



**FY 2016 Research Plan Narrative  
National Processed Raspberry Council  
For the period October 1, 2015 – September 30, 2016**

**Nutrition Research**

Dietary guidelines around the world recommend daily consumption of 5 to 9 servings of fruits and vegetables for the prevention and/or management of chronic illnesses like cardiovascular disease, cancer and neurological diseases. Raspberries, in addition to their attractive color and appealing flavor contain several essential phytochemicals and beneficial polyphenols that are believed to contribute to good health. They are considered a healthy food choice since they are low in total calories and fat, are high in dietary fiber, and are a good source of vitamin C, folate, potassium and magnesium

Rather than consuming extracts of individual components of foods, dietitians and other health professionals recommend that people eat whole foods because the complimentary and synergistic effects among their components far outweigh consuming individual nutrients or compounds.

While inflammation is the body's natural protective response to illness, stress and infection, inflammation can become harmful when the body's immune system malfunctions resulting in chronic inflammation. The general consensus is that chronic inflammation is at the root of chronic illness, and food with anti-inflammatory properties may play an important role in preventing and/or helping to manage a whole host of health issues. There is growing interest in dietary intervention to fight inflammation. A growing body of research suggests that raspberries, a rich source of bioactive polyphenols, have anti-inflammatory properties and may offer beneficial effects against inflammatory-related diseases.

Raspberries are a significant source of Vitamin C and other important health promoting bioactive compounds, including anthocyanins. They are a particularly rich source of cyanidin and are unique among the berries for their high ellagitannin content, which can be hydrolyzed to yield ellagic acid. Raspberries also deliver phytonutrients (individual compounds from plants found in fruits and vegetables). A growing body of research is investigating how some phytonutrients may offer protection against some cancers, heart disease, stroke, high blood pressure, cataracts, osteoporosis and other chronic health conditions.

The nutrition-dense profile of raspberries and the presence of beneficial phytochemicals that are absorbed by the human body influence several mechanisms that may affect health. For example, the low sugar and high fiber content of raspberries is consistent with nutritional profiles of foods that promote improved glucose response. Fiber helps reduce hunger and may lead to a feeling of satiety. Research suggests that moderate consumption of raspberries may help to prevent the development of early atherosclerosis and alleviate the symptoms of arthritis in animal studies.

The goal of NPRC funded research is to establish a link between raspberry consumption and health. Wellness communication programs will then use funded research results to raise public awareness about the health benefits of raspberries to ultimately increase demand for raspberries.

During Roundtable meetings with leading scientists and marketers following the Berry Health Benefits Symposium, a biennial conference of scientists from around the world conducting research on the health benefits of berries, a series of priorities for future research for raspberries were identified and subsequently adopted to guide solicitation of research proposals.

Those priorities are:

1. Diabetes prevention and management (including insulin resistance, beta cell function, glucose control, vascular diseases)
2. Metabolic Syndrome
3. Inflammation
4. Cardiovascular Health
5. Cognitive function/motor skills

During the next Raspberry Roundtable, scheduled for October 2015, these priorities will be reviewed.

### **Post-Harvest Research**

The Council has recognized post-harvest research could drive increased demand by delivering value added new products, product innovation, or enhanced microbial control utilizing cutting edge technology. The Council will consider proposals in these areas.

### **FY 2016 Research Budget: Total recommended: \$835,587.**

The FY 2016 research budget has three components:

1. Program management and services expenses. These annual administrative expense items are necessary to support research projects and related activities.
2. FY2016 Ongoing Multi-Year and New Research Projects. A Request for Proposal (RFP) was sent to scientists who have presented and/or attended the Berry Health Benefits Symposium. The proposed budget includes funds for new projects that result from the RFP and second year expenses of previously approved multi-year projects.

3. FY 2015 Research Projects. This budget represents the balance remaining on FY 2015 contracted expenses which have yet to be invoiced pending receipt of final reports.

**Program Management and Services: Total recommended: \$86,000.** Included is a portion of the Executive Director's time and expenses to complete activities that support funded research, Council travel to attend and participate in Council and committee meetings to discuss nutrition and post-harvest research, and an allocation of direct administrative expenses necessary to support research program functions (printing, phone, supplies, shipping/postage, memberships, subscriptions to professional journals, and legal services for contract review). A Science Advisor will assist the Executive Director and the Research Committee as it reviews and assesses the merits of current and potential future research projects, and to review marketing communications for scientific accuracy.

