



National Center for Food Safety and Technology

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Nutrition – HPP Platform

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2009 PROJECT PROPOSALS

NUTRITION – HEALTH
PROMOTING FOODS PLATFORM

NEW (OR CONTINUING) PROJECT PROPOSAL (2009-2010)

Science Platform: Nutrition – Health Promoting Foods

Title: Processing on nutrition quality of foods

Project Leader(s): Indika Edirisinghe, Britt Burton-Freeman

New or Continuing: New **Start: July 2009** **End: December 2010**

Background and Justification:
Greater than 65% of deaths are due to poor dietary habits. Many attribute these poor habits to a food supply that is overly processed and dependent on fat, sugar and salt as the primary sensory-imparting ingredients (eg., flavour). As a result, an energy-rich, nutrient poor food supply exists and obesity, including the diseases it contributes (diabetes, vascular disease, cancer, etc.) continues to rise. While food processing provides a number of preservation advantages and increases food variety and availability across the U.S.; in no other time has it been more critical to (re)evaluate these benefits with respect to the effects of food processing on nutritive, health promoting endpoints. With this background, we propose establishment of a research program at NCFST to define processing issues on nutrition quality of foods and moreover, to provide data that can be used to drive improvement of current processing practices and or development of new technologies to deliver safe, health promoting foods widely to the general public. Initial studies will focus on thermal vs non-thermal treatment alternatives, such high pressure and determine whether processing strategies to reduce thermal degradation units impacts key nutrients and non-nutrient bioactive composition in model fruit and vegetable systems. Subsequent studies will evaluate impact of processing on sensory quality of model food system and bioavailability of key nutrients and bioactive compounds.

Project Objectives (and Milestones, with timeline, if a continuing project):

Milestones:

1. Establish nutrition studies laboratory and train personnel in methodology – 01/31/09
2. Obtain preliminary data on the processing effects of key essential and non-essential bioactive nutrients in a model fruit and vegetable system - 9/30/09
3. Obtain preliminary data on sensory quality and the bio-availability of target nutrients in humans after processing model fruit and vegetable preparation – 9/30/10
4. Determine bioavailability in humans (select 2 best processing options for pilot testing). – 2009-2010

Benefits to Stakeholders:
Establishment of nutrition program at NCFST will provide resources that are not widely available to stakeholders and will provide new opportunities for research project development.

NEW (OR CONTINUING) PROJECT PROPOSAL (2009-2010)

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| Science Platform: Nutrition – Health Promoting Foods | | |
| Title: Effect of processing on phenolic compounds in fruit. | | |
| Project Leader(s): Indika Edirisinghe, Britt Burton-Freeman | | |
| New or Continuing: Continuing | Start: November 2008 | End: December 2010 |
| Background and Justification: <p>Phenolic compounds are widely distributed throughout the plant kingdom and believed to modulate several biological processes related to disease risk in humans including oxidative stress, platelet function, inflammation, endothelial function, and cancer initiation and propagation. Fruits, vegetables, whole grains, seeds and nuts are natural vehicles of these compounds; however, foods and beverages derived from plants are chemically complex. They differ remarkably in content, composition and bioavailability of phenolic compounds as well as co-existing nutrient and non-nutrient components; many of which themselves impart benefit, or may impede the bioavailability or action of beneficial compounds. Additionally, most foods and beverages available widely to the general public today are processed, namely for purposes of food safety, but also for quality and multi-ingredient usage. Processing can have a range of effects on nutritive quality of foods and beverages; from destruction of compounds to enhancing their bioavailability. While there is considerable interest in the health promoting effects of phenolic compounds., there are multiple variables contributing to their potential benefit for the general public, of which processing may play an important role. Hence, understanding the <u>impact</u> of processing on foods that are natural suppliers of these nutrients is a target area for specific, public health relevant research to be conducted. The NCFST is well equipped in capability and expertise to address questions of chemical preservation and bioactivity related to processing. Therefore, we propose to develop a system for which the processing effects on essential (eg., vit C, folate) and non-essential bioactive compounds (eg., flavonoids) can be tested in foods for changes in nutrition quality composition and bioactivity. Initial studies will focus on a fruit system to serve as the model for testing thermal vs non-thermal treatment alternatives on target nutrient and non-nutrient bioactive content. Subsequent studies will evaluate impact of processing on bioactivity in an established in vitro and ex vivo method, and bioavailability in humans.</p> | | |
| Project Objectives (and Milestones, with timeline, if a continuing project): <i>Milestones:</i> <ol style="list-style-type: none">1. Perform thermal and high pressure processing (thermal alone, high pressure alone and thermal mild temperature + high pressure) to model system of fruit / berry puree and characterize the pre- and post- composition (qualitative and quantitative changes) of target compounds (ie., vit C, folate, anthocyanins, quercetin, etc.) - 2008-20092. Determine changes in stability /preservation of compounds in mixed ingredient formulation (eg. dairy base, carbonated water). - 2008-20093. Determine changes in antioxidant activity (eg., ORAC). – 2008-20094. Determine changes in bioactivity, as measured by activation/phosphorylation of eNOS in vitro in human endothelial cell model – 2009-20105. Determine bioavailability and activity in humans (select 2 best processing options for pilot testing). – 2009-2010 | | |
| Benefits to Stakeholders: <p>New information relative to processing effects on nutrition quality of fruit. Data to consider / support innovation in fruit processing and new opportunities for the commercialization of safe, fruit-based product(s)/ingredients.</p> | | |

