LACF shelf-stable foods and ESL foods
- Rank: 17 (continuing)
- Team: N. Reddy, Skinner
- Benefits to Stakeholders: application of HPP for inactivation of *C. botulinum* spores of type A and both non-proteolytic and proteolytic type B strains in low-acid shelf-stable and ESL food products

# File Process for High Pressure Processing of Low-acid Canned Foods

- Objective:
  - Establish process for high pressure treatment using the 35 L high pressure-high temperature unit located at the NCFST
- Rank: none
- Team: Patazca, Parisi, Rodriguez, Keener (IPSC)
- Benefits to Stakeholders: alternative to thermal treatment for the production of shelf-stable food products

# Evaluation Of Enzyme-based Time-Temperature For Validation of Thermal Sterilization of Low-Acid Foods.

- Objective:
  - Compare the thermal resistance properties of two enzymes from the hyperthermophilic organism *Pyrococcus furiosus* with those of widely recognized test organisms.
- Rank: 21 (continuing)
- Team: Keller
- Benefits to Stakeholders: Rapid, easy-to-use tools that can provide accurate estimates of lethality are needed to facilitate innovation and increase speed to market of heat preserved foods. Enzyme-based time-temperature integrators (TTIs) offer a cost-effective alternative to the traditional microbiological validation methods

# Packaging

# Determination of Organic and Inorganic Chemicals Released from Polymer-clay Nanocomposite Food Packaging

- Objective:
  - To determine migration of organic and inorganic chemicals into food simulants from Polymer-clay nanocomposites (PCN) packaging materials.
- Rank: 33 (continuing)
- Team: Duncan
- Benefits to Stakeholders: determine safety issues concerning the use of PCN packaging materials for food products.

# Evaluation of Non-Destruction High Voltage Technique for the Detection of the Pinhole Leaks and Delamination in Trays and Foli-Lamimated Pouches for Foods

- Objective:
  - To Evaluate a HVLD System for the inspection and integrity assurance of semi-rigid containers, bottles, and foil-laminated pouches for foods.
- Rank: 6 (continuing)
- Team: Song
- Benefits to Stakeholders: a more reliable and therefore safer system of package inspection. Enhance efficiency in removing defective packages, reduce the risk of product recalls and subsequent outbreaks, and improve overall security of the food supply.

# Use of Migration Models for Indirect Food Additive Approval

- Objective:
  - To determine D and K values of migrating compounds to substantiate the use of existing migration models for regulatory reviews
- Rank: 13 (continuing)
- Team: Song and Koontz
- Benefits to Stakeholders: validate migration models for broad properties of migrating compounds for use in FCN. Industry FCNs will potentially take less time to prepare and require less laboratory effort and experimental cost.

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# **Processing Outreach and Capabilities**

Brian Parisi

Ninad Labhe

Andre Rehkopf

Dr. Alfredo Rodriguez



Eduardo Patazca

Dr. Katie Bialka

Dr. Kathiravan Krishnamurthy

The engineering group pictured above works on process engineering applied to food safety, technology and applied nutrition. Our main fields of action are transport phenomena (theoretical, numerical, experimental and statistical), kinetics of microbial inactivation and chemical degradation; and process development and validation corresponding to technologies such as high pressure, UV, MW, US, etc.

We support collaborative projects with the FDA, and perform contract work.