**FY 2016 Nutrition Research Projects (2<sup>nd</sup> Year of Ongoing Projects and New Project Funding): Total recommended: \$610,238.**

- a. **Meijin Zhu: Dietary Gut Microbiota: \$54,422.** Matching grant funds of \$120,598 over the two-years proposed to complete the study more than double funds available to support this project. The project will study the impact of whole fruit rather than an extract. Gut Microbiota and biological metabolites, rather than consumed compounds, are rapidly becoming recognized as the key to bioactivity. Creating a large body of science on biomechanisms will be critical to establishing any future health claim for raspberries. Recommended funds are for year two of a two-year study.
- b. **Neil Shay: Defining the Metabolic Benefits of Raspberries and Raspberry Compounds: \$75,000.** Shay's two-year project is designed to examine the ability of raspberries and specific raspberry compounds to influence a series of metabolic conditions of interest to the raspberry industry including diabetes, chronic inflammation, obesity, and cardiovascular health. Year two research will determine the biomechanisms of metabolic benefits from raspberry consumption. The proposal includes matching funds of approximately 2/3 of the funding request. Recommended funds are for year two of a two-year study.
- c. **Giuliana Noratto: Protective Effects of Raspberries Against Diabetes Through Modulation of Gut Microbiota: \$41,928.** Noratto's proposal calls for approximately \$25,000/year of matching funds, doubling resources available for this multi-year project. Recommended funds are for year two of a proposed three-year study. The objective of this project is to assess the health benefits of raspberry consumption as it pertains to diabetes, diabetes-induced metabolic disorders, inflammation, and cardiovascular risk factors. The moderation of Metabolic Syndrome through dietary change by improving gut microbiotic health could have a significant impact on overall health by lowering multiple risk factors.
- d. **Jack Losso: Molecular Mechanisms Underlying the Protective Effects of Red Raspberries Against Insulin Resistance: \$36,930.** This clinical project will establish the effects of whole red raspberry consumption on insulin sensitivity and inflammation, and provide data on how Type 2 diabetes patients respond to red raspberry intervention. The in vitro portion of the project will determine the molecular mechanisms

of cellular protection. Recommended funding is for year two of a proposed three-year study.

- e. **Britt Burton-Freeman: Red Raspberries and Insulin Action: \$78,255.** Burton-Burton-Freeman's clinical study will examine the relationship between red raspberries and oxidative inflammatory stress, and the relationship of these responses to insulin action and red raspberry consumption to reduce diabetes risk factors. Recommended funding is for year two of a two-year study.
- f. **Ara Kirakoysan: Cardioprotective Benefits of Red Raspberries: \$57,827.** Kirakoysan's proposal draws its hypothesis from Crozier's work on biomechanisms. Taking a holistic view of health, it addresses the moderation of metabolic syndrome to lessen the public health burden of heart disease by reducing cardiovascular risk factors of elevated cholesterol and insulin resistance. Recommended funding is for year two of a two-year study.
- g. **Ana Rodrigues-Mateos: Impact of raspberry Polyphenol Consumption on Vascular Function in Healthy Individuals: \$48,040.** A randomized, controlled crossover study will be conducted in order to investigate the effects of raspberry polyphenols in vascular function in healthy individuals. The findings emanating from the present proposal will contribute to understand the potential cardiovascular health benefits of raspberry polyphenols and provide necessary scientific data for future dietary recommendations.
- h. **Barbara Shukitt-Hale: The Effects of Raspberries on the Interaction Between Inflammation, Psychomotor, and Cognitive Behavior: \$62,750.** This study will explore the interaction between baseline motor performance and daily raspberry intake required to achieve improvement in motor function. Three hypotheses will be tested: 1) consumption of raspberry will improve and/or preserve motor function; 2) daily consumption of raspberry will preserve the motor function among good motor performers; 3) the degree of improvement in motor performance observed will correspond to a reduction in inflammation biomarkers.
- i. **Amanda Carey: Effects of Red Raspberry Supplementation on High Fat Diet-Associated Alterations in Behavior, Inflammation, and Brain Plasticity: \$35,890.** This project proposes to determine if dietary supplementation with red raspberry (*rubus idaeus*) can allay the cognitive dysfunction associated with consumption of a High Fat Diet.
- j. **Shanil Juma: Effect of Red Raspberry Juice on Range of Motion, Pain Symptoms, and Cartilage/Inflammatory Markers in Individuals with Symptomatic Knee Osteo-Arthritis: \$59,563.** Although there is a lack of agreement regarding the definition of Osteo-Arthritis (OA), it is generally viewed as a degenerative disorder involving cartilage degradation in aging. In addition to age, a number of other factors have been suggested as risk factors for the development of OA including: genetics, obesity, joint hypermobility, and trauma. An alarming number of both men and women are afflicted with this disorder, particularly knee OA. Given the limitations and side effects of established osteoarthritis medications, there is increased interest in complementary and alternative treatments. One such area that shows promise includes the exploration of bioactive components found in berries such as red raspberries. Raspberries are a rich

in polyphenolic compounds including anthocyanins and proanthocyanidins. These phenolic compounds have been shown to be potent inhibitor of the inflammatory process.

