V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Food 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
133	Pollution Prevention and Mitigation			10%	
204	Plant Product Quality and Utility (Preharvest)			5%	
306	Environmental Stress in Animals			5%	
308	Improved Animal Products (Before Harvest)			5%	
311	Animal Diseases			5%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals			5%	
501	New and Improved Food Processing Technologies			10%	
502	New and Improved Food Products			10%	
603	Market Economics			5%	
606	International Trade and Development			5%	
607	Consumer Economics			8%	
702	Requirements and Function of Nutrients and Other Food Components			5%	
703	Nutrition Education and Behavior			5%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			5%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			5%	
723	Hazards to Human Health and Safety			7%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Extension	Research

Year: 2012	1862	1890	1862	1890
Plan	0.0	0.0	10.0	0.0
Actual Paid Professional	0.0	0.0	81.5	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**
0	0	906260	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	6678765	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	10875105	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

This program will result in multiple outputs as a result of the following proposed activities:

- Conducting laboratory, pilot-plant experiments and data collection
- Conducting research experinments
- Developing knowledge and new technology of food processing systems
- Developing curricular materials
- Developing quality monitoring protocols
- Developing products, curriculum, resources
- Developing services
- Presenting seminars and professional talks
- Conducting workshops and training sessions
- Publishing scientific findings
- Partnering

2. Brief description of the target audience

There are diverse audiences for information this project generates. They can be classified into four general groups: (1) the general public and food consumers; (2) state and federal food regulatory agencies; and (3) the research community including scientists working in government, industry, and academic sectors; and (4) the commercial food processing industry or commodity groups.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

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

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

Patent Applications Submitted

Year: 2012

Actual: 3

Patents listed

FLEXIBLE FILMS AND METHODS OF MAKING AND USING FLEXIBLE FILMS
PI - Kaiser, Clive / Christensen, J. Mark

Automated Zebrafish Chorion Removal and Single Embryo Placement: Optimizing Throughput of Zebrafish Development Toxicity Screens
PI - Mandrell, David / Simonich, Michael / Tanguay, Robert L. / Truong, Lisa / Sarker, Mushfiqur Rahman / Jephson, Caleb / Moore, Aaron

ECD IN AN RF-FREE ELECTROMAGNETOSTATIC CELL ON A TRIPLE QUADRUPOLE MASS SPECTROMETER
PI - Barofsky, Douglas F. / Voinov, Valery G.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	40	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- IMPROVED ANIMAL AND PLANT PRODUCTION SYSTEMS...1 - number of experiments or tests to reduce percentage of mortality, to enhance hatchability, or to identify a marker of immunity

Year **Actual**

2012	0

Output #2

Output Measure

- EFFECTS ON AND PROTECTION OF HUMAN HEALTH...1 - Numbers of nutrients/minerals that increase health-enhancing nutrients in novel product development or numbers of mineral supplementation developed to reduce the incidence of cancer

Year	Actual
2012	0

Output #3

Output Measure

- EFFECTS ON AND PROTECTION OF HUMAN and ENVIRONMENTAL/ECOLOGICAL HEALTH...1 - Agricultural/Environmental chemical analyses to - assess risks of toxins - develop analytical methods and biomarkers for agricultural chemicals and other contaminants - evaluate the variation and patterns in the incidence of human pesticide exposures - assess risk factors for the development of various cancers by DNA damage and compromising DNA repair mechanisms. - identify, validate, localize and characterize specific responsive genes, which have the potential to serve as biomarkers of toxins - develop and evaluate transgenic lines that show changes in reporter gene expression in response to toxicants - refine agrichemical risk assessment for aquatic insects to include life history and behavior - develop, refine, improve quantitative procedures that improve our ability to assess the risks that pest management practices pose to beneficial invertebrates.

Year	Actual
2012	0

Output #4

Output Measure

- TECHNOLOGY, MODELS AND ANALYSES THAT INFORM DECISION-MAKERS, INDUSTRY, AND PEERS REGARDING FOOD PRODUCTS...1 - identify food quality attributes that enhance heath

Year	Actual
2012	0

Output #5

Output Measure

- TECHNOLOGY, MODELS AND ANALYSES THAT INFORM DECISION-MAKERS, INDUSTRY, AND PEERS REGARDING FOOD PRODUCTS...2 - develop value-added products through a systematic product development strategy

Year	Actual
2012	0

Output #6

Output Measure

- TECHNOLOGY, MODELS AND ANALYSES THAT INFORM DECISION-MAKERS, INDUSTRY, AND PEERS REGARDING FOOD PRODUCTS...3 - determine best food processing technology and method for food product development and safety, including high pressure processing, laser technology, and radio frequency identification tags.

Year	Actual
2012	0

Output #7

Output Measure

- OTHER SCHOLARLY EXCELLENCE: participation on professional boards and panels, as well as science panels, awards, etc.

