

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Food Processing, Product Storage, and Food and Product Safety

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
216	Integrated Pest Management Systems	15%		5%	
401	Structures, Facilities, and General Purpose Farm Supplies	9%		5%	
403	Waste Disposal, Recycling, and Reuse	3%		5%	
501	New and Improved Food Processing Technologies	15%		10%	
502	New and Improved Food Products	9%		10%	
503	Quality Maintenance in Storing and Marketing Food Products	9%		10%	
701	Nutrient Composition of Food	5%		10%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	5%		10%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%		25%	
723	Hazards to Human Health and Safety	20%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	1.0	0.0	5.0	0.0
Actual Paid	6.0	0.0	4.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
35000	0	197335	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
35000	0	197335	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
730000	0	978049	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Food Safety:

- Conduct research on preventing contamination of foods with pathogenic microorganism during production, processing, storage, distribution, and/or consumer use.
- Conduct research on eliminating or reducing the numbers of potential pathogenic microorganisms in foods during production, processing, storage, distribution, and/or consumer use.
- Conduct research on detecting contamination of foods with pathogenic microorganisms.
- Conduct research on detecting microbial toxins in foods.
- Conduct research on detecting undeclared allergens in foods.
- Provide technical information and assistance to food industry and/or consumers to determine safe food production, food processing, and/or food handling procedures.
- Conduct food safety workshops designed to provide certification in recognized food safety systems such as Hazard Analysis Critical Control Points (HACCP).
- Conduct technical assistance projects designed to assist food production / food processing enterprises in developing comprehensive, written food safety programs and to pass third-party audits of comprehensive food safety programs.
- Disseminate food safety recommendations to industry and consumers via popular press, fact sheets, eXtension publications, web-based outreach, workshops, and/or peer-reviewed journal articles.

Food Processing:

- Conduct research on improving or maintaining the quality of processed foods.
- Conduct research on developing profitable new food products and food processing technology.
- Conduct research on maximizing the efficiency and sustainability of food processing operations.
- Conduct research on improving the healthfulness and nutritional value of processed food products.
- Conduct research on evaluating the economic feasibility of food processing activities.
- Provide technical information and assistance related to processing, analyzing the chemical and physical properties, and improving or maintaining the quality of processed food products.
- Provide technical information and assistance related to food product formulation and new food product development.
- Provide technical information and assistance related to selection and evaluation of processing technology
- Provide technical information and assistance related to food process evaluation.

- Provide technical information and assistance related to processed-food business economic planning and product marketing.
 - Serve as a resource to help commercial food processors recognize and comply with applicable food product processing and labeling regulations.
 - Disseminate recommendations for food processing industry best practices via popular press, fact sheets, eXtension publications, web-based outreach, workshops, and/or peer-reviewed journal articles.
- Product Storage:

- Conduct research that evaluates agricultural product storage and handling technologies with the aim of improving quality, safety, and costs. Provide technical applications, demonstrations and education for grain and food storage providers and handlers.

2. Brief description of the target audience

Food processors; handlers, manufacturers, and marketers of grain, feed and food; food safety regulators

3. How was eXtension used?

The Food Safety and Small Meat Processors Resource Areas were monitored for information regarding emerging issues of concern. Used as a reference for safety problems for on farm storage managers.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1200	20490	107	506

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2014

Actual: 1

Patents listed

System and Method for Producing Individually-Wrapped Peanut Butter Products. W. McGlynn, D. Bellmer, A. Nault. 2014.U.S. Patent Pending.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
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Actual	15	37	52
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V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of conferences and other extension outreach presentations

