

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Food Safety

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
402	Engineering Systems and Equipment	0%		15%	
404	Instrumentation and Control Systems	0%		6%	
501	New and Improved Food Processing Technologies	40%		20%	
502	New and Improved Food Products	10%		25%	
503	Quality Maintenance in Storing and Marketing Food Products	10%		11%	
701	Nutrient Composition of Food	0%		7%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	10%		8%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	30%		8%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Actual	8.1	0.0	8.0	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
378195	0	598730	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
378195	0	598149	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	4856108	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Each year, about 76 million people in the United States get sick from contaminated food. According to the U.S. Food and Drug Administration's Bad Bug Book, more than 50 bacteria, viruses, parasites and toxins are considered food-borne pathogens.

In an effort to help improve food processing technologies and minimize the risk of food-borne illness, efforts in this area include research to: ensure the microbial safety of foods; develop effective biosensors, RFID tags and other technologies for track, trace and security issues; develop sustainable packaging systems to enhance food quality and shelf life; enhance the economic and nutritional value of food products through post-harvest and food processing technologies; identify and control/eliminate the causes of microbial resistance to contaminants; and improve the diagnosis and prevention of known and emerging infectious diseases of livestock and poultry.

Extension activities include: assisting producers on improving the quality of their food as well as food safety issues as the food is sent to markets and stores, training food handlers from restaurants and farmer markets on food safety issues, and teaching children/youth on proper hand washing.

2. Brief description of the target audience

Food safety professionals, consumers, public health and other state agency representatives, risk assessors, commodity groups, agricultural producers (crop and livestock), food chain supply industry representatives, retail food stores, restaurants and farmers' market collaboratives and associations, and other researchers and academics.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	{NO DATA}	{NO DATA}	{NO DATA}	{NO DATA}
Actual	122	500	598	1000

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

Patent Applications Submitted

Year: 2010
 Plan:
 Actual: 2

Patents listed

MICL02007-Development of nanostructured biosensors for rapid detection of disease-causing agents in food and water; TEC2009-0053-02; 12/715,929, 3/2/10; and TEC2010-0034-01Prov; 61/334,090, 5/14/10.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	29	29

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of research programs to develop new biosensors and DNA chips that can rapidly and accurately detect a broad spectrum of harmful organisms in food and water, such as E. coli, Salmonella, Listeria, Campylobacter, etc.

Year	Target	Actual
2010	{No Data Entered}	3

Output #2

Output Measure

- Number of research programs to improve the microbial safety and quality of food.

Year	Target	Actual
2010	{No Data Entered}	6

Output #3

Output Measure

- Number of research programs to develop packaging systems that enhance food safety, quality and shelf life.

Year	Target	Actual
2010	{No Data Entered}	3

Output #4

Output Measure

- Number of research programs to reduce economic losses and food safety risks associated with livestock and poultry diseases.

Year	Target	Actual
2010	{No Data Entered}	5

Output #5

Output Measure

- Number of research programs to develop more effective harvest and post harvest protocols and practices to minimize loss and enhance food safety and product quality.

Year	Target	Actual
2010	{No Data Entered}	7

Output #6

Output Measure

- Number of research programs to examine the functions and effect of dietary nutrients on immune response and other metabolic functions.

Year	Target	Actual
2010	{No Data Entered}	2

Output #7

Output Measure

- Number of producers that are trained on food safety issues.

Year	Target	Actual
2010	{No Data Entered}	43

Output #8

Output Measure

- Number of producers trained on federal and state legislations regarding food safety.

Year	Target	Actual
2010	{No Data Entered}	43

Output #9

Output Measure

- Number of front-line food handler staff trained on how to reduce cross contamination.

Year	Target	Actual
2010	{No Data Entered}	79

Output #10

Output Measure

- Number of front-line food handler staff trained in proper cooking temperatures and storing processes.

Year	Target	Actual
2010	{No Data Entered}	79

Output #11

Output Measure

- Number of youth trained on hand washing practices.

Year	Target	Actual
2010	{No Data Entered}	598

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of research programs to develop new biosensors and DNA chips that can rapidly and accurately detect a broad spectrum of harmful organisms in food and water, such as E.coli, Salmonella, Listeria, Campylobacter, etc.
2	Number of research programs to improve the microbial safety and quality of food.
3	Number of research programs to develop packaging systems that enhance food safety, quality and shelf life.
4	Number of research programs to reduce economic losses and food safety risks associated with livestock and poultry diseases.
5	Number of research programs to develop more effective harvest and post harvest protocols and practices to minimize loss and enhance food safety and product quality.
6	Number of research programs to examine the function and effect of dietary nutrients on immune response and other metabolic functions.

