

### V(A). Planned Program (Summary)

#### Program # 8

##### 1. Name of the Planned Program

Human Health, Nutrition and Well-being

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
202	Plant Genetic Resources	5%	0%	15%	15%
206	Basic Plant Biology	5%	0%	15%	0%
502	New and Improved Food Products	10%	0%	15%	25%
701	Nutrient Composition of Food	10%	0%	10%	25%
702	Requirements and Function of Nutrients and Other Food Components	10%	0%	10%	25%
703	Nutrition Education and Behavior	15%	0%	0%	0%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%	0%	5%	0%
721	Insects and Other Pests Affecting Humans	10%	0%	10%	10%
722	Zoonotic Diseases and Parasites Affecting Humans	5%	0%	10%	0%
724	Healthy Lifestyle	10%	0%	10%	0%
802	Human Development and Family Well-Being	10%	0%	0%	0%
	<b>Total</b>	100%	0%	100%	100%

### V(C). Planned Program (Inputs)

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

Year: 2014	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	10.0	8.0	50.0	6.0
<b>Actual Paid</b>	12.0	0.0	47.0	6.2
<b>Actual Volunteer</b>	20.0	0.0	12.0	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
217956	0	833035	641350
1862 Matching	1890 Matching	1862 Matching	1890 Matching
217956	0	833035	50154
1862 All Other	1890 All Other	1862 All Other	1890 All Other
794400	0	20000000	273275

## V(D). Planned Program (Activity)

### 1. Brief description of the Activity

Human nutrition, health and well-being research and outreach programs will include, but not be limited to, the concepts listed below:

The Plants for Human Health Institute at Kannapolis, NC aims to enhance the nutritional value of fruits and vegetables and related compounds to improve human health and prevent disease. One of their first major accomplishments, collaborating with the David H. Murdock Research Institute and a nationwide consortium, is the sequencing of the blueberry genome, a major fruit when fresh fruit consumption and antioxidants for health are considered. Associated with the Institute, the NC Market Ready outreach program will provide information to growers and marketers for business management, marketing, safety and production management to facilitate the introduction and production of new crops evolving from the Institute's research efforts. Studies examine ways to identify and control tick species that vector Rocky Mountain Spotted Fever. A novel approach involved an all-natural botanical insect repellent for both ticks and mosquitoes. Biochemical research is developing technologies to produce effective vaccines against insect vectored diseases. Biochemists are seeking to understand ribosomal RNA targets for antibiotics in an effort to understand why antibiotics lose their effectiveness, ways to enhance the effectiveness of existing materials and possibly find new antibiotics with enhanced effectiveness or new modes of action. Also researchers are looking at the various potential uses of biofilms associated with bacterial masses, including the possibility of inactivating biofilms associated with disease causing organisms, making them susceptible to existing or new antibiotics or other antibacterial compounds. Geneticists are seeking to understand relationships between genetic makeups of animals and based on that, how environmental influences (chemicals, toxicants, food compounds) might influence cancer development. Outreach with partner and interested life sciences communities, the food and pharmaceutical industries and peer scientific communities provides new technologies and scientific information which may become the basis of startup or existing manufacturing companies.

### 2. Brief description of the target audience

- Peer researchers and collaborators, including health care providers
- Food processors and manufacturers
- Farmers and growers
- Consumers
- Allied technical service providers and consultants to growers, processors and marketers

### 3. How was eXtension used?

eXtension was not used in this program

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	218309	169730	0	0

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

**Patent Applications Submitted**

Year: 2014

Actual: 4

**Patents listed**

- 1) Title: Use of [6]-Shogaol metabolites in the treatment of cancer; Inventors: Shengmin Sang, Huadong Chen, Yingdong Zhu; Status: utility patent application filed 12/19/2013
- 2) Title: Use of Date Pulp in Fermentation Process to Produce Nutritional Supplement Inventor: Salam Ibrahim; Status: Provisional patent application filed 3/14/2014
- 3) Title: "Microfluidization of Cereal Brans and the Use Thereof in Foods" Inventors: Guibing Chen, Julia Raddatz and Tao Wang; Status: utility patent application filed 2/28/2014
- 4) Peptide Aptamers that Bind to the REP Proteins of ssDNA Viruses. 5051.726.IN2

