

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Food Safety - Food Production Systems: Development, Processing and Quality

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
501	New and Improved Food Processing Technologies	15%	0%	20%	25%
502	New and Improved Food Products	15%	0%	15%	30%
503	Quality Maintenance in Storing and Marketing Food Products	10%	25%	10%	20%
504	Home and Commercial Food Service	10%	25%	5%	0%
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	10%	25%	10%	0%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	40%	25%	40%	25%
Total		100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	54.0	2.0	55.0	6.0
Actual Paid Professional	71.0	16.0	52.0	4.2
Actual Volunteer	5.0	0.0	5.0	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
1106307	342000	904292	250028
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1106307	135989	904292	61881
1862 All Other	1890 All Other	1862 All Other	1890 All Other
4290025	196088	6602865	237560

V(D). Planned Program (Activity)

1. Brief description of the Activity

Multiple research and educational outreach programs will be conducted under the umbrella of improving the quality, safety, security, and nutrition of food products produced in North Carolina. Specific research projects will identify effective nutritional control strategies for replacement of growth-promoting antibiotics for improving gut function and reducing intestinal colonization and shedding of Salmonella; assessing the incidence, populations, serotypes, genotypes, and antibiotic susceptibility of Salmonella and Campylobacter fecal isolates as a function of farm, bird age, season, management practices, and strategic processing of commercial broiler, turkey, and layer farms; assessing novel antimicrobial strategies for use in reducing foodborne pathogens and biofilm formation on food processing contact surfaces; employing the antimicrobial properties of eggshell membranes for reducing the heat resistance of foodborne pathogens; development of Salmonella-specific inhibitory nanoparticles for preventing intestinal colonization; development of alternative layer molting diets for reducing the risk of Salmonella contamination of shell eggs; characterization of Campylobacter respiratory chain genes for use in developing rational drugs for controlling infection of food animals; conduct ecotoxicological studies to identify chemical pollutant sources that contaminate aquatic human foods; development of a high hydrostatic pressure system for reducing toxigenic histamine-forming bacteria in scombroid fish and vacuum and MAP packaged fresh tuna; develop a more efficient means of producing a high-gelling protein isolate from underutilized fish species and other meat sources that could replace surimi manufacture and improve the quality, sensory and yield characteristics of new and existing muscle food products; development of a Vienna sausage product without casings via an in-tube focused microwave field heating technology; improving the texture and yield of canned/pouched Albacore tuna by controlling precook proteolysis and injection of a tuna-derived protein isolate; application of continuous flow processing of foods and biomaterials using advanced focused microwave technology; and development and testing of tools, methods and devices for rapid sterilization and production of high quality vegetable and fruit purees; isolating, identifying and characterizing bioactive compounds from peanuts skin, sweet potato peels/flesh, pokeweed roots and rosehip fruits and wine grapes skins /seeds; developing value-added products incorporating bioactive compounds from select extracts and evaluating them for consumer acceptability; exploring industry partnerships for commercial utilization of prototyped products incorporating bioactive extracts; and isolating the most active fractions from pokeweed and rose hip that show strong antiproliferative and apoptosis activity against breast, colon, and cervical cancer cells. A very important aspect of this plan of work is to transfer technology and knowledge to our stakeholders and clientele, including efforts of the Plants for Human Health Institute's NC Market Ready and NC Fresh Produce Safety Task Force.

2. Brief description of the target audience

Primary food producers, food processors, foodservice operators, county extension agents, state and federal regulatory agencies, commodity associations, news media and consumers. The primary audience will be in North Carolina but will also extend to audiences in other states (state and federal agencies, local, state and federal politicians and other stakeholders).

3. How was eXtension used?

eXtension provides an array of plant and animal systems Communities of Practice that provide relevant information and strategies for producers, processors and marketers.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	40000	70000	0	0

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

Patent Applications Submitted

Year: 2013

Actual: 3

Patents listed

Microfluidization of Cereal Brans and the Use Thereof in Foods.

