USDA Nutrition Research:

*Food-based approaches to promoting nutritional & public health and decreasing chronic disease*

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DEPUTY ADMINISTRATOR

NUTRITION FOOD, SAFETY, AND PRODUCT QUALITY & NEW USES OF AG PRODUCTS
Human Nutrition NP107 2019-2024 Action Plan

1. Linking Agricultural Practices and Beneficial Health Outcomes

2. Monitoring Food Composition and Nutrient Intake of the Nation

3. Scientific Basis for Dietary Guidance

4. Prevention of Obesity and Obesity-Related Diseases

5. Life Stage Nutrition and Metabolism
USDA Human Nutrition Research Centers and Locations

- Western Human Nutrition Research Center
- Children’s Human Nutrition Research Center
- Arkansas Children’s Nutrition Center
- College Station, TX, Precision nutrition and responsive agriculture NEW
- Stoneville, - 1 scientist
- Burlington, VT Food systems for New England - NEW
- Jean Mayer Human Nutrition Research Center on Aging
- Beltsville Human Nutrition Research Center
- Grand Forks Human Nutrition Research Center
Food-based nutrition – impact on human health

Physiology/metabolism/genetics
- Physical activity
- Genetics
- Epigenetics
- Immunity
- Inflammation
- Microbiome

Dietary patterns
- Dietary Guidance
- Food Choice Drivers
- Dietary Surveillance

Food composition
- Food composition
- Ag/food industry impacts

The ARS Nutrition Scientific Program
New ‘Food Systems’ projects:

Burlington, VT
- Joint with the University of Vermont
- Diverse research team to include nutrition, environmental, animal, agronomic, food safety and social scientists

College Station, TX
- Joint with the Institute for Advancing Health Through Agriculture (IHA), Texas A&M University
- Focus on precision nutrition and responsive agriculture
- Emphasis on big data and big ag approaches
Food Composition: The New Approach

One-stop shopping
DIETARY PATTERNS

Dietary patterns

Dietary Guidance

Dietary Surveillance

Food Choice Drivers
Nutrition Surveillance

National survey data used for ....

- Federal Food Programs
- Dietary Guidelines for Americans
- Dietary Reference Intakes
- Healthy People 2020
- Food Labeling and Fortification
- Food Safety and Risk Assessment

...and much more
Factors affecting food choice

The relative reinforcing value of sweet versus savory snack foods after consumption of sugar- or non-nutritive sweetened beverages  Grand Forks, ND 2017

Perspectives on Barriers to Eating Healthy Among Food Pantry Clients  Houston, TX Health Equity  2017


Diet Quality for Sodium and Vegetables Mediate Effects of Whole Food Diets on 8-Week Changes in Stress Load  Davis, CA Nutrients 2018

Increasing dietary carbohydrate as part of a healthy whole food diet intervention dampens eight-week changes in salivary cortisol and cortisol responsiveness  Davis, CA Nutrients 2019

Authoritative parent feeding style is associated with better child dietary quality at dinner among low-income minority families  Houston, TX. Am. J. Clin. Nutr. 2018

**A Randomized Controlled-Feeding Trial Based on the Dietary Guidelines for Americans on Cardiometabolic Health Indexes.** Davis, CA. Am. J. Clin. Nutr., 2018


**Effect of varying quantities of lean beef as part of a Mediterranean-style dietary pattern on lipids and lipoproteins: a randomized crossover controlled feeding trial** Beltsville, MD. Am. J. Clin. Nutr. 2021
Physiology, Metabolism, Genetics

- Microbes (Numbers and Types)
- Food Components and Energy
- Microbial Metabolite(s)
- Disease Risk

Diagram:
- Microbes (Numbers and Types) connected to Food Components and Energy bidirectionally.
- Microbial Metabolite(s) connected to Disease Risk.
- Food Components and Energy connected to Disease Risk.
- Disease Risk connected to Microbial Metabolite(s).

Additional Connections:
- Microbes (Numbers and Types) connected to Food Components and Energy.
- Food Components and Energy connected to Disease Risk.