Year	Actual
2014	92

Output #2

Output Measure

- External funding obtained

Year	Actual
2014	1380000

Output #3

Output Measure

- Workshops, symposia, short courses, and round tables conducted

Year	Actual
2014	59

Output #4

Output Measure

- Technical assistance projects completed

Year	Actual
2014	129

Output #5

Output Measure

- Manuscripts submitted for publication in peer-reviewed journals

Year	Actual
2014	29

Output #6

Output Measure

- Extension publications completed

Year	Actual
2014	37

Output #7

Output Measure

- Number of air quality monitors tested
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Grain storage, food or pest control entities adopting new process or product
2	Number of food industry personnel newly certified as HAACP trained
3	Number of food industry personnel newly certified as having attended food safety and processing workshops
4	Number of food industry jobs created
5	Number of new food businesses started
6	New or improved food processing, food safety and/or product storage adopted by industry
7	Number of emergency response teams available in Oklahoma
8	Number of food producing/food processing enterprises that implemented a comprehensive food safety plan with team assistance
9	Number of food producing/food processing enterprises that passed a third-party food safety program audit with team assistance
10	Farm Focused Food Safety Training
11	Listeria monocytogenes produces strongly-adherent biofilms in food processing facilities.
12	Bacteriocins of lactic acid bacteria as potential biopreservatives for use in foods.

Outcome #1

1. Outcome Measures

Grain storage, food or pest control entities adopting new process or product

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	17

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

7-Eleven is a well-established convenience store chain with 110 locations across central Oklahoma. Over the years, 7-Eleven has expanded their line of food products. Robust sales of snack foods led to the construction and operation of the very successful 7th Heaven Bakeries® that serves their convenience stores. The FAPC was heavily involved in the development and startup of the bakery. Recently, 7-Eleven has decided to move into the sandwich business by building and operating a sandwich commissary. Consequently they approached the FAPC for help with this endeavor.

What has been done

Specialists from the OSU Food and Products Center visited with the client several times to discuss potential project needs and issues, especially regarding shelf-life, sanitation, and food safety. Assistance has been provided through team and individual response over a period of twelve months and included: product safety plans, quality plans, equipment and process recommendations, facility design, cleaning recommendations, labeling, formulation suggestions, and more.

Results

7-Eleven is planning the construction of a new 9,000 square foot commissary facility in 2015. The facility will manufacture and distribute sandwiches to 7-Eleven facilities across Central Oklahoma and will employ approximately 20 persons (new positions) and generate significant new tax revenue.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems
401	Structures, Facilities, and General Purpose Farm Supplies
503	Quality Maintenance in Storing and Marketing Food Products
723	Hazards to Human Health and Safety

Outcome #2

1. Outcome Measures

Number of food industry personnel newly certified as HAACP trained

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	66

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

Outcome #3

1. Outcome Measures

Number of food industry personnel newly certified as having attended food safety and processing workshops

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	312

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Underserved new and beginning producers of horticultural food crops have traditionally been difficult to contact due to the diverse locations and types of crops that they are growing. Because of this, the flow of information to these farmers has been limited. Basic information related to crop production is critical for these farms; both information and training in food safety is vital in allowing them to successfully expand their market opportunities.

What has been done

This project was originally started in 2012 and continued through 2014. Project funding was from a grant from the USDA Risk Management Agency (RMA). Work in 2014 focused on creating a food safety program for a group of farmers including the Hmong in eastern Oklahoma.

Results

A training workshop in basic Good Agricultural Practices (GAP) was held in conjunction with a regional grocery store chain. A cooperative program was established among the Hmong growers and a common packing shed was constructed. OSU personnel assisted in the process of obtaining 3rd-party GAP certification for the cooperative packing operation. As a result, over 30 growers were able to participate in an organized program of delivering fresh and minimally-processed produce to a regional grocery store chain.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems
502	New and Improved Food Products

503	Quality Maintenance in Storing and Marketing Food Products
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

Outcome #4

1. Outcome Measures

Number of food industry jobs created

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	83

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Granna's LLC is an established food company located in Bessie that the FAPC has been working with since 2003. Granna's makes and packages nutritious frozen meals and entrees for sale to nursing homes and institutional clients or direct home delivery. Due to steady growth, good management, and market opportunity, Granna's is planning to more than double their production capacity. They have been working with the city of Frederick to plan the transformation of an existing National Guard Facility into a food processing plant. An application for a USDA rural development grant has been made to help with the facility renovations. Granna's needed help to: (1) understand the requirements for transforming the National Guard Facility into a food processing plant; and, (2) get input for grant applications to help lower the cost.