The Use of a Sodium Bentonite Clay, Astra-Ben™, as a Processing Aid to Significantly Reduce or Eliminate the Aflatoxin from Aqueous Defatted Peanut Meal Dispersions for the Production of Defatted Peanut Meal Protein Concentrates or Isolates Appl # 13/734,264 US

Methods and Apparatuses for Thermal Treatment of Foods and other Biomaterials and Products Obtained Thereby (...For Expense Purposes Technology Numbers 04131, 03070, and 03016 are Tracked in 05013..) Appl # 2,812,925 Canada

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	5	101	106

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Highly focused non-degree credit group training activities to be conducted

Year	Actual
2013	478

Output #2

Output Measure

- Relevant and impacts focused research projects to be conducted

Year	Actual
2013	61

Output #3

Output Measure

- Local, area, regional and state conferences to be conducted

Year	Actual
2013	49

Output #4

Output Measure

- Number of firms adopting quality and safety strategies
Not reporting on this Output for this Annual Report

Output #5

Output Measure

- # Presentations at professional meetings
Not reporting on this Output for this Annual Report

Output #6

Output Measure

- # Media occurrences reporting research findings
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	Number of program participants who successfully pass the food safety certification examination
2	Number of participants completing National Seafood HACCP Alliance Education and other food safety HACCP workshops
3	Number of companies adopting new technologies
4	Number of new companies in food manufacturing
5	Number of food industry companies undergoing equipment and food safety audits
6	Number of new food products that industry can manufacture to improve health

Outcome #1

1. Outcome Measures

Number of program participants who successfully pass the food safety certification examination

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1882

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Centers for Disease Control and Prevention (CDC) estimates that roughly 1 in 6 Americans (or 48 million people) get sick from a foodborne illness each year. Food safety education is believed to be an integral part in preventing foodborne illness outbreaks.

What has been done

Cooperative Extension in cooperation with local health departments provided ServSafe training courses to food service managers throughout North Carolina.

Results

Statewide, 1882 food service employees received servsafe training and certification. ServSafe training has potentially saved food establishments approximately \$3,535,000 in costs.

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
504	Home and Commercial Food Service
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from

712 Agricultural and Other Sources
Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Number of participants completing National Seafood HACCP Alliance Education and other food safety HACCP workshops

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	89

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Food safety of fish and fishery products continues to be a concern of the U.S. Food and Drug Administration and consumers. Demand for HACCP training continues to be strong due to new business start-ups, turnover in personnel and the need to assist industry with interpretation and implementation of the preventive controls measures.

What has been done

NCSU has participated at the local, state and national levels in development and delivery of seafood HACCP workshops for the past 16 years. Most recently, we have helped to update the training curriculum (5th Edition) and develop a Trainers' Guide for use in Train-the-Trainers workshops that were offered across the nation. The basic curriculum has served a need but growing interest by participants indicates that advanced topics such as how to undertake a process validation and how to perform environmental sampling are needed. We shall pursue this opportunity in cooperation with other specialists with interest in the food safety field.

Results

Seafood processors in North Carolina and across the nation received certificates of course completion issued by the Association of Food and Drug Officials. This non-degree certificate program meets the training requirements in the FDA seafood HACCP regulation. In addition, seafood companies were given a better understanding of the expectations of FDA and improved their ability to conduct their own hazard analysis and develop and implement a HACCP plan. Firms needing additional assistance are given follow up consultation to review and help guide

them through the regulatory process. Statewide, 89 program participants completed the national seafood HACCP alliance and other food safety HACCP programs, and overall, 94 people were actually certified in HACCP.

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
504	Home and Commercial Food Service
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

Outcome #3

1. Outcome Measures

Number of companies adopting new technologies

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There is a need for new technologies to maximize the quality and nutrient retention of shelf stable fruit and vegetable products and make such products economically viable in both retail and commercial (institutional) markets.

What has been done

Continuous flow microwave sterilization and pasteurization for processing and aseptic packaging of fruit and vegetable products has been designed, developed, extensively tested, validated and commercialized.

Results

The developed technology has received several U.S. and multiple international patents and has been licensed to several start-up companies in North Carolina, including Yamco, Aseptia, and Wright Foods. Wright Foods, which was founded in 2012 in Troy, N.C., announced in July 2013 a \$53 million expansion that is projected to triple the size of the plant, adding 120,000 square feet and more than 500 new jobs.