Topics:
- Microbes
- Food Components and Energy
- Microbial Metabolite(s)
- Disease Risk
- Microbes (Numbers and Types)
- Food Components and Energy
- Microbial Metabolite(s)
- Disease Risk

- Microbes (Numbers and Types)
- Food Components and Energy
- Microbial Metabolite(s)
- Disease Risk
Bi-Directional Relationship between diet and microbiome:

*Dietary Vitamin K is Remodeled by Gut Microbiota and Influences Community Composition.*
Boston, MA. Gut Microbes, 2021

Microbiome influences the response to dietary components:

5-(*Hydroxyphenyl*)-γ-Valerolactone-Sulfate, a Key Microbial Metabolite of Flavan-3-ols, Is Able to Reach the Brain: Evidence from Different in Silico, In Vitro and In Vivo Experimental Models Beltsville, MD. Nutrients, 2019

Dietary Modulation of the Microbiome


Translational Study

*Maternal High-Fat Diet Programs Offspring Liver Steatosis in a Sexually Dimorphic Manner in Association with Changes in Gut Microbial Ecology in Mice.* Little Rock, AR. Sci. Reports, 2018

Dietary Modulation of the Microbiome and Health:

*Walnut Consumption Alters the Gastrointestinal Microbiota, Microbially Derived Secondary Bile Acids, and Health Markers in Healthy Adults: A Randomized Controlled Trial* Beltsville, MD. J. Nutrition 2019
Epigenomics and metabolomics reveal the mechanism of the APOA2-saturated fat intake interaction affecting obesity  

Bitter, Sweet, Salty, Sour and Umami Taste Perception Decreases with Age: Sex-Specific Analysis, Modulation by Genetic Variants and Taste-Preference Associations in 18 to 80 Year-Old Subjects  
Boston, MA. Nutrients 2018

A genomic atlas of systemic interindividual epigenetic variation in humans  
Houston, TX. Genome Biology 2019
Obesity

Asprosin is a Centrally Acting Orexigenic Hormone. Houston, TX. Nature Medicine, 2017.


Efficacy of a Community- Versus Primary Care–Centered Program for Childhood Obesity: TX CORD RCT Houston, TX. Pediatric Obesity, 2017
Immunity/Inflammation


Lack of Differences in Inflammation and T-Cell Mediated Function Between Young and Older Women With Obesity. Boston, MA. Nutrients, 2020


EPA and DHA Differentially Modulate Monocyte Inflammatory Response in Subjects with Chronic Inflammation in Part via Plasma Specialized Pro-Resolving Lipid Mediators: A randomized, Double-Blind, Crossover Study Boston, MA. Atherosclerosis, 2021
Elderly Function/Healthy Aging

Avocado Consumption Increases Macular Pigment Density in Older Adults: A Randomized Controlled Trial. Boston, MA. Nutrients, 2017

Nutrients and Bioactives in Green Leafy Vegetables and Cognitive Decline. Boston, MA. Neurology, 2018


Involvement of a Gut–Retina Axis in Protection Against Dietary Glycemia-Induced Age-Related Macular Degeneration. Boston, MA. PNAS, 2017
Diabetes


Blackberry Feeding Increases Fat Oxidation and Improves Insulin Sensitivity in Overweight and Obese Males. Beltsville, MD. Nutrients, 2018

Vitamin D Supplementation and Prevention of Type 2 Diabetes. Boston, MA. New Eng. J. Med., 2019

Intratrial Exposure to Vitamin D and New-Onset Diabetes Among Adults With Prediabetes: A Secondary Analysis From the Vitamin D and Type 2 Diabetes (D2d) Study. Boston, MA. Diabetes Care, 2020

An Anthocyanin-Rich Mixed-Berry Intervention May Improve Insulin Sensitivity in a Randomized Trial of Overweight and Obese Adults. Beltsville, MD. 2019 Nutrients
Cardiovascular Disease

