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USDA United States Department of Agriculture

USDA's 96th Annual Agricultural Outlook Forum

The Innovation Imperative: *Shaping the Future of Agriculture*

February 20-21, 2020 • Crystal Gateway Marriott Hotel, Arlington, Virginia

Food Loss and Waste: A Multi-Billion Dollar Opportunity

Tara H. McHugh

Center Director

USDA. Agricultural Research Service

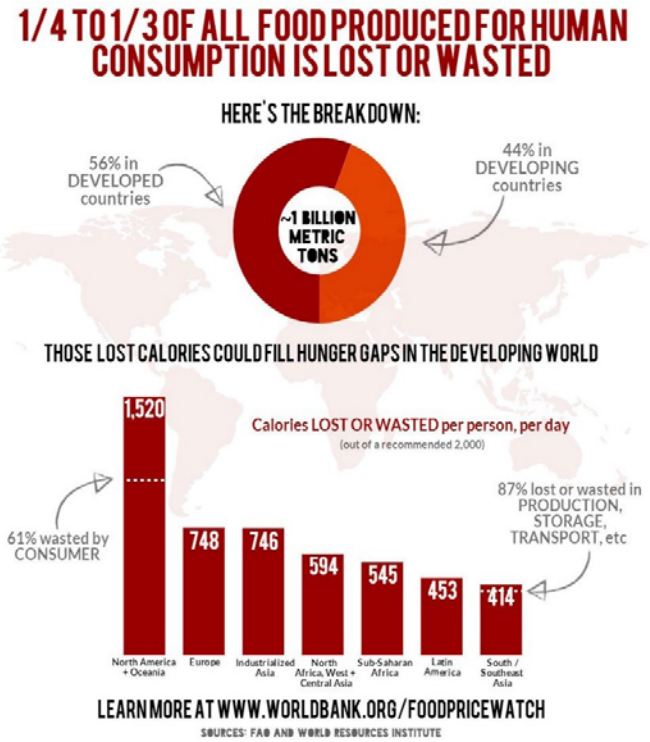
Western Regional Research Center, Albany, CA

The Challenge

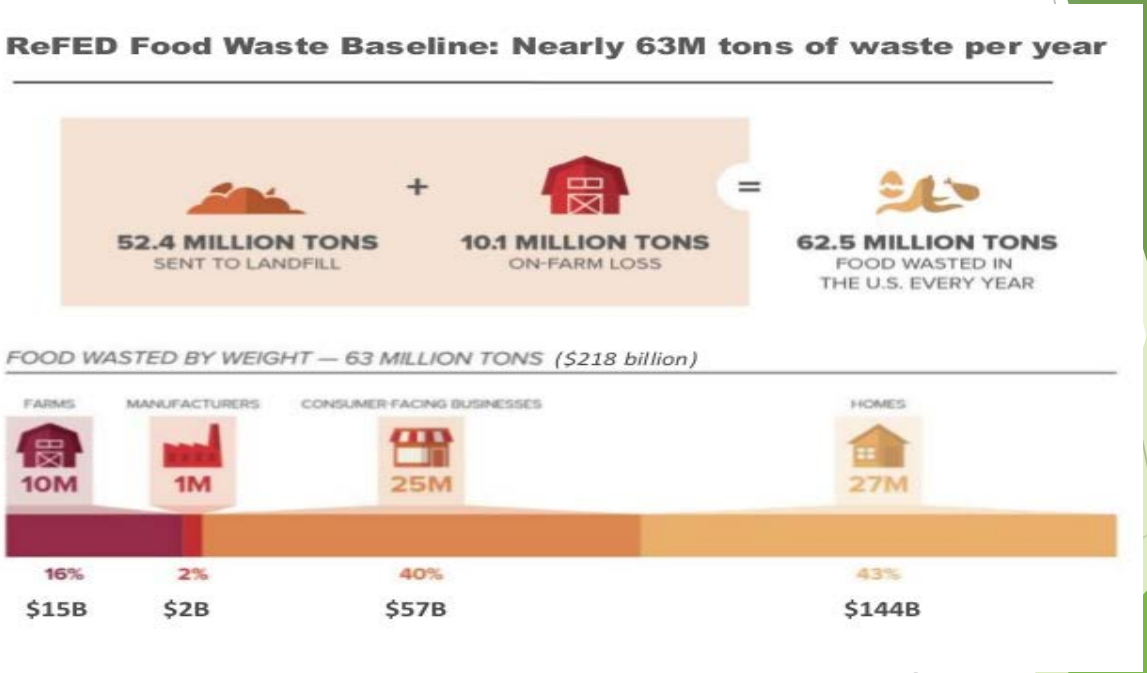
Every year, American consumers, businesses, and farms spend $218 billion a year, or 1.3% of GDP, growing, processing, transporting, and disposing food that is never eaten. That's 52 million tons of food sent to landfill annually, plus another 10 million tons that is discarded or left unharvested on farms.