Year	Actual
2012	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	2a - Characterize and model toxins arising from food production and processing (analytical) * New analytical methods and biomarkers to cost-effectively identify and track agricultural chemicals and other contaminants through time and space * Develop and transgenic lines of zebrafish for response to toxicants
2	3 - Methods to improve Animal Health production systems, for example through - improvement of maternal diet - enhancement of the efficacy of vaccination programs - development of diagnostic methods to assess immune health
3	A2 - Percentage of health risks reduced due to information regarding toxins arising from food production and processing
4	A4 - Improved food handling and regulations - Individuals and industry modify food production and handling practices. - Intervention strategies reduce bacterial contamination, increase shelf life, and reduce occurrences of food-borne illnesses.
5	A3 - Improved animal husbandry, such as - Poultry industry changes feed formulations to reduce embryonic mortality during incubation (thereby enhancing hatchability) and to improve animal health and to produce health-enhancing nutrients (thus developing value-added poultry foods). - Livestock producers use diagnostic methods and new vaccination programs to increase immunity (innate and acquired) in domestic animals
6	A5 - Informed policy-making and management related to food processing that prevent incidences of food-borne illnesses.
7	Change Indicator - Economic: - Application of knowledge and new leading-edge food technologies will result in improved food quality, value and safety with positive impacts on value-added food production, processing, handling, and distribution systems. - Sustainable competitive advantage for Northwest food industries that are able to accurately gage consumer demand for their products. - Improve the food economy by developing new, stronger, and growing food businesses in the state. - Help reduce the state's unemployment through the creation of jobs in these food companies. - Hatchability and value-added poultry foods will bring increased economic returns to the US poultry industry.
8	Change Indicator - Societal: - Better human and animal health, well-being, and survivability result with the use of nutrition and nutrigenomics and organic production. - Reduce health care costs associated with prostate cancer and improve the quality of life of thousands of American men . - Control the growth in the rate of obesity and osteoporosis among youth and solutions reverse trends in childhood obesity - Build environmental public health capacity - Mitigate how federal expenditures related to the farm subsidy program are linked to Medicaid expenditures for obesity related health conditions.
9	Change Indicator - Environmental (risk assessment, policies and management of exposure): - Enhanced environmental quality within an economically responsible context. - Reduced exposure of human and aquatic organisms to fluorochemicals - Moderate the relative contribution of regional U.S. and Canadian agricultural sources (both current and historic uses of these chemicals) and long-range or global sources in contributing to the deposition of agricultural chemicals to remote ecosystems in the Western U.S. - Minimize the risk of adverse impact of pesticide use on human health.
10	1 - Understanding Human Health and Nutrition (nutrition) relationships, such as a) new risk factors in prostate cancer and novel dietary modifications to reduce the incidence of prostate cancer, and b) learn of the mechanisms behind the health benefits of fruits and vegetables.

11	2 b- Characterize and model toxins arising from food production and processing (mechanisms, effects) * Identify agents, mechanisms, and dose response for reducing fetal risk from toxic chemicals * evaluate dioxin toxicity to humans and characterize specific responsive genes to toxicants * Examine mechanisms that underlie the immune suppression * Identify role of polymorphisms and mediators in relieving dioxin toxicity * Evaluate effects of aging on bioavailability of agricultural contaminants * Determine ways to evaluate extent that landfills are a significant source of fluorochemicals and the extent to which they are present in crops intended for human consumption
12	2c - Characterize and model toxins arising from food production and processing (education) * Provide technical training and resources to agricultural and regulatory stakeholders on ecotoxicology of pesticides and integrated pest, nutrient, and water management.
13	A1 - Nutritional health or additives provide disease mitigation, e.g., zinc supplementation will be an effective strategy in limiting the incidence of prostate cancer and effective dietary intervention strategies are broadly applied to reduce obesity
14	4 - Develop technologies and control strategies to improve food safety
15	5 - Detect incidences and pathways of food borne illnesses to: * reduce regulatory actions * reduce potential economic loss from diminished productivity * reduce incidences reported and absences due to illness.

Outcome #1

1. Outcome Measures

2a - Characterize and model toxins arising from food production and processing (analytical) * New analytical methods and biomarkers to cost-effectively identify and track agricultural chemicals and other contaminants through time and space * Develop and transgenic lines of zebrafish for response to toxicants

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is a tremendous need to more rapidly identify chemical hazards and to thoroughly understand the mechanism by which chemicals and nanomaterials produce toxicity. It is important to develop methods that will allow predictions of the toxic potential of novel compounds, thereby protecting human and the environment by reducing the use and release of highly toxic chemicals.