High Levels of Avenanthramides in Oat-Based Diet Further Suppress High Fat Diet-Induced Atherosclerosis in Ldlr\(^{-/-}\) Mice. Boston, MA. J. Agric. Food Chem., 2018


Innovation to Create a Healthy and Sustainable Food System: A Science Advisory From the American Heart Association. Boston, MA. Circulation. 2019
Food and Nutrition Research partnering

- Other ARS Program: Food Production, Processing Safety
- Other USDA Agencies: NIFA, ERS, FNS
- Other Departments: working through the ICHNR with other departments & Agencies
- Academic Institutions
- Public-Private partnerships
The Promise of Health Through Agriculture

Patrick J. Stover, Ph.D.
Professor and Director
Men in tanks must eat quickly and well

Food should be:
- Abundant
- Affordable
- Accessible
- Hunger
- Food Insecurity
New Imperatives: Agriculture and Food Systems

Historical Expectations

- Produce
  - Food
  - Fiber
  - Fuel

New Expectations

- Nourish and Sustain
  - Food for life-long health
  - Protect and sustain our environment
  - Ensure agriculture is economically viable
The U.S. loses about 175 acres of farmland every hour, mostly due to the expansion of urban and suburban areas.

American Farmland Trust

### Greatest Challenges of Our Time: Population Growth and Food/Nutrition

#### Worldwide:

- **2019**: 690 million malnourished people
- **2030**: 840 million malnourished people
- **2030**: 2 billion food insecure

#### In the United States:

- 50% of all adults suffer from pre-diabetes or diabetes.

The treatment of diabetes alone is **160 billion/year**, more than the annual budget of many key federal agencies.

“People with diabetes worldwide are at increased risk for liver, pancreatic, colorectal, endometrial, breast and bladder cancer. Women with diabetes are 27 percent likelier to develop cancer, compared with healthy women.” Diabetologia, 2018

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**Table:**

<table>
<thead>
<tr>
<th>Country</th>
<th>2017 Population (m)</th>
<th>2050 Population (m)</th>
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<tr>
<td>India</td>
<td>1.34bn</td>
<td>1.66bn</td>
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<tr>
<td>China</td>
<td>1.41bn</td>
<td>1.36bn</td>
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<tr>
<td>Nigeria</td>
<td>410.64m</td>
<td>190.89m</td>
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<td>United States</td>
<td>389.59m</td>
<td>410.64m</td>
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<td>Indonesia</td>
<td>321.55m</td>
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<td>Pakistan</td>
<td>306.94m</td>
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<td>Brazil</td>
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<td>Bangladesh</td>
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<td>DR Congo</td>
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<td>154.34m</td>
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<tr>
<td>Ethiopia</td>
<td>190.87m</td>
<td>154.34m</td>
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*Source: [Forbes](https://www.forbes.com/sites/niallmccarthy/2017/06/22/the-worlds-most-populous-nations-in-2050-infographic/#726189339f60)*
Obesity Disproportionately Affects Minority/Underserved Groups

- White
- Hispanic
- Non-Hispanic Black

[Map Image: https://www.cdc.gov/obesity/data/prevalence-maps.html]
The Committee directs USDA-ARS to provide to the Committee not later than 180 days after the enactment of this Act a report on the connection between how to advance science, policy, and practice for how healthier food enhances overall health, reduces obesity and related co-morbidity, and could lower health care costs.”
Going Forward: New Imperatives for Food & Agriculture
The Vision: *A Food System Focused on Health*

Agriculture as the solution to human, environmental and economic health
Institute for Advancing Health Through Agriculture

Responsive Agriculture

Precision Nutrition

Healthy Living
"I expect that in the year 2005 (when the entire human genome is scheduled to be mapped and sequenced), on the back of our foods, there are going to be a lot of things like that, because we are going to know a lot more about ourselves. And I think the field of nutrition, which, in my own opinion now, has not benefited from the advances in molecular genetics, will be a completely different field. That will be the most revolutionized field in the year 2005. And the reason is that we will know lots more, we will actually know something about nutrition so you won't pick up one day and say fat is good for you and the next day fat is bad for you. Because we will know that some people it is good for and some people it is bad for.