Meanwhile, one in seven Americans is food insecure.

Global Issue

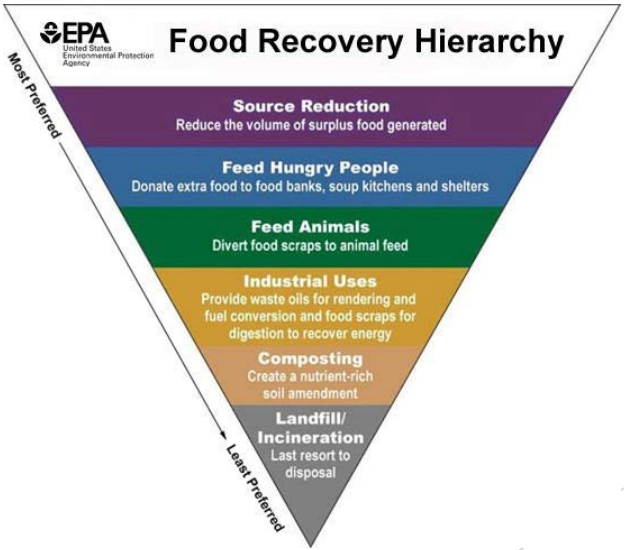


63 Million Tons ($218 B) Annually in United States



U.S. Food Waste Challenge

USDA and EPA
U.S. Food Loss and Waste 2030 Champions



Agricultural Research Service

2000 Research Scientists, 90+ Research Locations, $1.4 B

Mission: Conduct research to develop and transfer solutions to agricultural problems of high national priority.

National Programs

Bring Coordination, Communication and Empowerment to the 660 Research Projects and 15 National Programs in ARS

Gene Lester
National Program Leader
Nutrition, Food Safety and Quality

Office of Technology Transfer

Moves Research Discoveries into the Marketplace

Robert Greisbach
Deputy Assistant Adminstrator

Three Sections:

Administrative and Partnership, Patenting and Licensing

Two Technology Transfer Tools

Cooperative Research and Development Agreements (CRADAs)

and

Small Business Innovation Research (SBIR) Grants

Harvard Kennedy School

"Technological innovation is essential for fostering economic growth, enhancing global competitiveness, and protecting the environment."

FOOD WASTE

Undersized or Blemished Produce

Convert to Puree and Process into Healthy Foods

Forming Technology for 100% Fruit Bars

5.5M bars sold equating to millions of pounds of fruit

15% of Wine Grape Production is Waste
120,000 tons per year in California

Wally Yokoyama

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

Article

pubs.acs.org/JAFC

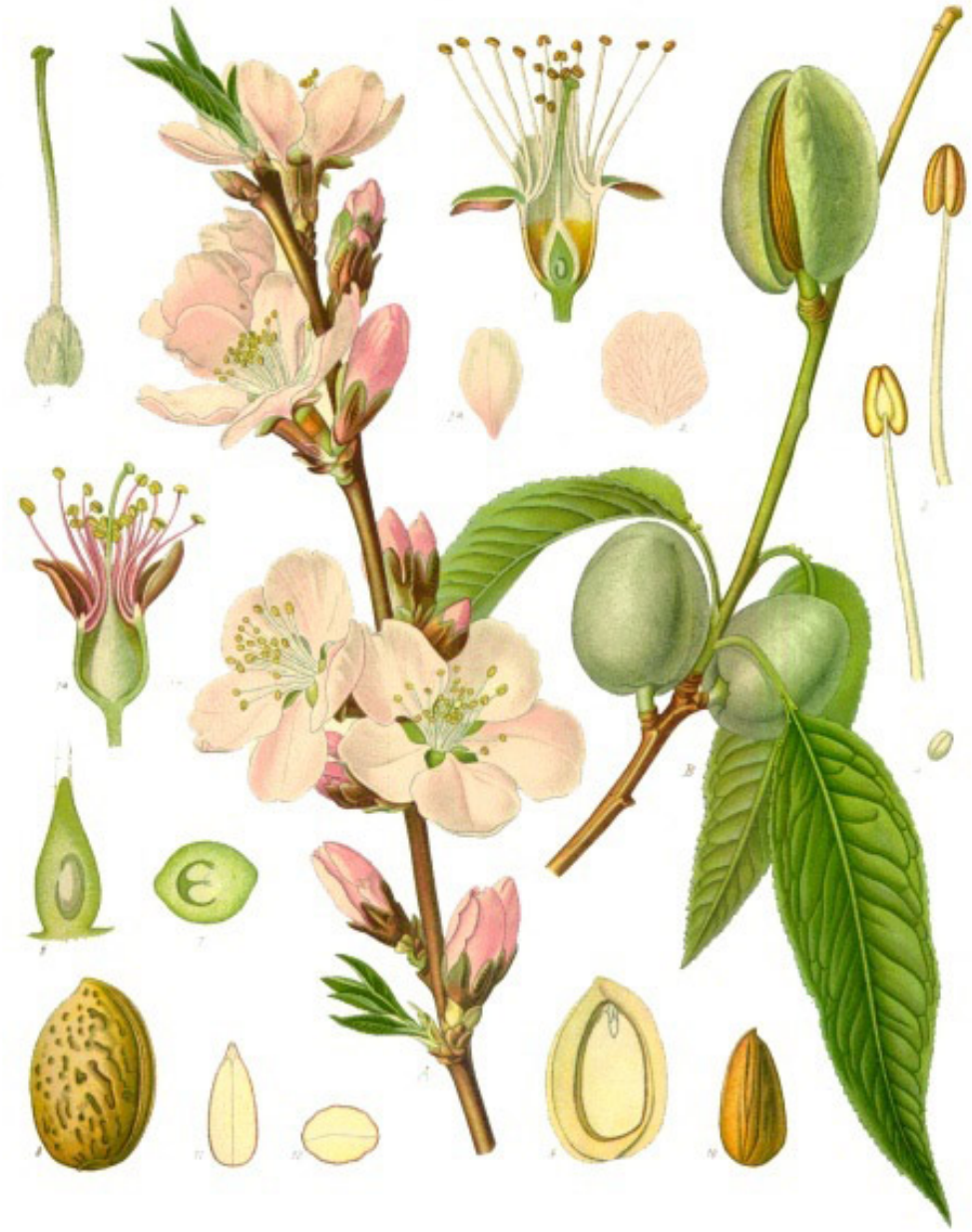
Modulation of the Intestinal Microbiota Is Associated with Lower Plasma Cholesterol and Weight Gain in Hamsters Fed Chardonnay Grape Seed Flour