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
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

Outcome #4

1. Outcome Measures

Number of new companies in food manufacturing

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Mechanical extraction of raw crabmeat results in 300 percent higher yield, with substantially less labor input, than the current industry process of cooking, cooling and hand-picking crabmeat. Recently a patented method for restructuring raw crabmeat was issued to Shure Foods Inc, a fledgling North Carolina-based company.

What has been done

NCSU researchers are partnered with Shure Foods to further develop and commercialize the technology and help the company transition from R&D to a sustainable business.

Results

The expected outcomes should deliver technical solutions for insuring a robust, consistent process for commercial production of high quality restructured crabmeat products, leading to full commercialization, and thus revival of the blue crab industry in eastern North Carolina and the mid-Atlantic region of the United States.

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
504	Home and Commercial Food Service
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

Outcome #5

1. Outcome Measures

Number of food industry companies undergoing equipment and food safety audits

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	334

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Acidified GMP and BPCS workshops are required for operating supervisors of aseptic and conventionally canned processing and packaging systems in food processing establishments. It

qualifies individuals to be commercial operators of plants producing aseptic and conventionally foods canned to meet the requirements of the umbrella GMP, the specific GMP for acidified foods and the specific GMP for Low Acid Canned Foods.

What has been done

Six industry workshops were conducted, resulting in the certification of 164 individuals. NCSU also earned two grants totaling \$1.7 million in the past year, focusing on closing research gaps and developing training curriculum for all acidified manufacturers, large and small as well as the regulatory bodies that regulate them. The curriculum for inspectors was completed and delivered three times, certifying 120 inspectors. During 2013, an NCSU researcher also became the process authority for approximately 52 products per month totaling 656 products.

Results

The average cost of a private process authority consultant is \$1,500 per diem, which without university assistance, these small businesses would have had to pay. This NC State assistance program has saved North Carolina entrepreneurs a minimum of \$939,000 in 2013, if each product would have only required one day of services from a consultant.

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

Outcome #6

1. Outcome Measures

Number of new food products that industry can manufacture to improve health

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Formulating dietary fiber-enriched foods using cereal bran presents challenges since they often adversely affect color, texture, flavor, and taste of the supplemented foods.

What has been done

NC A&T scientists established a protocol for processing wheat and corn brans using a microfluidization process to alter the physicochemical and antioxidant properties of wheat and corn brans. In addition, the effects of modified brans on product quality of bread and extruded corn cereal were investigated.

Results

Based on discoveries that resulted from this research, bread and extruded corn grits enriched with microfluidized brans showed better quality attributes than those supplemented with ground bran at the same substitution level.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products

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.)
- Other (National public health problem)

Brief Explanation

Rapidly changing environmental and economic conditions influence producers' and food businesses' abilities to adapt to change while ensuring sustainable production systems and environments. Continued effects of the economy on federal, state and local support for research and extension programs challenge our research and extension enterprises. Likewise, regulatory and other governmental policies and rules influence the educational and research capacities of our programs and present challenges to producers, processors and marketers to comply with new and often expensive regulations. And in an environment of reduced funding, the program competition for existing funds becomes a greater challenge. Nevertheless, emphasis is placed on those research and extension opportunities that have the greatest effect on sustainability of farms, families and businesses.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The evidence of outcomes and impacts of this program area reported herein are derived from our Extension Reporting System, faculty activity reports and impact statements, and Office of Technology Transfer. The data indicate that our research and extension programs continue to reach significant segments of our audience with relevant research and extension information that benefits their businesses. Based on the impact statements, publication records, intellectual property created, and effective outreach, especially with various food safety training and certification programs, the food supply continues to both safe and one that's evolving with new process and products. We continue to foster and lead change in this program.

Key Items of Evaluation

Note the role that faculty in this program area have in helping keep the state's population of food handlers and servers trained and certified.

The tools to capture additional outcomes and impacts from this program area need some revision to realize the fuller benefit of this program to the interests of both food safety and innovations in food products and manufacturing.