"We will be able to know what people can metabolize and what some people can't metabolize. ....We're going to have a new definition of what it means to be healthy."
• Diseases of nutrient deficiencies have a single cause and manifest similarly in most people in populations.

• Diet-related chronic diseases are complex in their etiology with many interacting risk factors (nutrition, sleep, exercise, genetics, etc) that exhibit great heterogeneity in populations and change over the lifespan.

• Stresses the need for common evidentiary standards across risk factors.

• Few chronic diseases are affected by:
  • single nutrients
  • single pathways

• Need system level markers that report on health (reduce to a wearable?).
Precision Nutrition: Animal Models

William T. Barrington,1,2 Phillip Wulfridge,2 Ann E. Wells,9 Carolina Mantilla Rojas,1 Selene Y.F. Howe,1 Amie Perry,1 Kunjie Hua,1 Michael A. Pellizzon10, Kasper D. Hansen1,6,8, Brynn H. Voy9, Brian J. Bennett9, Daniel Pomp,7 Andrew P. Feinberg,6 David W. Threadgill1,4,8

Genetics: Early Online, published on November 20, 2017 as 10.1534/genetics.117.300536
Precision Nutrition: The How

Personalized nutrition solutions include many technologies offered at several levels of specificity.

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Wearables

Viome

Continuous
Repeat
Fixed

(Frequency of recommendations)

Physical traits & lifestyle
Biomarkers
Genetics
Microbiome

(Personalization specificity)

Glucovation
AIRO
HEALBE
InsideTracker
NutriGene
DNAFit
Habit
Biogenomics
DNAlytics

Presented at: LUX Executive Summit; April 4-6, 2017
Population Approach vs. Precision Approach

Classification of subgroups?

How do we deal with the complexity of diet-related chronic disease and nutrition?

Can we find system-level biomarkers of diet-nutrition-function-disease?

Should We be Divorcing the Biology of Food and Health from Food Behaviors and Health?

Real world experiments
The Imperative to Connect Agriculture and Health is clear...
...The Pathway to Connect Precision Nutrition and Agriculture is not.

Questions:

What are the highest priorities to improve the food system and lower health care costs?

What does precision nutrition and nutrition security mean for food production?

Food and health equity is needed in underserved communities, how do we affect change within cultural contexts?

How can we establish greater public trust in science?
We can dream – Technology

- We have the unprecedented ability to manage and engineer agriculture, food and the environment to achieve whatever goals we can imagine.
Diet-Cancer Research and the Foundational Role of Food Composition Data

Janet A. Novotny, PhD
Research Physiologist
Beltsville Human Nutrition Research Center
USDA, REE, ARS
Multifunctional Nanoparticles

Laura Carson
Addisie Geremew
and Huichen Wang

August 10, 2022
USDA Moonshot Webinar
Introduction

Research areas

Omics
- Metagenomic
- Transcriptomic

Nanotechnology
- Nanoparticles
- Nanoemulsion
- Nanocoating

Plant Genetics

Metabolomics

Dissecting hemp (Cannabis sativa) strains variation

Multifunctional Nanoparticles

Stress physiology

Population genetics

Geremew, Carson et al., 2021

- Interactive effect of drought and fertilizers…
Cancer Incidence and Mortality Rates, Worldwide, Both Sexes, All Ages

- Breast
- Prostate
- Lung
- Colorectum
- Cervix uteri
- Stomach
- Liver
- Corpus uteri
- Thyroid
- Ovary
- Corpus uteri
- Liver
- Stomach
- Cervix uteri
- Colorectum
- Lung
- Prostate
- Breast

Worldwide per 100,000

- Mortality World per 100,000
- Incidence World per 100,000
PLANT FOCUSED
Methods Microbial Studies