Our high throughput screening system for toxicological and behavioral studies includes development of a novel behavioral system that can quantify zebrafish behavior as early as 24 hours post fertilization (useful for neurotoxicity screening) and moving to use of RNA ?sequencing for whole animal gene expression studies.

What has been done
We have screened the toxicity of over forty polycyclic aromatic hydrocarbon (PAHs), environmentally transformed PAHs, and complex mixtures in our system. We also competed the screening of the full EPA ToxCast chemical set (1078 individual compounds) which represents the largest in vivo toxicity study to date. We also completed a number of relevant toxicological screening experiments. One set is related to Trimethyltin chloride (TMT), an organotin contaminant widely detected in aqueous environments, posing potential human and environmental risks. We utilized the zebrafish model to investigate the impact of transient TMT exposure on developmental progression, angiogenesis, and cardiovascular development.

Results
Embryos were waterborne exposed to a wide TMT concentration range from 8 to 96 hours post fertilization (hpf). The predominant response observed in surviving embryos was pericardial edema. TMT exposure led to distinct disarrangements in the vascular system. High density whole genome microarrays were used to identify the early transcriptional changes following TMT exposure. Transcripts misregulated by TMT exposure were clustered in numerous categories. The research team was able to identify which ADP-ribosylation factors necessary for TMT-induced vascular toxicity.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
306	Environmental Stress in Animals
311	Animal Diseases
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
702	Requirements and Function of Nutrients and Other Food Components
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

<u>Outcome #2</u>

1. Outcome Measures

3 - Methods to improve Animal Health production systems, for example through - improvement of maternal diet - enhancement of the efficacy of vaccination programs - development of diagnostic methods to assess immune health

2. Associated Institution Types

- 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)
Lipid metabolism during early growth can have a significant impact on long term animal health and product quality. There needs to be better understanding the fundamental relationship between dietary lipids and fatty acid metabolism in poultry during embryogenesis and growth. Further, it is important to evaluate mechanisms by which feed supplements are able to augment innate and acquired immunity in domestic animals such as poultry and livestock.

What has been done
Studies were conducted to: (1) investigate fatty acid metabolism in neonatal chicks, (2) develop value-added wholesome functional poultry foods, and (3) investigate the use bi-products from biofuel industry in poultry feeding.

Results
Maternal diet led to enhancement of n-3 fatty acids in progeny chick tissues, and this early exposure can have long lasting effect on broilers. This has practical applications. Under commercial conditions, mortality during the first 2 weeks of growth is around 5% and this remains a problem for the broiler industry. In addition, metabolic disorders and heart-related conditions are the major cause of mortalities and morbidities in broiler birds and have been reported in birds as early as 3 days of age. Feeding trials conducted with broiler birds showed that Camelina meal, a high protein fatty acid byproduct from biofuel production, could be included up to 10% in the diets without compromising bird performance while increasing the n-3 fatty acid content, lipid stability and antioxidant capacity of meat. Camelina meal offers a new alternate feed source for producing meat products with high n-3 fatty acids and increased lipid stability.

4. Associated Knowledge Areas

KA Code	Knowledge Area
306	Environmental Stress in Animals
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
502	New and Improved Food Products
603	Market Economics
702	Requirements and Function of Nutrients and Other Food Components

Outcome #3

1. **Outcome Measures**

   A2 - Percentage of health risks reduced due to information regarding toxins arising from food production and processing

2. **Associated Institution Types**

   - 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Pacific Northwest produces over 70% of the world's supply of tall fescue (Festuca arundinacea) and perennial ryegrass (Lolium perenne) seed. Producers developed a market, mainly exporting to Pacific Rim countries) for straw/hay, a nutritious food resource for sheep and cattle. To combat insect predation and to produce more vigorous, drought-resistant plants, endophytic fungi are deliberately promoted; the endophytes produce ergot or lolitrem alkaloid toxins, which can cause deleterious effects in cattle and other herbivore species when endophyte-infected grasses are grazed or fed as hay. Fescue foot, summer syndrome, ryegrass staggers, and reproductive problems produce a high economic loss to industry.

What has been done
OSU research has shown that some ruminants have the ability to detoxify the toxic compounds. Identification of these detoxifying anaerobic ruminal microbes that are specific to certain toxins is useful in the production of probiotics which will allow susceptible animals to be unaffected by ingesting plant material previously toxic to them. Further, this research will elucidate the fate and metabolism of these toxic compounds within the animal. While a number of strategies now exist to manage fescue toxicosis, research continues because this problem occurs in diverse research areas. Informational updates are provided directly to farmers and ranchers via extension activities such as workshops, online literature and publications.