What has been done

A team has been assembled to help Granna's expand. Members include Mr. Bill Cunningham, Manufacturing Extension Agent; Mr. Don Lake, OCES Applications Engineer; the City of Frederick; Mr. Chuck Willoughby, OCES Food Products Center (FAPC) Project Lead; and Tim Bowser, OCES FAPC. OCES FAPC personnel contributed in four main areas: (1) developed a list of process and utility equipment needed; (2) drew a layout of the facility showing changes and improvements required; (3) put together a spreadsheet to estimate the cost of the new equipment

and facility improvements; and, (4) assisted with the process of collecting information for a USDA Rural Development grant.

Results

The facility remodeling and construction process (20,000+ sq. ft. total) is slated for 2015. Once the new plant is in operation, it is expected to generate from 10 to 20 new jobs and a significant tax income.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products

Outcome #5

1. Outcome Measures

Number of new food businesses started

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	21

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies

- 502 New and Improved Food Products
- 503 Quality Maintenance in Storing and Marketing Food Products

Outcome #6

1. Outcome Measures

New or improved food processing, food safety and/or product storage adopted by industry

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	72

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Kize Concepts is a relatively new company that manufactures a healthy energy bar product that is rapidly gaining market share for athletes and active consumers. Initially their products were completely made and packaged by hand. The production process was tedious and expensive. While quality was very good, the final result had too much variability. Increasing sales volumes were causing Kize run out of storage and processing space in their existing facility.

What has been done

Specialists from the OSU Food and Agricultural Products Center (FAPC) visited Kize to survey needs and help with an immediate packaging problem. The packaging problem was quickly solved, and the issues described above were systematically addressed. New processing equipment and techniques were identified and tried. Kize purchased and installed automatic bar forming equipment. Quality assessment tools were identified and developed for ingredients and final product. New packaging materials and techniques were tried. We helped Kize find a new processing facility that had a larger and cleaner space, with better utility at a better price.

Results

Kize Concepts is growing quickly and has hired additional help (two new persons) and has moved to a better location with more space. They continue to grow quickly and are positioning themselves for national distribution.

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
701	Nutrient Composition of Food
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

Outcome #7

1. Outcome Measures

Number of emergency response teams available in Oklahoma

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Grain entrapment is a safety concern for on farm and commercial grain managers.

What has been done

Funding has been secured and 3 new research/extension projects were initiated to train workers for safety practices and develop safety equipment to protect workers.

Results

2 safety workshops and existing publications/videos are scheduled to be presented both in English and in Spanish in 2015

4. Associated Knowledge Areas

KA Code	Knowledge Area
723	Hazards to Human Health and Safety

Outcome #8

1. Outcome Measures

Number of food producing/food processing enterprises that implemented a comprehensive food safety plan with team assistance

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	20

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A local meat processor was having problems with gas-producing bacteria on their meat products, resulting in product loss and lost sales.

What has been done

OSU Specialists established a graduate student fellowship to sample their facility monthly (incoming raw materials, premises/equipment surfaces, personnel, final retail products, returned products). Bacterial samples were identified by molecular sequence identification (PCR, 16S rRNA sequencing, sequence analysis).

Results

We identified how the bacteria gets into their plant, what sanitary practices can be performed to reduce the occurrence and minimize issues with their final product. In the prior year, the processor incurred ~\$500,000 in lost/reduced contracts and sales because of the spoilage problem. Helping them to overcome these spoilage issues makes them competitive with similar products and allowed them to retain sales through large vendors such as Walmart and Aldi.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

Outcome #9

1. Outcome Measures

Number of food producing/food processing enterprises that passed a third-party food safety program audit with team assistance

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
723	Hazards to Human Health and Safety

Outcome #10

1. Outcome Measures

Farm Focused Food Safety Training

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	70

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

This one-day training is designed for small to very small dairies, milk processors, shell egg producers, feed manufacturers, and fruit and vegetable producers, and provides necessary knowledge of preventive controls and food security to assist producers in meeting the requirements of the Food Safety Modernization Act (FSMA). Topics include FSMA, pathogens of concern, written food safety plans, monitoring and record keeping, and FDA's Food DEFENSE program.

What has been done

These workshops were provided around the state of Oklahoma on 13 February 2014, 13 March 2014 and 8 May 2014 and provided expertise in the area of food safety programs, especially as it relates to pathogens of concern, written food safety plans, liability & insurance issues, monitoring & record keeping, food DEFENSE, HACCP plans, sanitation programs & GMP's, pest management, recalls and understanding the Food Safety Modernization Act.

