UNDERSTANDING BIOACTIVE DIETARY CHEMICALS

The foods and drinks we consume contain natural chemicals (vitamins, minerals, fat, sugar, protein, flavonoids, toxicants, hormones, and more) that can positively or negatively impact human health.

Since 1971, a multistate project has brought together researchers at 22 land-grant universities to conduct cutting-edge research on the effects of dietary bioactive chemicals on human health, chronic diseases, and food safety.

To better understand bioactive dietary chemicals, researchers are investigating exposure levels, doses, factors influencing absorption and metabolism, synergistic effects with other compounds, and transgenerational effects.

Understanding bioactive dietary chemicals is important for scientists, farmers, food processors, healthcare professionals, and policymakers charged with determining optimal human nutrition requirements, maintaining the safety of the food supply, and preventing and treating chronic disease.

The multistate project structure provides many advantages.

- Collaboration allows members to share research facilities, tools, and other resources and limits unnecessary duplication of research efforts.
- With researchers in multiple states, this project can study populations with different dietary patterns and share findings widely.
- Diverse expertise in microbiology, nutritional epidemiology, cancer research, big data, biocomputing, and more allows the team to investigate the complex role of dietary bioactive chemicals from various angles to get a more complete picture.
- As faculty at land-grant universities, project members can share their expertise with students.

This project is supported in part by the Hatch Multistate Research Fund through the USDA National Institute of Food and Agriculture and by grants to project members at participating institutions: University of Arizona, University of California-Berkeley, University of California-Davis, Colorado State University, University of Connecticut, University of Guam, University of Hawaii, University of Illinois, Michigan State University, University of Minnesota, University of Nebraska, University of Nevada, New Mexico State University, Ohio State University, Oregon State University, Purdue University, Rutgers University, University of Tennessee, Utah State University, University of Vermont, Washington State University, University of Wisconsin.
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The Multistate Research Fund Impacts Program communicates the importance and value of Hatch Multistate research projects.
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Multistate Research Fund
IMPACTS

RESEARCH HIGHLIGHTS

Researchers discovered bioactive chemicals and determined their effects on human health. Studies shed light on mechanisms involved in bioactivity and determined how agricultural practices and processing techniques affect bioactivity. For example, researchers:

Characterized specific bacteria taxa and metabolites consumed in foods and beverages that reduce the prevalence of obesity and type 2 diabetes. *California*

Completed several human clinical trials that linked intake of probiotic supplements to improvements in gut health, immune parameters, inflammation, and vascular function in humans. *Colorado*

Identified a placental enzyme that could be targeted through dietary interventions to protect fetuses from maternal high-fat diets. *Colorado*

Determined that crickets (which are growing in popularity as a sustainable food source) provide prebiotic and anti-inflammatory effects and a good source of iron when consumed. *Colorado*

Showed that consuming CBD reduces inflammation, but bioactivity varies with different preparations. *Colorado*

Provided epidemiological evidence that drinking high amounts of citrus juices increases risk of skin cancer. *Connecticut*

Found that indigenous mango leaves can be processed into a functional food, such as herbal tea, that has anti-diabetic activity. *Guam*

Showed that polyphenols from native cacao and bitter melon may protect against diabetes. *Hawaii*

Showed that reusing frying oils multiple times creates byproducts that exacerbate the development of lung and breast cancer. *Illinois*

Developed a diet that optimizes protein to reduce colon inflammation and colon cancer risk according to a preclinical animal model. *Illinois*

Demonstrated that certain polyphenolic compounds in dried plums have significant impacts on inflammation and tumor formation. *Michigan*, *Texas*

Suggested that an omega-3 fatty acid supplement (DHA) can reduce the risk of or delay progression of lupus. *Michigan*

Used bioactive peptides from dry beans to develop diet-based ways to treat hypertension and other cardiovascular diseases. *Nebraska*

Provided the first demonstration that diets high in sulfur (such as diets high in processed meats and low in vegetables and legumes) are associated with development of colorectal cancer. *Nebraska*

Showed that a compound in hops reduces obesity induced by high-fat diets in rodents, and its effects on the liver and hippocampus could help reverse obesity-related neurocognitive decline. *Oregon*

Performed the first human studies on the bioactivity of benzo[a]pyrene, which is carcinogenic and found in almost all food. *Oregon, Lawrence Livermore National Laboratory, Pacific Northwest National Laboratory*

Discovered that bacteria growth in the human intestine depends on the type of carbohydrate fuel they receive, which has important implications for probiotics and prebiotics. *Indiana*

Found that red raspberry ketones have anti-obesity effects in mice. N*ew Jersey*

Found that black raspberries may be a useful prebiotic or probiotic for suppressing gut inflammation. *Utah*

Showed that cooking reduces the ability of some types of sorghum bran to protect against cancer. *Michigan*

Identified a genetic marker for the allele that makes wild turkeys resistant to aflatoxin in feed, which will help breed resistant domestic turkeys and save the industry millions of dollars each year. *Tennessee*, *Utah*

Showed how dietary iron absorption is controlled, which will guide ways to combat anemia in livestock and humans. *Wisconsin*

Discovered gene-diet interactions that govern the influence of dietary fats on heart disease risk. *Colorado*

Showed that the adverse impacts of the Western diet can be passed down to offspring through epigenetic mechanisms. *Utah*

Showed that grape pomace could be added to extruded foods to enhance nutritional value without negatively affecting quality. *Washington*

This project developed research tools, techniques, and models that will enable future discoveries. For example, members:

Developed a non-invasive method for monitoring metabolism in egg cells and embryos. *Colorado*

Identified metabolomic signatures that more precisely indicate high and low fruit and vegetable intake compared to self-reporting. *Colorado*

Developed methods to discover unreported metabolic events in diverse biological samples, including urine, blood, other biofluids, and tissue samples. *Minnesota*

Created a standardized tool to evaluate the impact of food compounds on human digestion and health. *Nebraska*

This project developed workshops, courses, and tools to educate students and scientists about bioactive chemicals. For example, project members:

Created 3D-printed models of the human microbiome as a tool for K-12 and college courses. *Nebraska*

Created the Southwest Agriculture and Food Security Education project, in which students complete e-learning courses related to food security, food safety, and agro-terrorism and gain certifications offered by the Department of Homeland Security and the Federal Emergency Management Agency.

Participated in the 2021 Ag and Health Summit, a first-of-its-kind event that brought together plant breeders, nutritionists, and microbiome scientists to understand how to improve crop development and productivity in ways that benefit human health. *Nebraska*

Worked with the Universidad Autonoma de Chihuahua in Mexico to organize and participate in an international food research workshop session that attracted 86 attendees and stimulated international research collaboration. *Indiana, Nebraska, New Mexico, Ohio, Oregon, Minnesota*

IMPACTS

Discovering and understanding bioactive chemicals provides new opportunities for disease prevention and treatment. Findings have led to more accurate nutrition labels and dietary guidelines, including recommended daily amounts. This research has made it easier to provide individualized dietary recommendations based on a person's genetics, microbiome, and other factors.

By determining acceptable levels of exposure to specific bioactive compounds, this project has illuminated ways to improve the safety of our food supply. Findings have also pinpointed ways that food can be grown or processed to mitigate safety risks or improve health benefits.