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2014	Extension	Research	Total
<b>Actual</b>	26	134	160

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Non-degree credit group activities conducted related to human health, nutrition and well-being

Year	Actual
2014	3686

**Output #2**

**Output Measure**

- Targeted audiences participate in workshops and demonstrations on human health, nutrition and well-being

<b>Year</b>	<b>Actual</b>
2014	126126

**Output #3**

**Output Measure**

- Conduct research projects related to human health, nutrition and well-being

<b>Year</b>	<b>Actual</b>
2014	40

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Identify and develop new food constituents or compounds that can benefit human health or nutrition
2	Create new plant materials (germ plasm, breeding lines, cultivars) that contain health benefiting compounds
3	Research projects generate findings that impact the knowledge of and control of vectors that impact human health and safety
4	Research projects generate findings that impact the knowledge of prevention or curing of diseases influenced by interactions of genetics and the environment

## **Outcome #1**

### **1. Outcome Measures**

Identify and develop new food constituents or compounds that can benefit human health or nutrition

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Condition Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	2

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Grape pomace (GP), a residue of grapes from wine industry, has great potential to serve as an antioxidant and dietary-fiber-rich ingredient to improve the nutritional value of food products. However, the particle size of GP may influence its health benefits and applications.

#### **What has been done**

Pomaces of four cultivars of grapes grown in North Carolina were collected, dried and processed into powders with four different average particles sizes. NCA&T scientists then evaluated the effects of particle size on functional properties.

#### **Results**

This research showed that reducing particle size of GP mechanically can improve the accessibility of polyphenol, which may increase the bioavailability of GP polyphenols when GP-containing food products are consumed.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
206	Basic Plant Biology
502	New and Improved Food Products
701	Nutrient Composition of Food
724	Healthy Lifestyle

## **Outcome #2**

### **1. Outcome Measures**

Create new plant materials (germ plasm, breeding lines, cultivars) that contain health benefiting compounds

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Condition Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	0

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

In this era of diminishing returns for novel drug development and escalating costs for health care, plants and related natural products offer a 'final frontier' for new drug and health product discoveries. Plant-based medications (including functional foods) can offer safe, time-tested, efficacious alternatives to drugs, so that proactive consumers can take charge of health maintenance. Plant-derived bioactives, featuring multiple molecular modes of action, are far less likely to be overcome by a microbe's ability to build up immunity, and they can provide a broad-spectrum potency unavailable through synthetic drugs.

#### **What has been done**

Research taking place at NCSU's Plants for Human Health Institute is dedicated to discovery of the natural, health-protective constituents inherent in edible plants, determination of the mechanisms of action in the human body, and, subsequently, development of concentrated, efficacious, unprecedented, and cost effective functional food ingredients and phytopharmaceutical components. Recently, researchers engineered development of protein-phytoactive stable functional ingredients for use in fortified foods that require long shelf life and portability (e.g. sports, NASA, Army), and demonstrated that consumption of the ingredients improved physical performance, weight management, and endurance. In addition, routine intake improved immune response in athletes compromised after sustained physical exertion. In a parallel line of research, scientists have developed hypoallergenic peanut protein ingredients (complexed with phytoactives) which offer promise for oral immunotherapy, and potentially for processing hypoallergenic food products.

