FOODS FOR HEALTH
Seed Grant Awards

The Foods for Health Seed Grant Competition is a university-wide initiative with a primary goal of advancing transdisciplinary collaboration and scientific approaches integrating foods and nutrition, metabolomics, and health. Ten multidisciplinary teams, representing fourteen departments and units across five colleges, were awarded a total of $250,000 in 2016-17.

Autumn 2016 Awards

Untargeted and targeted metabolomics approaches to determine hepatic anti-inflammatory activities of green tea in nonalcoholic steatohepatitis

PI: Richard Bruno, Professor, Department of Human Sciences
Co-PIs: Rachel Kopec, Assistant Professor, Human Nutrition; Ken Riedl, Acting Director, Nutrient & Phytochemical Analytic Shared Resource, CFAES/CCC; Morgan Cichon, Research Scientist, Discovery Themes, OAA

Nonalcoholic steatohepatitis (NASH) is the most prevalent liver disorder in the U.S., lacking any management strategies other than lifestyle modifications at this time. Green tea contains anti-inflammatory polyphenolic catechins that are efficacious for treating NASH in laboratory animal models. The objective of this project is to use untargeted and targeted metabolomics-based approaches to identify changes in global metabolic profiles and specific catechin metabolites responsible for decreasing TLR4/NFκB-mediated liver injury in experimental models of NASH in mice consuming diets with green tea extract. The outcomes are expected to further define the anti-inflammatory mechanism of green tea catechins and to provide foundational support for translational studies in humans for effectively managing NASH.

Metabolomics discovery to identify determinants of adipose tissue inflammation in obesity

PI: Willa Hsueh MD, Professor, Division of Endocrinology, Diabetes, and Metabolism, Department of Internal Medicine, Director, Diabetes and Metabolism Research Center
Co-PIs: Arpad Somogyi, Associate Director of CCIC Mass Spec and Proteomics Office of Research Campus Chemical Instrumentation Center (CCIC); Vicki Wysocki, Professor, Department of Chemistry and Biochemistry, Director of CCIC Mass Spec and Proteomics

Adipocytes within the visceral and subcutaneous adipose tissue are the primary site of fat storage in the body and have capabilities to act as immune cells with both adaptive and innate functions. Our goal is to determine the impact that weight gain has on the adipocyte

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lipid metabolome and insulin sensitivity. High fat diets increase the amounts of pro-inflammatory ceramides, diacylglycerides, fatty acids and phosphatidylcholines and decrease phosphatidylethanolamines and sphingomyelin in adipocytes. Further adipocyte metabolite profiling will provide new insights about the inflammatory milieu of adipose tissue and antigens being presented to the immune system during obesity.

Effects of dietary sphingomyelin on neonatal piglet intestinal health and membrane composition

**PI:** Sheila Jacobi, Assistant Professor, Department of Animal Sciences, OARDC

**Co-PIs:** Rafael Jimenez-Flores, Professor, Department of Food Science & Technology; Morgan Cichon, Research Scientist, Discovery Themes, OAA

Nutritional support of gastrointestinal growth and development is a significant component of neonatal development. The high worldwide prevalence of enteric diseases and dysfunction has led to much interest in understanding the role of dietary nutrients in the establishment and maintenance of a functioning gastrointestinal tract. Piglet models of intestinal development and function serve as an agri-medical model for the developing piglets and human infants. This project will compare the effects of dietary sphingomyelin, when delivered in the milk fat globule membrane versus a soy-based diet, on intestinal and plasma lipid profiles to identify how bioactive nutrients modulate lipid transport in the gut and blood.

The impact of metabolic syndrome on fat soluble vitamin uptake

**PI:** Rachel Kopec, Assistant Professor, Department of Human Sciences

**Co-PI:** Richard Bruno, Professor, Department of Human Sciences

The mechanisms by which obesity reduces plasma levels of essential fat-soluble vitamins (A, E, D and K) is unknown. Using metabolomics profiling, we expect to elucidate the mechanisms of intestinal absorption that differentially and/or similarly affect a variety of dietary fat-soluble compounds in human subjects diagnosed with metabolic syndrome compared to age- and gender-matched healthy adults.

Metabolome-based genome-wide association study of innate immunity in rice

**PI:** Guo-Liang Wang, Professor, Department of Plant Pathology

**Co-PI:** Joshua Blakeslee, Assistant Professor, Department of Horticulture and Crop Science, OARDC

A multitude of pathogens lead to significant losses in the yield of rice, a staple food for more than half of the world population. Rice blast is caused by the fungus *Magnaporthe oryzae*, and is a serious disease that has a particularly devastating impact on yield. Although various methods have been developed to control rice blast, none are more effective, economical, or environmentally friendly than host-mediated resistance to the pathogen. The functions of host metabolites that are produced in response to the infection of this fungal pathogen have not been unraveled. We are using a metabolome-based genome-wide association study (mGWAS) to identify key metabolites associated with “pathogen resistance” and associated genes. These results are expected to provide new biomarkers that will be useful for efforts to breed resistance to rice blast.