Plant Extraction

Plant

Plant Extract

Zn nitrate or Cu sulfate hydrate, silver nitrate

Bio-reduction

Synthesized nanoparticles

NP Characterization

Size and Zeta potential measurement using Litesizer

Plant NPs

Confirmation of NPs synthesis

Functional group identification using FTIR
Comparison of the FTIR spectra of the metal salts, Plant extract and NPs
Variation in particle size distribution and zeta potential of Rn-AgNPs across time
Absorption Spectra of NPs

Left - various temperatures; right – time intervals.
SEM micrograph (a) and EDX spectra (b) of synthesized NPs
Effect of NPs on Cancer Cell Studies

- 19 plant nanoparticles
  - The nanoparticles CuO NPs-A, CuO NP-B and ZnO NP- A

- Human cancer cells:
  1. Human lung cancer cells: A549
  2. Human skin fibroblast: AG1522
  3. Human cervix adenocarcinoma cells: HeLa(first immortalized human cells)
Cell Survival Studies

AG1522

![Graph showing cell survival (%) vs concentration for CuO, CUS, and ZnO. The graph indicates that AG1522 has similar cell survival to A549.](image)

Similar to A549
Microscopic Studies – A549
Cell Survival Studies
Microscopic Studies – AG1522
Cell Survival Studies
Preliminary Results

- CuO NPs significantly reduced cell survival in A549 and AG1522 cells
- ZnO NPs is mildly effective at cell killing in A549 and AG1522 cells
- A549 cells are more sensitive to CuO nanoparticle than AG1522 cells
USDA has been monitoring the composition of the US food supply for more than 100 years.
FoodData Central

Search Foods in FoodData Central:

Download Data

Get an API Key

API Guide

https://fdc.nal.usda.gov
Primary Data Types

Foundation Foods
Basic foods and ingredients
Food variability, analysis approaches, sampling location, etc.

Standard Reference (SR) Legacy
~8000 foods & ~150 food components

Food and Nutrient Database for Dietary Studies (FNDDS)
~7000 foods in a format of serving sizes to facilitate dietary surveys

Global Branded Foods Database
~400,000 foods
International: US, Canada, New Zealand, Costa Rica

Experimental Foods Database
Analysis by novel methodologies
Effects of preparation and processing
Impacts of environment and agricultural practices

Progressive Design
Maps and connections among foods and food features
Crosstalk with other databases, including health databases
### Foundation Foods

Data for food components including nutrients derived from analyses, and metadata for a range of single foods and ingredients providing insights into variability. Foundation Foods highlight information on samples and acquisition details.


<table>
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<tr>
<th>NDB Number</th>
<th>Description</th>
<th>Most Recent Acquisition Date</th>
<th>SR Food Category</th>
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<tr>
<td>9504</td>
<td>Apples, Fuji, with skin, raw</td>
<td>2020-05-05</td>
<td>Fruits and Fruit Juices</td>
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<tr>
<td>9503</td>
<td>Apples, gala, with skin, raw</td>
<td>2020-05-05</td>
<td>Fruits and Fruit Juices</td>
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<tr>
<td>9501</td>
<td>Apples, honeycrisp, with skin, raw</td>
<td>2020-06-01</td>
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<td>9502</td>
<td>Apples, granny smith, with skin, raw</td>
<td>2020-08-28</td>
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<td>9500</td>
<td>Apples, red delicious, with skin, raw</td>
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<tr>
<td>9400</td>
<td>Apple juice, with added vitamin C, from concentrate, shelf stable</td>
<td>2021-02-01</td>
<td>Fruits and Fruit Juices</td>
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### Apples, gala, with skin, raw