Results
The years since 2010 marked an important period for the Oregon hay export industry: zero clinical cases were reported from Japan with regards to ryegrass staggers, the disease resulting from consumption of lolitrem B in perennial ryegrass straw. This is the result of Dr. Craig and the straw export industry working closely with the Japanese to streamline testing of the 33,000 containers of straw shipped annually from the west coast for the endophyte toxins ergovaline and lolitrem B. In addition, the Oregon Department of Agriculture established OSU laboratory accreditation for

testing of ergovaline and lolitrem B, using ISO 17025 standards as a reference for our QA/QC.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
204	Plant Product Quality and Utility (Preharvest)
306	Environmental Stress in Animals
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
502	New and Improved Food Products
603	Market Economics
606	International Trade and Development
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
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

A4 - Improved food handling and regulations - Individuals and industry modify food production and handling practices. - Intervention strategies reduce bacterial contamination, increase shelf life, and reduce occurrences of food-borne illnesses.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Vibrio parahaemolyticus is the leading cause of human gastroenteritis associated with seafood consumption in the U.S. Numerous outbreaks of V. parahaemolyticus infection linked to raw oyster consumption have been documented in the U.S. The Centers for Disease Control and Prevention (CDC) recently reported a 78% increase in the incidence of Vibrio-associated infections in 2006 from the 1996-1998 baselines and estimated that 45,000 cases of V. parahaemolyticus infection occur each year in the U.S. Development of post-harvest processes to eliminate V. parahaemolyticus in oysters will minimize illnesses associated with seafood consumption.

What has been done
Effects of temperature (5 - 20°C) on efficacy of depuration in reducing Vibrio parahaemolyticus in Pacific oysters were investigated with a goal of developing a depuration condition capable of reducing Vibrio parahaemolyticus in raw oysters by >3.0-log units (>99.9% reduction) without significant adverse effects on oysters.

Results
Depuration of oysters at temperatures between 7 and 15°C reduced V. parahaemolyticus populations in oysters by >3.0 log MPN/g after 5 days with no loss of oysters. This depuration process allows the shellfish industry to produce raw oysters for safe consumption without killing the oysters, such as being processed by thermal pasteurization or high pressure processing. Refrigerated seawater depuration also enhances the ability of oysters to survive in a low-temperature environment such as storage at 5ºC, which increases the shelf life and value of depurated oysters.

4. Associated Knowledge Areas

KA Code	Knowledge Area
306	Environmental Stress in Animals
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
603	Market Economics
607	Consumer Economics
702	Requirements and Function of Nutrients and Other Food Components
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 #5

1. Outcome Measures

A3 - Improved animal husbandry, such as - Poultry industry changes feed formulations to reduce embryonic mortality during incubation (thereby enhancing hatchability) and to improve animal health and to produce health-enhancing nutrients (thus developing value-added poultry foods). - Livestock producers use diagnostic methods and new vaccination programs to increase immunity (innate and acquired) in domestic animals

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The US poultry industry annually produces over 43 billion pounds of high quality broiler chickens and turkeys, and over 90 billion eggs, which in 2010 had a market value of $34.7 billion. Avian influenza virus is an important concern to the poultry industry both in the US and worldwide. Current influenza vaccines for poultry are expensive, subtype-specific, and not widely used in the US. A cost-effective and efficacious influenza vaccine for use in commercial poultry farms would help protect against avian influenza outbreaks. We secured USDA funding to develop a vaccine against H5N1 virus infection in chickens.

What has been done
We constructed a live bacterial vaccine against avian influenza by expressing a conserved peptide from the ectodomain of M2 antigen (M2e) on the surface of Lactococcus lactis (LL). Chickens were vaccinated subcutaneously or intranasally with the lactococcal vaccine (LL-M2e). Challenged with high pathogenic avian influenza virus A subtype H5N2, vaccinated birds had significantly lower viral titers in the trachea and significantly longer median survival time. Data showed that intranasal vaccination of chickens with LL-M2e provided a significant increase in survival compared to non-vaccinated birds. Survival correlated with serum IgG response to the vaccine.

Results
The strategy of using M2e as a vaccine is different from the conventional one currently used for human seasonal vaccines. Current vaccines and natural infection induce a humoral response to two immunodominant viral surface antigens, hemagglutinin (HA) and neuraminidase (NA). However, HA and NA undergo intense selective pressure due to the host immune response and

are constantly changing. The use of M2e as antigen would avoid the problem of genetic drift and shift that characterizes both HA and NA because M2e is genetically stable. Research indicates that LL-M2e induced a humoral response, but not a cellular response. Clearly, additional work will be required to develop a vaccine that provides full protection. However, we are currently testing other non-pathogenic bacterial vectors and other influenza virus antigens that may improve upon these initial results.