- k. Min Du: Browning of White Fat to Prevent Obesity and Metabolic Syndrome: Role of Raspberry Polyphenols: \$59,633.** The hypothesis of this project is that polyphenols and dietary fibers associated with raspberry ingestion increase circulatory polyphenols, which activate AMP-activated protein kinase (AMPK) and promote browning of white fat, eliciting strong hypoglycemic, hypolipidemic, and anti-obesity effects. The project will pursue two specific objectives: 1) Examine the impact of dietary raspberry on the browning of white fat, and 2) Explore the role of AMPK in mediating the beneficial effects of dietary raspberry. A whole fruit approach will be pursued so that data obtained will be directly applicable to the raspberry industry.

**Completion of projects funded in FY 2015: Total recommended: \$139,349.**

- a. Shanil Juma: Bone Protective Effect of Whole Red Raspberries in Postmenopausal Women: \$8,269.** Recommended funds are to complete this one-year study. The impact of diet, beyond foods high in calcium, is an emerging area of bone density research. Study results could compliment findings from previous studies on raspberries arthritic inflammation, bone and joint health.
- b. Chris Gill: Raspberry Consumption and Colonic Health: balance remaining: \$3,750.** Recommended funds are to complete this two-year study. This is a unique opportunity to investigate the impact of a raspberry diet on colonic micro-biota in samples that have been subject to human digestion rather than laboratory-simulated digestive processes, and determine potential protective effects.
- c. Daniele Del Rio: The Protective Effects of Raspberry Polyphenol Metabolites: \$10,000.** The recommended budget will complete a two-year study that will establish baseline bio-availability data. In addition to looking at raspberries and cardiovascular health, it will address neurodegeneration mechanisms.
- d. Meijin Zhu: Dietary Gut Microbiota: \$13,606.** Recommended funds are to complete the first year of a two-year study. Matching grant funds of \$120,598 over the two-years proposed more than double funds available to support this project. The project will study the impact of whole fruit rather than an extract. Gut Microbiota and biological metabolites, rather than consumed compounds, are rapidly becoming recognized as the key to bioactivity. Creating a large body of science on biomechanisms will be critical to establishing any future health claim for raspberries. Recommended funds are for year two of a two-year study.
- e. Neil Shay: Defining the Metabolic Benefits of Raspberries and Raspberry Compounds: \$18,750.** Shay's project is designed to examine the ability of raspberries and specific raspberry compounds to influence a series of metabolic conditions of interest to the raspberry industry including diabetes, chronic inflammation, obesity, and cardiovascular health. Recommended funds are to complete the first year of a two-year study.
- f. Giulianna Noratto: Protective Effects of Raspberries Against Diabetes Through Modulation of Gut Microbiota: \$9,839.** Noratto's proposal calls for approximately

\$25,000/year of matching funds, doubling resources available for this multi-year project. Recommended funds are to complete year one of a proposed three-year study. The objective of this project is to assess the health benefits of raspberry consumption as it pertains to diabetes, diabetes-induced metabolic disorders, inflammation, and cardiovascular risk factors. The moderation of Metabolic Syndrome through dietary change by improving gut microbiotic health could have a significant impact on overall health by lowering multiple risk factors.

- g. Arpita Basu: Postprandial Metabolism and Type 2 Diabetes: \$12,030.** Recommended funds are to complete year one of a proposed two-year study. This clinical study with human patients will address the role of raspberries in the dietary management of Type 2 diabetes and the effects of raspberries to modulate metabolic stresses contributing to vascular dysfunction and cardiovascular disease in diabetic patients.
- h. Jack Losso: Molecular Mechanisms Underlying the Protective Effects of Red Raspberries Against Insulin Resistance: \$24,742.** This clinical project will establish the effects of whole red raspberry consumption on insulin sensitivity and inflammation, and provide data on how Type 2 diabetes patients respond to red raspberry intervention. The in vitro portion of the project will determine the molecular mechanisms of cellular protection. Recommended funding is to complete year one of a proposed three-year study.
- i. Britt Burton-Freeman: Red Raspberries and Insulin Action: \$19,564.** Burton-Burton-Freeman's clinical study will examine the relationship between red raspberries and oxidative inflammatory stress, and the relationship of these responses to insulin action and red raspberry consumption to reduce diabetes risk factors. Recommended funding is to complete year one of a proposed two-year study.
- j. Ara Kirakoysan: Cardioprotective Benefits of Red Raspberries: \$14,359.** Kirakoysan's proposal draws its hypothesis from Crozier's work on biomechanisms. Taking a holistic view of health, it addresses the moderation of metabolic syndrome to lessen the public health burden of heart disease by reducing cardiovascular risk factors of elevated cholesterol and insulin resistance. Recommended funding is to complete year one of a proposed two-year study.
- k. Shyam Sablani: Ultraviolet Light (UV-C) Treatment for Improving Safety of Red Raspberries: \$4,440.** Recommended funds are to complete the second year of a two-year project to investigate the efficiency of ultraviolet light to inactivate foodborne pathogens and its effect on berry quality.