ADVANCING HUMAN NUTRITION RESEARCH

The ARS Human Nutrition research program enhances the quality of the U.S. diet and improves health through research. Principal components of the Human Nutrition research program include linking agricultural practices and beneficial health outcomes; monitoring food composition and nutrient intake; ensuring the scientific basis for dietary guidance; prevention of obesity and obesity-related diseases; and life-stage nutrition and metabolism (understanding how nutrition promotes health from conception to old age). This research is conducted by 165 scientists who are either employed directly by ARS or by universities. The following accomplishments highlight ARS advances human nutrition research in 2021.

Lean beef in a Mediterranean diet pattern reduces heart disease risk. Eating red meat has a reputation for being bad for the heart, but when consumed as part of a healthy diet, it might reduce heart disease risk factors such as bad cholesterol. ARS researchers in Beltsville, Maryland, and Pennsylvania State University colleagues conducted a dietary intervention study to determine how much lean beef can be included in a Mediterranean diet pattern to promote heart health. Volunteers daily consumed either 0.5, 2.5, or 5.5 ounces of lean beef as part of a healthy Mediterranean diet pattern or 2.5 ounces as part of a typical American diet. The researchers determined that a Mediterranean diet pattern that included lean beef consumption at all three levels reduced bad cholesterol and other risk factors for heart disease. While the traditional Mediterranean diet is low in lean beef, this study demonstrates how people can incorporate lean beef into a healthy diet and benefit further from beef's other key nutrients.

> **The ARS program in human nutrition focuses on food-based strategies to ensure the nutritional health of all Americans. Research is primarily carried out at six Human Nutrition Research Centers that conduct carefully controlled human studies and support animal/biochemical studies.**

Adolescents with prediabetes or type 2 diabetes have impaired metabolic flexibility. Metabolic flexibility refers to the ability to utilize different nutrients (fats and sugars) and to transition between them while fasting and after a meal. Impaired metabolic flexibility can lead to metabolic disease, but it is not clear whether metabolic flexibility is impaired in obese youth. ARS-funded researchers in Houston, Texas, found that adolescents with prediabetes and type 2 diabetes have a defect in metabolic flexibility and are not able to change fuel use as easily as normal weight individuals or obese individuals who maintain normal sugar levels. The impairment results from severe insulin resistance that in turn impairs the appropriate use of available fuels. These results highlight the need for additional studies to investigate how changes in diet or physical activity could improve how the body utilizes these nutrients and help mitigate the risk of type 2 diabetes.

Carbohydrates and fat intake influence the risk of metabolic diseases. It is not clear how the cellular process methylation controls genes associated with the risk of metabolic diseases such as obesity, type 2 diabetes, high blood pressure, hypertension, and abnormal lipids. ARS-funded researchers in Boston, Massachusetts, enrolled 3,954 Hispanic, Black, and White volunteers in a study to assess if carbohydrate and fat intakes influenced methylation and the risk of metabolic diseases. For each group, and in a combination of the three groups, the analyses demonstrated strong associations of a specific methylation marker with metabolic characteristics such as body mass index, triglyceride, glucose, and hypertension. The results demonstrated carbohydrate intake induces a specific methylation site that reduces the risk of

To download this two-pager, please visit https://go.usa.gov/xS9xz

the metabolic diseases in the study, but that fat intake inhibits a specific methylation site and increases the risk of these metabolic diseases. These findings identify how balancing carbohydrate and fat intake can affect metabolic disease risks that currently affect millions of Americans.

Vitamin A (VA) supplementation improves immune function in Bangladeshi infants. Vitamin A (VA) protects against respiratory and intestinal infections, but the protective mechanism is not fully known. In animals, VA increases a protein that allows immune cells to migrate to the intestinal mucosal immune sites where they protect against pathogenic microorganisms. However, this has not been shown in humans. ARS researchers in Davis, California, and International Centre for Diarrhoeal Disease Research colleagues in Bangladesh conducted a trial of VA supplementation in 306 Bangladeshi newborns and found that VA increased expression of this protein by T regulatory (Treg) cells in early infancy. Treg cells play a central role in regulating immunity at mucosal surfaces. These results suggest that VA supplementation during infancy prompts an increased expression of this specific protein, which in turn reduces the risk of death from common childhood infections in populations at risk of VA deficiency.

Ausmus, Stephen. Registered dietitian and president-elect of the Maryland Dietetic Association Jessica Kiel (left) encourages shoppers to use the U.S. Department of Agriculture's (USDA) ChooseMyPlate.gov interactive tools, which use USDA Agricultural Research Service (ARS) national nutrient data to make better, healthier food choices on Dec. 28, 2011. USDA photo. https://flic.kr/p/dQok5p.