**Data Type:** Foundation  **Food Category:** Fruits and Fruit Juices  **FDC ID:** 1790341  **FDB Number:** 9600

#### Components

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<th>Average Amount</th>
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<td>Water</td>
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<td>9 Samples</td>
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<td><strong>Vitamins:</strong></td>
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<td>Niacin</td>
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<tr>
<td>Vitamin B6</td>
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<td>Folate, Total</td>
<td>µg</td>
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<td>Identifier Type</td>
<td>Type</td>
<td>Description</td>
<td>Serving Weight</td>
<td>Serving size weight unit</td>
<td>Serving Size</td>
<td>Vitamin C, total ascorbic acid per serving size (mg)</td>
<td>Vitamin C, total ascorbic acid per 100 unit serving (mg)</td>
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<tr>
<td>9002</td>
<td>NDB #</td>
<td>SR Legacy</td>
<td>Acerola juice, raw</td>
<td>242</td>
<td>g</td>
<td>1 Cup</td>
<td>3670</td>
<td>1000</td>
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<td>3002</td>
<td>NDB #</td>
<td>SR Legacy</td>
<td>Acerola, lynx, Indian cherry, raw</td>
<td>99</td>
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<td>9001</td>
<td>NDB #</td>
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<td>Acerola, lynx, Indian cherry, raw</td>
<td>98</td>
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<td>1640</td>
<td>1680</td>
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<td>SR Legacy</td>
<td>Beverages, Orange-flavor drink, breakfast type, with pulp, frozen concentrate</td>
<td>424</td>
<td>g</td>
<td>1 can</td>
<td>1030</td>
<td>243</td>
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<td>14425</td>
<td>NDB #</td>
<td>SR Legacy</td>
<td>Beverages, Orange drink, breakfast type, with juice and pulp, frozen concentrate</td>
<td>430</td>
<td>g</td>
<td>1 can</td>
<td>827</td>
<td>190</td>
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<td>11589</td>
<td>NDB #</td>
<td>SR Legacy</td>
<td>Wasabu, (chinese preserving mixture), raw</td>
<td>3700</td>
<td>g</td>
<td>1 wasabu</td>
<td>741</td>
<td>13</td>
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<tr>
<td>11190</td>
<td>NDB #</td>
<td>SR Legacy</td>
<td>Brussels sprouts, frozen, unprepared</td>
<td>907</td>
<td>g</td>
<td>1 package (2 lb)</td>
<td>672</td>
<td>74.1</td>
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<td>14209</td>
<td>NDB #</td>
<td>SR Legacy</td>
<td>Beverages, Fruit punch drink, frozen concentrate</td>
<td>419</td>
<td>g</td>
<td>1 can (12 fl oz)</td>
<td>650</td>
<td>196</td>
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<tr>
<td>11112</td>
<td>NDB #</td>
<td>SR Legacy</td>
<td>Cabbage, red, raw</td>
<td>1134</td>
<td>g</td>
<td>1 head, large (about 5-1/2&quot; dia)</td>
<td>646</td>
<td>57</td>
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<tr>
<td>11094</td>
<td>NDB #</td>
<td>SR Legacy</td>
<td>Broccoli, frozen, spares, unprepared (Includes foods for USDA’s Food Distribution Program)</td>
<td>607</td>
<td>g</td>
<td>1 package (2 lb)</td>
<td>620</td>
<td>68.3</td>
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<tr>
<td>11183</td>
<td>NDB #</td>
<td>SR Legacy</td>
<td>Collard, frozen, chopped, unprepared</td>
<td>1381</td>
<td>g</td>
<td>1 package (3 lb)</td>
<td>544</td>
<td>40</td>
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<tr>
<td>11090</td>
<td>NDB #</td>
<td>SR Legacy</td>
<td>Broccoli, raw</td>
<td>608</td>
<td>g</td>
<td>1 bunch</td>
<td>542</td>
<td>89.2</td>
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<tr>
<td>35203</td>
<td>NDB #</td>
<td>SR Legacy</td>
<td>Russ Hip, wild (Northern Plains Indian)</td>
<td>127</td>
<td>g</td>
<td>1 cup</td>
<td>541</td>
<td>426</td>
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<tr>
<td>02900100</td>
<td>Food Code</td>
<td>Survey (FNDDS)</td>
<td>Fruit flavored drink, with high vitamin C, powdered, not reconstituted</td>
<td>224</td>
<td>g</td>
<td>1 cup</td>
<td>517</td>
<td>231</td>
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</tbody>
</table>
Food Composition is Critical Part of Connecting the Pieces of the Research Puzzle