NEW (OR CONTINUING) PROJECT PROPOSAL (2009-2010)

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| Science Platform: Nutrition – Health Promoting Foods | | |
| Title: Stability of Water Soluble Vitamins in Berry Juices and Purees Pasteurized by High Pressure Processing and Traditional Thermal Processing | | |
| Project Leader(s): Jack Cappozzo | | |
| New or Continuing: New | Start: June 1, 2009 | End: December 31, 2009 |
| Background and Justification: Water soluble vitamins, such as vitamin C and some of the B-vitamins (especially folic acid and thiamine) are labile during thermal processing. High Pressure Processing (HPP) offers a non-thermal approach to maintain nutrient quality and preserve the “fresh-like” qualities of processed fruits and vegetables. This project will examine HPP parameters on the stability of water soluble vitamins (vitamin C, folic acid and thiamine) in berry juices and purees. In addition, this project will assess the stability of these nutrients in fruit juices and purees during the shelf-life of these products. | | |
| Project Objectives (and Milestones, with timeline, if a continuing project): <i>Milestones:</i> <ol style="list-style-type: none">1. Establish Berry Matrix Materials for producing juices and puree and acquire baseline or control value on water soluble vitamins.2. Establish HPP and thermal processing parameters for juices and purees3. Produce Samples from HPP and thermal processing and determine values on water soluble vitamins.4. Measure Shelf life values for water soluble vitamins Evaluate Data and Report | | |
| Benefits to Stakeholders: This research will enable industry and government stakeholders to obtain data not available and understand the nutritional impact from a non-thermal pasteurization process. | | |

NEW (OR CONTINUING) PROJECT PROPOSAL (2009-2010)

Science Platform: Nutrition – Health Promoting Foods

Title: Define the mechanism of plant flavonoid on oxidative stress- and inflammatory-mediated insulin resistance *in-vitro* in human muscle and adipose tissues- A pre-clinical study to support future clinical studies.

Project Leader(s): Indika Edirisinghe, Britt Burton-Freeman

New or Continuing: New **Start: July 2009** **End: December 2010**

Background and Justification:
Insulin resistance (IR) is the hallmark feature of the metabolic syndrome and 70 to 80 million Americans will suffer from its consequences; overt diabetes and cardiovascular disease and eventually death. Even more recently, are reports linking systemic insulin resistance and impaired cognitive function, including associations with Alzheimer disease. We recently reported that consumption of a strawberry beverage compared to placebo beverage reduced markers of oxidative stress and inflammation and reduced the insulin requirement to achieve glucose homeostasis in response to a high fat meal in overweight men and women. These data suggest, but do not confirm that strawberries via their bioactive constituents contribute to improved insulin signaling and hence, may have an important role in reducing IR. Our hypothesis is that strawberry elicits its beneficial effect on insulin signalling through anti-oxidant mechanisms. Strawberries are rich in polyphenolic anti-oxidant compounds. Therefore, we propose that polyphenolic antioxidants derived from strawberry extract will restore impaired oxidative stress- and inflammatory-mediated insulin signalling resulting in increased insulin sensitivity and lower risk for chronic disease.

Project Objectives (and Milestones, with timeline, if a continuing project):

Milestones:

1. Establish human primary muscle and adipose cell culture systems and grow enough cells to carry out experiments– 10/01/09
2. Preparation of strawberry, tomato and grape extracts (freeze drying technology): Analyze their composition and ORAC values- 12/31/09
3. Treat cells with different extracts and identify the regulation of insulin downstream cell signalling pathways in the presence or absence of oxidative stress (pre-treat cells with oxidants such as H₂O₂) or/and inflammation (pre-treat cells with inflammatory inducers such as TNF- α). – 10/31/10
4. Analysing data and preparing reports and manuscripts. -12/31/10

Benefits to Stakeholders:
Establishment of pre-clinical experiments to support future clinical studies at NCFST will provide resources that are not widely available to stakeholders and will provide new opportunities for research project development.