Results

These workshops were provided around the state of Oklahoma on 13 February 2014, 13 March 2014 and 8 May 2014 and provided expertise in the area of food safety programs, especially as it relates to pathogens of concern, written food safety plans, liability & insurance issues, monitoring & record keeping, food DEFENSE, HACCP plans, sanitation programs & GMP's, pest management, recalls and understanding the Food Safety Modernization Act.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

Outcome #11

1. Outcome Measures

Listeria monocytogenes produces strongly-adherent biofilms in food processing facilities.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Listeria monocytogenes is an important pathogen of ready-to-eat (RTE) foods, especially meat products (i.e., hotdogs, luncheon deli meats, etc). . L. monocytogenes is responsible for ~2,500 illnesses per year (~25% fatality rate) and numerous recalls of ready-to-eat meats annually. The bacterium is a contaminant of raw meat ingredients used in the manufacture of processed meats and because of its ability to form biofilms, it is a persistent contaminant in meat processing plants. RTE meat products are prone to be contaminated if it is present in the post-process areas and the significance stems from the fact that consumers do not always re-heat or cook RTE meats. L. monocytogenes? involvement with outbreaks, illnesses, and deaths from contaminated cantaloupe has also prompted a closer look at its presence on vegetables and produce.

What has been done

We have investigated the molecular basis of adherence in L. monocytogenes using liquid chromatography-mass spectrometry (Orbitrap). We compared 5 methods of extracting proteins from the surface of L. monocytogenes that were compatible with the mass spectrometry equipment in the OSU DNA/Protein Core Facility.

Results

One method of extracting surface proteins was selected as better (UB-Ghost) and used for further studies in comparing the proteins isolated from the surface of strongly-adherent strains of *L. monocytogenes* with those of weakly-adherent strains. We also examined the proteins from the surface of adhered cells (i.e., attached to beads) with those in solution (i.e., planktonic cells). Differences were found that identified select proteins as involved with attachment. The project resulted in the advanced training of 1 graduate student. In addition, information on the molecular basis of attachment of *L. monocytogenes* may allow unique interventions to prevent adherence and reduce biofilms in food processing facilities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

Outcome #12

1. Outcome Measures

Bacteriocins of lactic acid bacteria as potential biopreservatives for use in foods.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Lactic acid bacteria (LAB) are generally-recognized-as-safe (GRAS) by the U.S. FDA and can be freely used in foods as food ingredients. Some strains of LAB also produce bacteriocins (i.e., antimicrobial peptides) that have been proposed for use as biopreservatives against *L. monocytogenes*.

What has been done

Bacteriocin-producing (Bac+) lactic acid bacteria (LAB) were isolated from a variety of food products and animal sources. Antimicrobial activity against *L. monocytogenes* was detected by

41 isolates obtained from 23 of 170 food samples (14%) and 11 of 110 samples from animal sources (10%) tested. Isolated Bac+ LAB included *Lactococcus lactis*, *Lactobacillus curvatus*, *Carnobacterium maltaromaticum*, *Leuconostoc mesenteroides*, and *Pediococcus acidilactici*, as well as *Enterococcus faecium*, *Enterococcus faecalis*, *Enterococcus hirae*, and *Enterococcus thailandicus*.

Results

These data continue to demonstrate that despite more than a decade of antimicrobial interventions on meats and produce, a wide variety of food products still contain Bac+ microbiota that are likely eaten by consumers and may have application as natural food preservatives. This project provided advanced training for 3 graduate students and 1 post-doc.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

No change here. Drought conditions hinder progress for safety and grain quality initiatives and research. Funding from corporate sponsors is limited due to low check off dollars. Limited formula funding has hindered our ability to conduct applied research and technical assistance projects. In addition, financial and in-kind support from industry partners has been flat.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Extension and outreach programs were evaluated based on before and after assessments of attendee knowledge using questionnaires for product storage safety programs. Attendees were evaluated primarily on their knowledge of definitions and applications of major program concepts, e.g. how to employ basic principles of food safety programs such as HACCP.

A needs assessment for safety training is planned for 2015. Surveys of fire departments and elevator managers will provide information about safety equipment availability and training experience in Oklahoma.

Key Items of Evaluation