### Results

Preliminary outcomes have led to research partnerships with the U.S. Army and discussions with food companies with interest in adapting technology to consumer products, specifically for the performance athletics market, and for allergy concerns. Research leads particularly in the allergy arena are being pursued to address alternative protein allergies (milk, soy, egg). In the sports nutrition arena, the research thrusts have led to new partnerships with researchers at New Zealand company Plant & Food Research to combine forces to assess impacts on athletic performance.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
206	Basic Plant Biology
502	New and Improved Food Products

### Outcome #3

#### 1. Outcome Measures

Research projects generate findings that impact the knowledge of and control of vectors that impact human health and safety

#### 2. Associated Institution Types

- 1862 Extension
- 1862 Research
- 1890 Research

#### 3a. Outcome Type:

Change in Knowledge Outcome Measure

#### 3b. Quantitative Outcome

Year	Actual
2014	2

#### 3c. Qualitative Outcome or Impact Statement

##### Issue (Who cares and Why)

Poultry is the number one food animal product associated with cases of Campylobacteriosis in humans. Campylobacter infections in humans tend to be self-limiting but the medical costs and associated costs due to missed work, etc., are staggering. This issue is very important to the industry as carcasses contaminated with Campylobacter are a zoonotic threat to consumers.

**What has been done**

NCSU scientists have been collecting samples on farm and attempting to identify patterns for infection and antibiotic resistance. Their goal is to identify risk factors for introduction of Campylobacter onto a farm, then develop mitigating practices to reduce the risk.

**Results**

Researchers have gathered much information and have raised awareness to this as a potential food-borne pathogen for the growers/workers as well as the consumers. This work is ongoing.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
721	Insects and Other Pests Affecting Humans
722	Zoonotic Diseases and Parasites Affecting Humans

**Outcome #4**

**1. Outcome Measures**

Research projects generate findings that impact the knowledge of prevention or curing of diseases influenced by interactions of genetics and the environment

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	1

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Apoptosis, or controlled cell death, is dysfunctional in cancer cells, which leads to an accumulation of unwanted cells that are unable to die. Current chemotherapeutic agents used to treat various forms of cancer induce cell death by re-establishing apoptosis. A major disadvantage of the current therapeutic strategy is that tumorigenic cells build resistance to these drugs because the therapies target proteins that have early entry in the apoptotic program. Consequently, combined approaches are generally used to increase effectiveness. Even with combination therapy, an astounding one in four deaths in the U.S. are due to cancer, suggesting that alternative therapeutic strategies are required to decrease the mortality rate of this disease. Procaspase-3 is the terminal protein in the apoptotic cascade that, once activated, commits the

cell to undergo apoptosis. Currently there is no therapeutic strategy to directly activate procaspase-3 even though there is a large pool of inactive procaspase-3 in many cancer cells.

**What has been done**

Scientists at NCSU are studying the activation of caspases and other closely related proteins.

**Results**

By understanding how caspase-3 is formed and activated, it may be possible to design small molecules that activate it in cancer cells. Such compounds would represent new therapeutic methods for the treatment of cancer.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
722	Zoonotic Diseases and Parasites Affecting Humans
724	Healthy Lifestyle

**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**

Rapidly changing political, policy and economic conditions influence citizens' and businesses' abilities to adapt to change while ensuring healthful living and high quality life. Continued economic conditions affect federal, state and local support for research and extension programs, in some cases creating challenges to maintain productive and impactful programs. The regulatory environment often creates challenges for farmers, processors, handlers and food providers; often compliance is expensive and complicated, especially the required documentation. Nevertheless, successful operators develop strategies to comply to ensure that the food supply is safe and plentiful and the environment is protected. Emphasis will continue to be placed on those programs in research and extension that have the greatest effect on sustainability of citizens, families and businesses.

**V(I). Planned Program (Evaluation Studies)**

**Evaluation Results**

Data from our Extension Reporting System, faculty activity reports and impact statements, and Office of Technology Transfer were used to assess outcomes in this program area. Despite the challenges and influencers noted above, the data available indicate that this program is reaching suitable segments of the audience and that faculty are productive, when considering development of new technologies and publication records. We will continue to strive for a program that is relevant and productive for stakeholders and supports a creative and productive faculty.

### **Key Items of Evaluation**

Efforts will continue to discover and develop natural products and other technologies to enhance healthy living, reduce disease and enhance nutrition, including developing new plants from which compounds to enhance health might be derived. Our faculty and extension reporting efforts can be improved to capture more concrete impacts of this planned program area.