4. Associated Knowledge Areas

KA Code	Knowledge Area
306	Environmental Stress in Animals
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
502	New and Improved Food Products
603	Market Economics
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

Outcome #6

1. Outcome Measures

A5 - Informed policy-making and management related to food processing that prevent incidences of food-borne illnesses.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	250

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Berries are important small fruit crops in the Northwest. The fruit industry is faced by a number of issues to fully utilize the fruit resources. There is a great need to develop organic production systems for fresh and processed blackberry that maximize plant growth, yield, fruit quality, and food safety; and to provide nutritional benefits. The potential for pathogenic bacteria to survive in blackberry juice and wine needed to be evaluated to understand their importance in post-processing contamination. Wine grape pomace is an underutilized bio-waste byproduct from

wineries; there is a great need for utilization of this bio-residual, especially in the area of converting grape pomace into value-added bio-products.

What has been done
Blackberries were tested for a number of characteristics. Fruit qualities and bioactive compounds in fresh organic blackberries associated with different organic planting and management systems were evaluated during postharvest refrigeration storage and freeze processing. Blackberries were puréed and pressed, and a portion of the juice was inoculated with Saccharomyces cerevisiae and allowed to ferment to completion (wine). Results indicated that processed blackberries did not support the survival of either pathogen for a period longer than 108 h in juice or 40 min in wine. Antioxidant dietary fibers (ADF) were developed from wine grape pomace by developing economically feasible drying methods that maximized the retention of bioactive compounds. ADF applications as a functional food ingredient were also evaluated.

Results
We produced information on the storage and processing effects on the quality and nutraceutical benefits of blackberries that can be used by processors to develop better procedures for retaining the nutraceutical components of berries and by consumers to better understand potential health benefits of the various products. New knowledge on the impact of different organic production systems on the quality and storability of fresh organic blackberries was developed. Such information will be valuable for optimizing the most practical organic agricultural production system. Additionally, workshops were offered to small-scale specialty food processors in processing technologies and food safety controls. Information was also delivered through website, extension publications and a new book to reach broader audiences. The delivery of education and training programs ensured food safety in the production of specialty foods in the US Pacific Northwest region.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
603	Market Economics
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
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

Change Indicator - Economic: - Application of knowledge and new leading-edge food technologies will result in improved food quality, value and safety with positive impacts on value-added food production, processing, handling, and distribution systems. - Sustainable competitive advantage for Northwest food industries that are able to accurately gage consumer demand for their products. - Improve the food economy by developing new, stronger, and growing food businesses in the state. - Help reduce the state's unemployment through the creation of jobs in these food companies. - Hatchability and value-added poultry foods will bring increased economic returns to the US poultry industry.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Emerging food businesses and specialty food producers often need help to develop their products, learn safe food processing and storage techniques, and understand their markets and businesses. The Food Innovation Center Experiment Station (FIC) was established to provide programs to improve food processing safety and efficiencies, produce high quality and wholesome value-added products, use sensory and consumer testing to link agricultural producers and processors to their consumers, and improve the food economy of the Northwest. Its faculty investigates quality aspects of fruit and vegetable varietals and other Northwest foods. Research and outreach activities are specifically integrated to assist the food sector in food safety and in maintaining a wholesome food supply

What has been done
FIC faculty developed innovative technologies such as the use of carbon dioxide lasers to improve infusions of syrups (yield and quality). Sensory and economic research determined markets for grass fed beef and raw milk cheese. Two pilot projects in traceability were successfully implemented in OR and WA processing facilities and showed that a RFID enabled tracking system was proved to be technically feasible and can generate valuable information to improve productivity and efficiencies in a food processing plant, reduce human errors caused by paper based tracking system, and improve the speed for food safety recalls. The impact of certifying seafood for ecologically sound aquaculture practices was published.

Results

With Oregon Department of Agriculture, FIC examined adoption of Good Agricultural Practices (GAPs) by producers. They worked collaboratively with colleagues at Washington State University to strengthen food safety training programs in the food processing industry. Several food start-up companies have been launched and others are expanding their operations through FIC efforts and the Get Your Recipe to Market workshops. Food safety information is part of workshop activities. Follow-up efforts have assisted some with product development and new marketing challenges. Work was completed in the area of seafood safety and a web-site developed for assisting health professionals become more knowledgeable in risks and benefits in seafood consumption. This web-site is also used by consumers who wish to know more about seafood safety.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
603	Market Economics
607	Consumer Economics
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
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 #8

1. Outcome Measures

Change Indicator - Societal: - Better human and animal health, well-being, and survivability result with the use of nutrition and nutrigenomics and organic production. - Reduce health care costs associated with prostate cancer and improve the quality of life of thousands of American men . - Control the growth in the rate of obesity and osteoporosis among youth and solutions reverse trends in childhood obesity - Build environmental public health capacity - Mitigate how federal expenditures related to the farm subsidy program are linked to Medicaid expenditures for obesity related health conditions.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Obesity is a critical concern and drives research on behaviors related to diet intake, exercise and weight control. Healthy eating is a broader concept that encompasses the ability to determine and choose nutritious, low energy dense foods, and to influence the behaviors associated with promoting healthy food intakes within families of pre-adolescent children. Changes in both diet composition and level/type of physical activity (PA) are important to reverse risk factors for chronic disease in individuals who are overweight or obese. Achieving a balance of food intake on a daily basis, regular consumption of foods that meet both nutrient density and energy density is often difficult; much of the public is challenged to understand as well as implement the concept of healthy eating, contributing to obesity and many related maladies.

