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

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	54.0	2.0	55.0	6.0
Actual Paid Professional	76.0	3.5	95.0	6.0
Actual Volunteer	1.0	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**
749881	171684	1379402	208415
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
749881	159818	1379402	76185
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
5772719	12572	10705705	299940

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 includes a wide array of plant and animal systems Communities of Practice that provide relevant information and strategies for producers,procesors, and marketers.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	43040	81183	0	0

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

Patent Applications Submitted

Year:	2012
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	14	121	135

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2012	468

Output #2

Output Measure

- Relevant and impacts focused research projects to be conducted

Year	Actual
2012	57

Output #3

Output Measure

- Local, area, regional and state conferences to be conducted
  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of firms adopting quality and safety strategies

Year	Actual
2012	165

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
2012	1509

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Despite food safety communication efforts by many sectors, foodborne illness remains a significant heath issue in the US. It is estimated taht up to 70% of illness come from food handlers making behavioral mistakes.

What has been done
Food safety certification course offered through organizations such as the international HACCP Alliance and National Seafood HACCP Alliance were conducted for food manufacturing firms and state and federal regulatory personnel.

Results
Knowledge of biological, chemical and physical risks associated with agricultural products and processes employed in manufacturing and production systems has increased. Certification of course participants fulfills state and federal regulatory requirements in a number of food areas, such as acidified food products, seafood, meat and poultry products. In addition, compliance of firms increased and safety of food improved through participation in courses. In 2012, North Carolina cooperative extension field faculty delivered food manager trainings to 1509 individuals in North Carolina who received ServSafe program certification. In addition, Good Farmers? Market Practices, was delivered in a workshop form to 483 market vendors representing 67 markets across North Carolina. These workshops have resulted in measurable infrastructure changes and behavior changes including increased access to handwashing facilities and increased temperature control.

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 #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
2012	3

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.

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
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The development of advanced thermal processing technologies for foods and biomaterials to maximize nutritional and sensory quality of processed products as well as provide safe, shelf-stable foods without need for refrigeration provides opportunities for economic development.

What has been done
Several unique and novel technologies have been developed and tested in NCSU labs and pilot plants. Aseptia/Wright Foods has licensed a portfolio of our patented and patent-pending technologies and opened a fruit and vegetable processing plant in Troy, NC in August 2012.

Results
The plant currently employs 90 people. The company announced plans for further expansion, which will include increasing the work force to as many as 500 full time employees. The economic impact has been significant for the city of Troy, Montgomery County and North Carolina.

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
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New food manufacturing products are desired by food manufacturers to enhance quality, shelf life and nutritive value.

What has been done
Food scientists and engineers have discovered ways to rapidly sterilize and package shelf stable intermediary fruit and vegetable products for use in food manufacturing, and they've created complementary approaches to ensure quality control and safety of the materials.

Results
Several unique and novel technologies have been developed and tested in NCSU labs and pilot plants. Aseptia/Wright Foods has licensed a portfolio of our patented and patent-pending technologies and opened a fruit and vegetable processing plant in Troy, NC in August 2012. The plant currently employs 90 people and announced plans for expansion, which will increase the work force to as many as 500 full time employees. The economic impact has been significant for the city of Troy, Montgomery County and North Carolina.

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
2012	1000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
It is important that food manufacturing processes and personnel understand and apply all know principles for effectively ensuring the safety of food products.

What has been done
Training and preparation for processing/manufacturer process audits is a role that food scientists have served for our industry. Preparation for GMP and other food safety audits equip personnel to protect the integrity of safe food manufacturing processes.

Results
Acidified GMP and BPCS workshops are required for and directed at the level of operating supervisors of aseptic and conventionally canned processing and packaging systems in food processing establishments. These workshops qualify 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. An NCSU faculty member has co-instructed or coordinated five of these workshops and certified 100 individuals. In addition, the FDA has recognized the faculty member as an acidified foods process authority.

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
2012	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New food products that promote health are needed to help ensure public health.

What has been done
The potential of grape pomace (GP) as a source of DF and dietary polyphenol for healthy food development was investigated.

Results
NCA&T researchers found that incorporating 5-10% of GP in bread formulation significantly increased dietary fiber and polyphenol contents, and antioxidant activity of bread. Sensory qualities such as color, taste, flavor and texture of GP-fortified bread were acceptable, although consumer ratings were slightly lower than for white bread. The results indicate that GP is suitable to be used in baking as a source of natural antioxidants and dietary fiber.

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 (weather extremes, economic climate) influence producers 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 continure to 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 and reduced funding, the program competition for existing funds becomes a greater challenge to manage. Nevertheless, emphasis is placed on those research and extension opportunities that have the greatest effect on sustainability of farms, families and businesses, i.e., economic, environmental and social and quality of life viability.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Information in this report is compled from North Carolina Cooperative Extension reporting system, faculty activity reports and impact statements, Office of Technology Transfer and the business offices at the two institutions. The data indicate that, despite continuing budget challenges, our research and extension programs continue to reach significant segments of our audience with relevant research and extension information that has benefit to their enterprises. Based on the impact statements, publications and patents filed, our research and extension faculty on the two campuses and across the state continue to foster and lead change.

Key Items of Evaluation

Research and extension programs and activities seek to excel in the following areas:

1. generate disseminate information that will enhance the safety of the food system--from production the table--and eliminate food borne illness
2. discover new technologies for handling and processing of food materials the will enhance their nutrition value and quality, find more uses in food manufacturing, and lead to new businesses
3. develop engineering solutions to take full advantage of the nutritive value and quantity of raw food materials generated in our agricultural systems
4. leadership is GAP, HACCP and other programs to enhance food safety