Outcome #1

1. Outcome Measures

Number of research programs to develop new biosensors and DNA chips that can rapidly and accurately detect a broad spectrum of harmful organisms in food and water, such as E.coli, Salmonella, Listeria, Campylobacter, etc.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The rapid detection of harmful organisms and disease-causing agents in food and water, and the ability to track and trace sources is critical to human health. In the food safety arena, it is estimated that 76 million food-borne illnesses occur each year in the United States, accounting for 325,000 hospitalizations and 5,000 deaths. Biosensors can play a key role in food safety by quickly identifying contaminants in water supplies, food processing and assembly lines, raw food materials and food products before they cause problems further up the food chain.

What has been done

Research to: synthesize, characterize and evaluate nanostructured interfaces that enable molecular level investigations of systems of medical, scientific and technological interests; investigate using radio frequency identification in tracking, tracing and security issues related to the movement of goods through the supply chain; and to combine the novelty of nanoscale transducing material and biosensing techniques to address the detection and diagnostic challenges in food and water safety.

Results

Biosensor research resulted in the successful synthesis of "green" biogenic gold nanoparticles using microorganisms as bio-nano-factories, which included *T. curvata*, *T. fusca*, and *T. chromogena*. Several detection biosensor modalities were also developed: a biosensor that successfully detected *E. coli* O157:H7 on screen printed carbon electrode chips with an assay time of 70 minutes from sampling to detection; a nano-BEAM biosensor that could detect anthracis protective antigen A in DNA concentrations as low as 0.01 ng per microliter, and HA from the Influenza A virus H5N1 at 1.4 M in 10 percent mouse serum. Researchers also demonstrated an electrospun biosensor for the detection of *E. coli* O157:H7 and bovine diarrhea virus at 60 CFU/mL and 1000 CCID/mL for bacterial and viral samples, respectively.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Number of research programs to improve the microbial safety and quality of food.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Each year, about 76 million people in the United States get sick from contaminated food. More than 50 bacteria, viruses, parasites and toxins are considered food-borne pathogens, including the so-called "Big Three" of bacterial food contaminants: *Listeria monocytogenes*, *Salmonella* and *E. coli* O157:H7. Microbial testing, aimed at ensuring the safety of food products, is very important for producers and processors in order to avoid consumer health issues linked to the ingestion of foodborne pathogens.

What has been done

Research to: develop strategies to enhance the safety, quality and shelf-life of ready-to-eat foods, with a focus on the transfer of *E. coli* O157:H7 during commercial processing of leafy greens; assess the risk of humans to mycotoxins via foodborne and airborne exposure and develop appropriate mitigation strategies to protect human and animal health; increase the understanding of the mechanisms and dynamics of antimicrobial resistance transmission between humans, animals and the environment; identify the mechanisms by which probiotic bacteria exert their beneficial effects when ingested by host animals; help prevent liver cancer by limiting human exposure to aflatoxin in food; and to understand the process of *E. coli* chromosomal DNA

replication and its regulation at the biochemical level.

Results

Researchers contaminated 20 pounds of radicchio lettuce with E. coli and ran it through a pilot-scale processing line, then ran 2,000 pounds of uncontaminated iceberg lettuce through the line. They then sorted through 40, 50 pounds bags of greens and bits left on the processing equipment and found radicchio in every bag of processed lettuce and more than 200 pieces on the processing line. This information will give the leafy green industry suggestions about improved equipment design, when they need to shut down the line and sanitize the entire line, and how much additional product may be at risk if E. coli O157:H7 is later found in a bag of salad greens.

In research looking at DNA and its replication in E. coli, researchers detected and identified a protein that inhibited chromosomal DNA replications -- a truncated form of ribosomal protein L2. As one of the most evolutionally ancient among ribosomal proteins, it is essential for ribosome biogenesis and a key to understanding chromosomal DNA replication.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #3

1. Outcome Measures

Number of research programs to develop packaging systems that enhance food safety, quality and shelf life.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In packaging systems, chlorine dioxide gas is used for vapor-phase decontamination in treating produce before packaging and sanitizing products inside their packages. Yet very little is known

about its effects on packaging material properties and performances. In terms of the containers themselves, use of a reusable plastic-based packaging system would greatly reduce the costs associated with packaging and address environmental issues.

What has been done

Research to: develop and use new types of packaging systems for fruits and vegetables; promote functional and sustainable package systems that optimize the utilization of raw materials; and to identify new approaches for decontaminating and improving the quality of fresh and fresh-cut produce.

Results

In research comparing the shelf-life performance of corn-based, compostable containers made using polylactic acid (PLA) with several types of conventional, petroleum-based packages, researchers found that, in some cases, PLA performs better than the conventional plastics tested. Further, packaging material such as PLA has the potential to be returned to the fields as a fertilizer and soil conditioner, benefitting the farmer and reducing solid wastes in landfills.