What has been done
The team evaluated transcripts from focus groups of parents of Asian, Hispanic and Non-Hispanic whites of pre-adolescent children to determine pulse points reflecting motivational support for encouraging healthy eating among their children, and to identify difference in messages framed in English versus Spanish. They also conducted focus groups to identify college student ranking of health fullness of various basic foods and barriers to healthy eating on campus. Research also addressed the importance of teaching women to make changes in their own health behaviors and lifestyle, and then to model these healthy behaviors in the home to improve the health of the family

Results
Framing and language of nutrition education messages were developed to appropriately appeal to specific groups. New or improved obesity intervention strategies in the community setting were developed. We identified objective, physiological-based measures that correspond to target behaviors (bio-behavioral markers) for use later as measures of intervention progress and success or means for tailoring effective interventions. Advances in the study of obesity included markers and strategies that have become standards in methods and measurement of childhood overweight and resiliency. These are being used in a number of locations due to collaborations on multistate projects by team members.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
502	New and Improved Food Products
607	Consumer Economics

702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
723	Hazards to Human Health and Safety

Outcome #9

1. Outcome Measures

Change Indicator - Environmental (risk assessment, policies and management of exposure): - Enhanced environmental quality within an economically responsible context. - Reduced exposure of human and aquatic organisms to fluorochemicals - Moderate the relative contribution of regional U.S. and Canadian agricultural sources (both current and historic uses of these chemicals) and long-range or global sources in contributing to the deposition of agricultural chemicals to remote ecosystems in the Western U.S. - Minimize the risk of adverse impact of pesticide use on human health.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Changes in the regulatory process for agricultural and general use pesticides have occurred over the past 10 years, for example, organophosphate insecticides have been phased-out from most residential uses by regulatory restrictions by the U.S. EPA. It is important to tracking changing trends in the epidemiology of human exposure incidents involving agricultural and general use pesticides in the United States. This project also explores the potential applications as well as the limitations of biomarkers of exposure to pesticides, and their relationship to health status in the general population.

What has been done
Epidemiological analyses were conducted on large regional and national data sets to assess whether changes have occurred in the incidence of human exposure to important agricultural and other pesticides including organophosphates and pyrethroids. The data sets that were analyzed included the National Poison Data System (NPDS), the Oregon Poison Center, the National Pesticide Information Center (NPIC), and the National Health and Nutrition Examination Survey (NHANES). In addition, the current toxicological literature was extensively reviewed to further delineate the use of biomarkers in the assessment of exposure and health effects from pesticides in the U.S. population.

Results
Analysis consistently confirmed significant decrease in the number of human exposure incidents involving organophosphate insecticides. This has been associated with an increased incidence of exposures to other pesticide classifications including the pyrethroids, with its own potential adverse health effects. We identified significant differences in the risk of symptomatic pesticide exposures among Oregon residents, with higher risk among individuals living in rural areas. The use of geographic information systems in this project is now being used by other poison control centers in the U.S. to better track and monitor when and where pesticide and other exposures occur. Additionally, an invited review of scientific evidence on human biomarkers of exposure to organophosphates identified significant limitations in the use of dialkyl phosphates as biomarkers of exposure and health effects in epidemiological studies, human diet and other pathways. The article and related webinars have been cited and attended by hundreds of public health practitioners and officials.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
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 #10

1. Outcome Measures

1 - Understanding Human Health and Nutrition (nutrition) relationships, such as a) new risk factors in prostate cancer and novel dietary modifications to reduce the incidence of prostate cancer, and b) learn of the mechanisms behind the health benefits of fruits and vegetables.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Prostate cancer remains a very significant contributor to the morbidity and mortality of U.S. men. Increased vegetable intake has long been associated with decreases in prostate cancer risk. However, mechanisms for chemoprevention are unclear. Nutritional strategies that decrease inflammation oxidative stress, decrease DNA damage and/or target aberrant epigenetic alterations, such as acetylation, in prostate cancer have the potential to dramatically reduce the incidence of prostate cancer, reduce health care costs associated with prostate cancer, and improve the quality of life of thousands of American men.