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Impacts of Salmonella infection on the chemical and biological landscape of the gut

**PI:** Brian Ahmer, Department of Microbial Infection and Immunity, College of Medicine  
**Co-PIs:** Vicki Wysocki, Department of Chemistry and Biochemistry; Kelly Wrighton, Department of Microbiology, College of Arts and Sciences

*Salmonella* is the leading cause of death from food-borne illness in the U.S., with little known about its impact on the gut. Recently, we found *Salmonella* induced inflammation, drastically altered the gut landscape, and increased the abundance of *Lactobacillus* and *Proteobacteria*. We seek a high-resolution understanding of the genetic mechanisms and chemical factors that allow *Salmonella* to rapidly proliferate in the inflamed gut using metatranscriptomics, a quorum sensing reporter assay, and mass-spectrometry to characterize the global metabolite pool. These approaches are expected to result in the development of new therapeutic strategies with broader ramifications to other gastrointestinal diseases, including ulcerative colitis, Crohn’s disease and colon cancer.

Metabolomic and Transcriptional Responses to Diets Containing Red or Tangerine Tomatoes

**PI:** David Francis, Department of Horticulture and Crop Sciences, CFAES  
**Co-PIs:** Steven Clinton, Internal Medicine, Medical Oncology; Jessica Cooperstone, Food Science & Technology, College of Food, Agricultural and Environmental Sciences

Tomato consumption is associated with many health benefits. After consumption, tomato carotenoids and their metabolites accumulate in the liver, where they are hypothesized to protect against diseases by altering gene expression. It is unknown how consumed tomatoes alter the chemical profile and cellular processes in the mammalian liver. Our objectives are as follows: 1) define how carotenoids, apo-carotenoids, and the metabolomic signatures of mouse livers are altered by tomato consumption; 2) determine how tomato consumption alters liver gene expression signatures; and 3) integrate metabolomic and transcriptomic data using a systems biology approach. The results will guide future nutritional interventions using tomatoes to prevent disease.

The Effects of Dietary Modification on the Brain Lipidome after Chemotherapy

**PI:** Tonya Orchard, Human Nutrition, College of Education and Human Ecology  
**Co-PIs:** Rachel Kopec, Human Nutrition, College of Education and Human Ecology, Courtney DeVries, Neuroscience, College of Medicine

Breast cancer chemotherapy produces long-lasting cognitive side effects, with no effective treatment available at this time. We have shown that chemotherapy increases brain inflammation and diminishes the capacity of neurons in the brain to communicate, that omega-3 fatty acids (n3-FAs) diminish these adverse alterations, and that dietary sucrose exacerbates the damaging effects. Targeted metabolomic analyses will be used to study the resolution of inflammation in the brain of mice administered chemotherapeutic agents and fed n3-FAs. In addition, the
profiles of lipid metabolites in the brains of mice fed a diet with high sucrose either with or without n3-FA, in the presence of chemotherapy, will be determined. The results are expected to generate new hypotheses regarding the basis for sucrose-mediated antagonism of the protective effects of n3-FAs on brain chemistry during chemotherapy.

Using targeted and broad-spectrum metabolomics to identify metabolism-based changes leading to decreased meat quality in fast growing turkeys

**PI:** Sandra Velleman, Department of Animal Sciences  
**Co-PIs:** Daniel Clark, Department of Animal Sciences, Joshua Blakeslee, Horticulture and Crop Science, Manager of OARDC Metabolite Analysis Cluster

Consumer demand for high-quality, lean animal protein, places a significant demand on poultry producers to improve turkey performance resulting in a significant emphasis on increasing turkey growth rate at the expense of meat quality. Our goal is to use a combination of targeted and broad-spectrum metabolomics to determine how selection for increased growth alters muscle metabolism. Results will be used to leverage both industry and federal funds to determine how changes in metabolism are associated with muscle growth and meat quality in order to develop management strategies that will improve meat quality without sacrificing meat yield.

Functional Foods and Oral Cancer Prevention: Hybrid NMR-MS Metabolic Signature of Experimental Oral Carcinogenesis and Black Raspberry Chemoprevention

**PI:** Christopher Weghorst, Environmental Health Sciences, College of Public Health  
**Co-PIs:** Thomas Knobloch, Environmental Health Sciences, College of Public Health; Steve Oghumu, Environmental Health Sciences, College of Public Health; Rafael Brüschweiler, Biological Chemistry and Pharmacology, College of Medicine, Chemistry and Biochemistry, College of Arts and Sciences, Office of Research, Campus Chemical Instrumentation Center (NMR) ; Arpad Somogyi, Office of Research, Campus Chemical Instrumentation Center (Mass Spec and Proteomics)

Oral cancer will account for 49,670 new cases and 9,700 deaths in the US in 2017. The costs associated with disease are estimated to exceed $54 billion and oral cancer remains in the top 10 most common cancers worldwide. We have demonstrated that black raspberries (BRB) prevent cancers in the oral cavity, esophagus, and colon as consumption modifies markers of chronic inflammation and abnormal cell growth. Using NMR- and MS-based methodologies, we will identify key metabolites involved in BRB-mediated oral cancer chemoprevention to identify potential mechanisms by which BRBs inhibits oral cancer.

Learn how FFH is integrating food, nutrition, and metabolomics for health at discovery.osu.edu/ffh