Researchers exploring the possibility of turning packages into small sanitation chambers to allow for a longer and more thorough exposure to the appropriate bactericide have developed an internal packaging design and ClO₂ dosage that demonstrated a significant microbial reduction while maintaining the produce's (lettuce and cherry tomatoes) appearance and texture. The packages designed for these products will become another asset within the sanitation process and will improve product safety.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
404	Instrumentation and Control Systems
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

Outcome #4

1. Outcome Measures

Number of research programs to reduce economic losses and food safety risks associated with livestock and poultry diseases.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Increasing numbers of domestic livestock and more resource-intensive production methods are encouraging animal epidemics around the world, a problem that is particularly acute in developing countries, where livestock diseases present a growing threat to the food security of already vulnerable populations. Further, the economic impacts of zoonotic diseases are enormous. The World Bank estimates that if avian influenza becomes transmissible from human to human, the potential cost of a resulting pandemic could be US \$3 trillion. These issues require substantial research investment and thinking through the health impacts of agricultural intensification to control epidemics that are decimating herds and endangering humans.

What has been done

Research to: detect emerging or re-emerging infectious diseases in livestock and poultry; develop sound and economical control and prevention strategies for bovine viral diarrhea virus; determine the efficacy of antibacterial drugs as a therapy for clinical mastitis; develop and enhance the efficacy and technology of Gram-negative bacterins; measure rates of natural transformation of antibiotic resistance and virulence genes in chickens; and to better understand the microbial ecology of the rumen and gastrointestinal tract of livestock.

Results

Implementation of the Upper Peninsula BVDV Eradication project continues. To date, over 50 percent of the UP cattle farms are enrolled in the program, and the number of verified BVDV-free animals tested through the program has reached more than 20,000.

Studies investigating the role of oxidative stress on mammary gland inflammatory responses to mastitis-causing pathogens identified, for the first time, key enzymatic pathways that could be targeted for therapeutic intervention.

Recently completed trials determined that infection with Bovine Leukosis Virus (BLV) may impair the ability of dairy cattle to serologically respond to a series of multiple immunizations with J5 E. coli bacterin.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #5

1. Outcome Measures

Number of research programs to develop more effective harvest and post harvest protocols and practices to minimize loss and enhance food safety and product quality.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Farmers and food sellers have been concerned about losses since agriculture began. Yet the problem of how much food is lost after harvest to processing, contamination, spoilage, insects or rodents takes on greater importance as world food demand grows. Cutting post-harvest losses could add a sizable quantity to the global food supply and reduce the need to intensify in the future. Estimates of total postharvest food loss are controversial and range widely, generally from about 10 percent to as high as 40 percent.

What has been done

Research to: develop harvest/post-harvest technology to help the fruit, vegetable and chestnut industries remain economically and environmentally sustainable; enhance the value of dairy and dairy-based products; identify protein markers that are indicators for soft wheat processing quality; develop improved methods for the design and operation of thermal processing systems for protein foods; help increase the economic value of foods through application of traditional and advanced technologies; and to develop innovative processing that adds value to fresh or processed meats.

Results

Research has confirmed CT x-ray as a means of characterizing and quantifying disorders in fresh in-shell chestnuts.

Rayfresh Foods, Inc., Ann Arbor, MI is using the results of MSU research findings related to the use of x-ray technology in killing pathogens to build the first commercial-sized x-ray machine for food irradiation. The researchers were able to demonstrate that x-ray technology is effective in killing bacterial pathogens (leafy green and almonds) without causing undesirable changes in product quality.

Research examining the molecular structure of soft wheat proteins in relation to end-use quality showed that a stronger protein flour was more desirable for crackers than for cakes and cookies and that the starch fraction of wheat flour plays a dominant role in governing the texture of noodles, followed by the water-soluble fractions, and then the type of protein.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
701	Nutrient Composition of Food

Outcome #6

1. Outcome Measures

Number of research programs to examine the function and effect of dietary nutrients on immune response and other metabolic functions.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Researchers have for many years noted nutrient deficiencies associated with cases of impaired immune response and a tendency to infectious disease. The problem of under-nutrition affecting immune system response is not limited to the malnutrition typically found in developing countries. The elderly, persons with eating disorders, alcoholics, persons with certain diseases, and premature and small-for-gestational-age babies may have immune system problems related to nutrient status. The better we can understand the metabolism and function of nutrients and their role in immune response, the more effective preventive and intervention strategies can be.

What has been done

Research to: determine the effects of dietary zinc on the immune response; and to investigate the metabolism and function of Vitamin A.

Results

Studies of the morbidly obese after gastric bypass surgery indicate that most patients are low in zinc in spite of being provided zinc supplements. This is due to reductions in the area of the gut needed for zinc absorption. Researchers are currently investigating the extent and duration of this problem, which could lead to more infections and poorer immune function.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food

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

The economic challenges being faced by Michigan continue to affect these programs, particularly related to funding and staffing levels due to budget cuts, appropriations changes and competing public priorities. In addition, because of the inclusion of the five new national priorities in this year's reporting, many of the projected numbers in our original planned programs had to be revised. Five out of the six original programs are included in the report, but a significant number (about 35 percent) were cross-walked into the new planned programs.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}