What has been done
We have found that sulforaphane, a phytochemical derived from broccoli, inhibits prostate cancer cell growth in vitro and in rodent models of prostate cancer. The mechanism appears to be related to targeting epigenetics and histone deacetylases. Moreover, the effects of sulforaphane is specific to cancer cells, not normal cells. Bioavailability studies in humans show that absorption of sulforaphane is higher from broccoli sprouts as a whole food than broccoli supplements. We also show that the micronutrient zinc, is very effective at limiting inflammation associated with the aging using a rodent model. Zinc levels are high in the prostate and this work suggests that maintaining zinc status may be important in limiting inflammation and maintaining prostate health.

Results
Our novel dietary research established low dietary zinc as risk factor for DNA damage and cancer risk and other chronic diseases and low cruciferous vegetable intake as a risk factor for the development of prostate cancer. We gained knowledge of the mechanisms behind the health benefits of zinc and cruciferous vegetables. Dietary modifications can reduce the incidence of prostate cancer. Larger trials are needed to identify effective dietary intervention strategies that are broadly applicable nutrition recommendations and will significantly reduce the burden of prostate cancer. As obesity is also a major risk factor for prostate cancer, the proposed research may impact this susceptible population.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
723	Hazards to Human Health and Safety

Outcome #11

1. Outcome Measures

2 b- Characterize and model toxins arising from food production and processing (mechanisms, effects) * Identify agents, mechanisms, and dose response for reducing fetal risk from toxic chemicals * evaluate dioxin toxicity to humans and characterize specific responsive genes to toxicants * Examine mechanisms that underlie the immune suppression * Identify role of polymorphisms and mediators in relieving dioxin toxicity * Evaluate effects of aging on bioavailability of agricultural contaminants * Determine ways to evaluate extent that landfills are a significant source of fluorochemicals and the extent to which they are present in crops intended for human consumption

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Quantitative analytical methods are a prerequisite to understanding the occurrence, fate, and transport of contaminants in the environment or for monitoring biomarkers in humans and biota. Analytical methods must be developed for contaminants for which no analytical methods exist, and ghey must also be developed and validated for the environmental or biological matrix in which the analytes will occur. New analytical methods should be sensitive, selective, and robust while minimizing the time required for analysis and the waste (organic solvent and solid) generated. Sample preparation is one of the most time-consuming steps in the analysis of environmental samples and it is the most prone to problems. Thus, new analytical methods should be created to minimize or eliminate sample preparation.

What has been done
A number of analytical methods were developed at OSU that are based on direct, large-volume injection techniques for the analysis of polar organic contaminants such as fluorochemicals, biomarkers, illicit drugs, pharmaceuticals, and anabolic steroids by liquid chromatography (LC) and tandem mass spectrometry (MS/MS). Simple modifications were made to existing commercial LC instruments so that large volumes of river and surface water and municipal wastewater could be directly analyzed by LC-MS/MS. Methods were also developed to analyze large volumes of organic extracts for the analysis of fullerenes and persistent, bioaccumulative fluorochemicals in groundwater.

Results
Fullerenes were present in natural combustion byproducts and tightly bound to natural forms of carbon in soils, indicating that the bound fraction is unlikely to be mobile in the environment. This research allowed us to create a critical review describing the analytical challenges associated with carbon nano material analysis, which has been cited 50 times since its publication. Municipal wastewater is a major source of environmental fluorochemcials with minimal removal during treatment. Fluorochemicals then move undegraded through a river system and the only means of controlling this is to decrease human use; this finding may help regulators focus on reducing the number of products containing the most persistent forms of fluorochemicals. Analysis for illicit drugs in municipal wastewater provide sensitivity similar to other more time-consuming methods; this approach quantifies per capita drug use/excretion and reveals the diurnal flows of illicit drugs in a community. Such data may help drug epidemiologists better understand drug use by resident

versus commuter populations for a given municipality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
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 #12

1. Outcome Measures

2c - Characterize and model toxins arising from food production and processing (education) * Provide technical training and resources to agricultural and regulatory stakeholders on ecotoxicology of pesticides and integrated pest, nutrient, and water management.

2. Associated Institution Types

- 1862 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)
Fescue toxicosis and perennial ryegrass staggers are two of the most common toxic plant diseases plaguing livestock in the United States, and result from consumption of forage containing the endophyte-produced mycotoxins ergovaline and lysergic acid (fescue toxicosis) and lolitrem B (ryegrass staggers). It is estimated that the toxicological effects of ergot and lolitrem alkaloids cost between $0.5 and $1 billion in livestock losses annually in the United States alone.

What has been done
We have begun delineating the metabolism of these toxins in animals so that a better risk assessment can be conducted which evaluates the presence of these toxins and their metabolites in by-products available for human consumption. Research on these toxins is warranted, as the

possible impact of bioaccumulation of these toxins under varying exposure conditions on both toxicity and as residues in food products has not been thoroughly investigated and could affect the manner by which these compounds are regulated. We investigated four dairies in the Willamette Valley, Oregon, which experienced reproductive problems associated with the presence of a large, previously unidentified, peak eluting at 5 min in a standard ergovaline high-performance liquid chromatography assay.