Mechanistic studies to strengthen evidence

Associations of food and disease in large groups

Feasibility studies with animal models

Randomized, controlled clinical trials with highly controlled diets in people
“Brassica” or “Cruciferous” Family of Vegetables

- Vitamin C
- Folate
- Carotenoids
- Vitamin E
- Fiber
- Flavonoids
- Vitamin K
- Potassium
- Glucosinolates

- Beta-Carotene → Vitamin A
- Lutein
- Kaempferol
- Quercetin
- Isorhamnetin
- Glucoraphanin → Sulforaphane
- Sinigrin → Allyl-Isothiocyanate
- Others
**USDA Research Results**

A Person’s Lean vs. Overweight Status Affects Circulating Levels of Healthful Dietary Compounds

**Absorption of Healthful Broccoli Components Into Blood**

A Person’s Genes (Genotype) Can Affect Circulating Levels of Healthful Dietary Compounds

Absorption of Healthful Broccoli Components Into Blood

Isothiocyanate Mass in Blood Plasma (nanomoles)

Hours after a Broccoli Meal

Gene “GSTM1” Present

Gene “GSTM1” Missing

Food Components Can Up-Regulate Detoxification Enzymes, An Important Mechanism of Dietary Cancer Prevention

USDA Research Results

Kale Effect on CYP1A2 Activity in Humans

Charron, Novotny, Jeffery, Kramer, Ross, Seifried (2020) J Funct Food 64: 103624
Our Genes Can Affect How Food and Food Components Up-Regulate Our Detoxification Enzymes

**USDA Research Results**

USDA is using a cutting-edge methods for broad assessment of nutrient metabolism, for use in novel artificial intelligence efforts to better understand diet and cancer prevention.

The Whole Diet Matters

Cancer Mortality and Diet Quality

Mortality Associated with Different Food-Related Groups

<table>
<thead>
<tr>
<th>HEI components</th>
<th>All-cause mortality†</th>
<th>Cancer-specific mortality‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>0.67 (0.52 to 0.86)</td>
<td>0.65 (0.38 to 1.14)</td>
</tr>
<tr>
<td>Meat</td>
<td>0.82 (0.60 to 1.11)</td>
<td>0.66 (0.37 to 1.20)</td>
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<tr>
<td>Grain</td>
<td>0.92 (0.71 to 1.20)</td>
<td>1.25 (0.82 to 1.91)</td>
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<tr>
<td>Fruit</td>
<td>0.71 (0.51 to 0.98)</td>
<td>0.58 (0.32 to 1.03)</td>
</tr>
<tr>
<td>Dairy</td>
<td>0.78 (0.65 to 0.94)</td>
<td>0.86 (0.57 to 1.30)</td>
</tr>
<tr>
<td>Fat</td>
<td>0.90 (0.71 to 1.15)</td>
<td>0.65 (0.42 to 1.02)</td>
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<tr>
<td>Saturated fat</td>
<td>0.72 (0.60 to 0.86)</td>
<td>0.55 (0.36 to 0.86)</td>
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<tr>
<td>Cholesterol</td>
<td>1.00 (0.83 to 1.19)</td>
<td>1.03 (0.74 to 1.43)</td>
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<tr>
<td>Sodium</td>
<td>1.04 (0.81 to 1.35)</td>
<td>0.75 (0.46 to 1.23)</td>
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<tr>
<td>Variety</td>
<td>0.76 (0.63 to 0.97)</td>
<td>0.67 (0.41 to 1.10)</td>
</tr>
<tr>
<td>Overall</td>
<td>0.59 (0.45 to 0.77)</td>
<td>0.35 (0.19 to 0.63)</td>
</tr>
</tbody>
</table>

Deshmukh et al. (2018) NJCI Cancer Spectrum
USDA’s initiatives to broaden available information about the composition of foods and to expand the food information web while also conducting cutting-edge research will continue to advance our understanding of cancer prevention through diet.