Results
We believe the new peak defined through extensive mass spectrometry analysis in this case report represents a novel ergot alkaloid. We offered rationales for elucidation of its structure, with the closest starting point comprising an m.w. of 566-a fructofuranosyl-(2-1)-O-beta-D-fructofuranoside derivative of 6,7-secoergoline from Claviceps fusiformis. This m.w. requires modifications, such as reduction of two double bonds in the secoergoline component to give the target 570 m.w. The analysis provides a starting point for eventual elucidation of this apparently new ergot alkaloid, and a guide to encourage further investigation as to its association with endophyte toxicosis in livestock.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
502	New and Improved Food Products
702	Requirements and Function of Nutrients and Other Food Components
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 #13

1. Outcome Measures

A1 - Nutritional health or additives provide disease mitigation, e.g., zinc supplementation will be an effective strategy in limiting the incidence of prostate cancer and effective dietary intervention strategies are broadly applied to reduce obesity

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
General human populations are exposed to polycyclicaromatic hydrocarbons (PAHs) primarily though diet, including environmental contamination of food stuffs, through production of PAHs during cooking or processing, and through environmental contaminates such as tobacco smoke or pollution. In this project, we expect to elucidate mechanisms by which chemopreventive agents commonly available in foods - represented here by red raspberry extract (RE) and major RE components, cyanidin-3-O-glucosides (C3OGs) - antagonize cancer by PAHs. We propose to improve scientific knowledge concerning the interaction between genes and diet, and how genetic diversity affects the relationship between whole diet as a risk factor for chronic disease.

What has been done
We investigated biochemical and cellular responses dependent upon MMR proteins to a model PAH. Biochemical studies showed that MutSalpha (necessary for MMR) bound mismatched B[a]P-adducted substrates with higher affinities than the corresponding matched substrates, and with similar affinities to mismatched substrates without B[a]P lesions. Preliminary data from cellular studies suggested that MMR plays a role in signaling the DNA replication arrest seen following reactive diolepoxide form (BPDE)-exposure, perhaps by helping to resolve the signal for arrest.We also received two grant awards which allowed support for the recruitment, retention, and training of the next generation of research scientists.

Results
Our data demonstrate for the first time that MMR-proficiency does impact the mutagenicity of a model PAH, consistent with our hypothesis that MMR status would similarly influence risk of PAH-induced carcinogenesis. On-going analyses will expand the analysis of the mutational spectra in MMR-proficient versus ?deficient cells treated in parallel at different doses, and address the biochemical mechanism of the MMR-dependent responses through analysis of PAH-lesion-provoked excision and processing.

4. Associated Knowledge Areas

KA Code	Knowledge Area
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
702	Requirements and Function of Nutrients and Other Food Components
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 #14

1. Outcome Measures

4 - Develop technologies and control strategies to improve food safety

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Oregon hazelnuts industry produces 99% of the hazelnuts grown in the United States. Recent incidences of microbial contamination could prove detrimental to the reputation and economic sustainability of the industry.

What has been done
A research project in the use of postharvest processing techniques to reduce the level of pathogens in hazelnuts was undertaken. Results showed that initial washings were effective in reduction of total microbial load. In addition, the study showed the ability of different sanitizers to kill bacteria while controlling for the physical removal aspect of microbial reduction. This work was presented to the Hazelnut Marketing Board and growers association as well as resulted in a thesis on this topic.

Results
The new knowledge should improve handling techniques without greatly impacting the effort and cost of sanitation of the hazelnuts.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
603	Market Economics
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 #15

1. Outcome Measures

5 - Detect incidences and pathways of food borne illnesses to: * reduce regulatory actions * reduce potential economic loss from diminished productivity * reduce incidences reported and absences due to illness.

2. Associated Institution Types

- 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)
A real-time PCR DNA method for detection of soy, an allergen, in foods has been developed. However, the methods need to be tested with seafood.

What has been done
Specific primers were developed for detection; the ability of the primer to detect different soy products was validated and the sensitivity of the primer for detection of soy using real-time PCR was explored. In addition, the method was compared to traditional ELISA based detection methods for ability to detect soy in a complex food matrix. Matrices explored included protein-, water-, carbohydrate-, and lipid- based matrices. Finally, the impact of heating matrices prior to analysis was also evaluated.

Results
Results determined that although real-time PCR DNA based methodologies could be as sensitive for their detection of soy, the inclusion of soy at 10% in a matrix significantly reduced the ability of the method to quantitatively predict the amount of soy in the product.

4. Associated Knowledge Areas

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

702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
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

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

V(I). Planned Program (Evaluation Studies)

Evaluation Results

formative evaluation is still ongoing

Key Items of Evaluation