Hyunsook Kim,[*,†,‡,⊥] Dong-Hyeon Kim,[§] Kun-ho Seo,[§] Jung-Whan Chon,[§] Seung-Yeol Nah,[‡] Glenn E. Bartley,[¶] Torey Arvik,[⊥] Rebecca Lipson,[⊥] and Wallace Yokoyama[¶]

Innovation

"Never before in history has innovation offered promise of so much to so many in so short a time."

Bill Gates

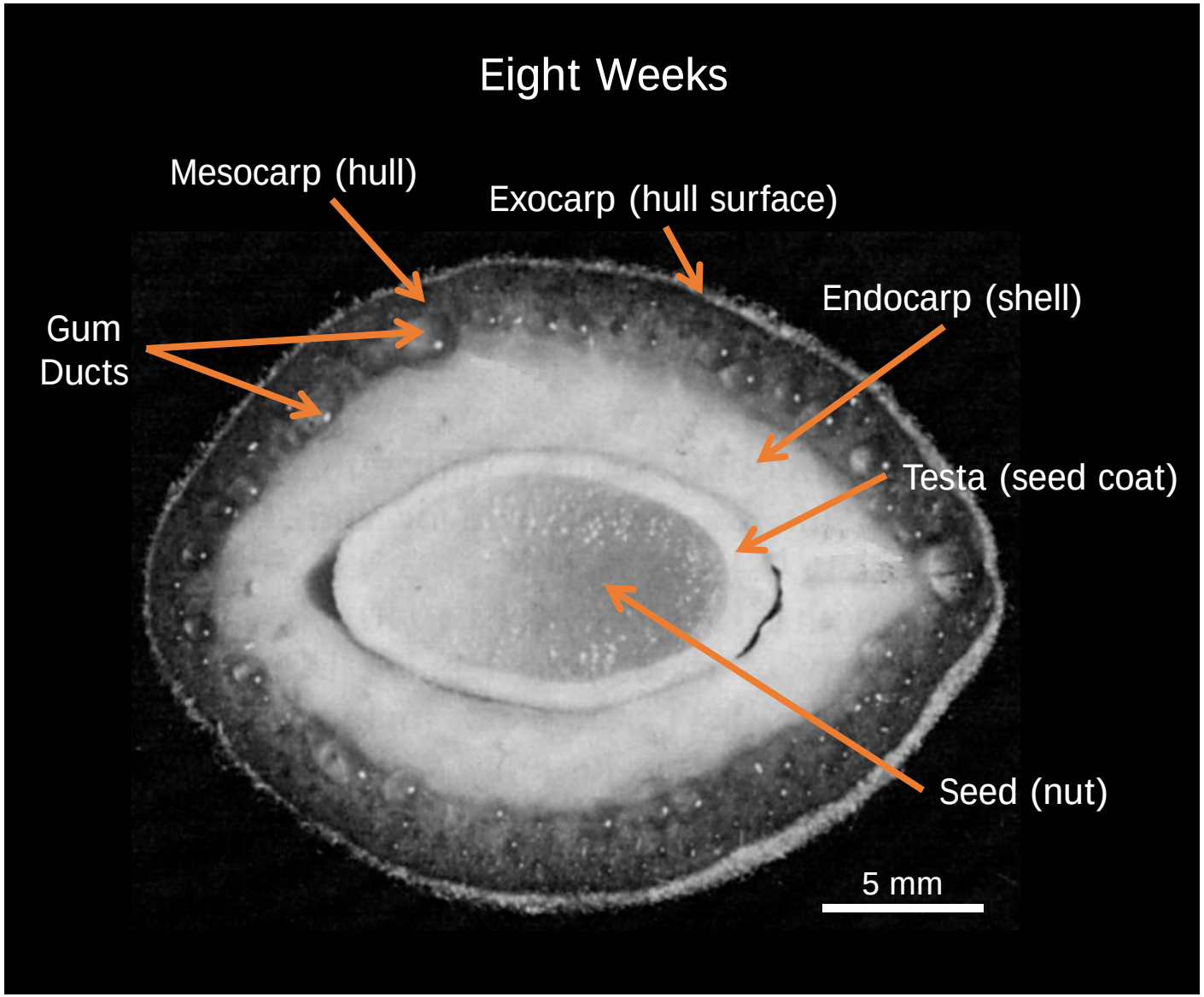


Bioproducts from Almond Shells & Hulls

Delilah F. Wood
de.wood@usda.gov

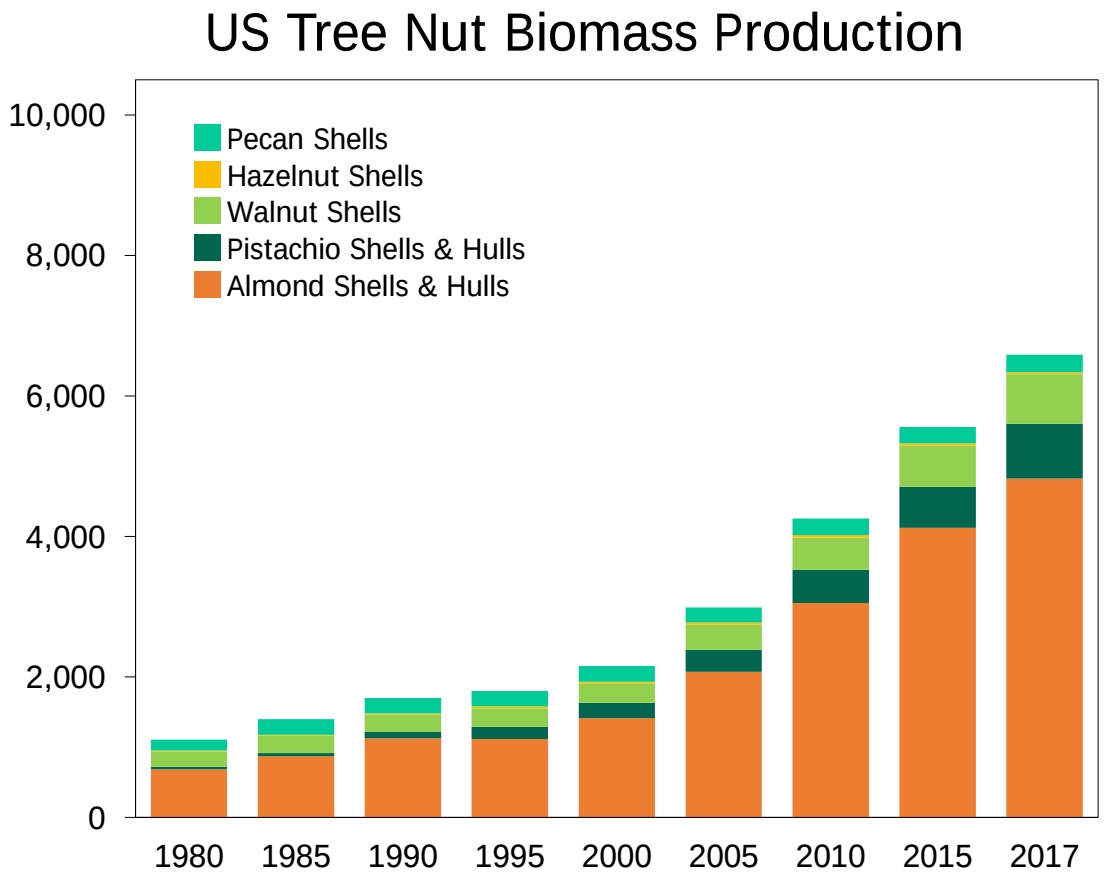
USDA

Almonds & Biomass

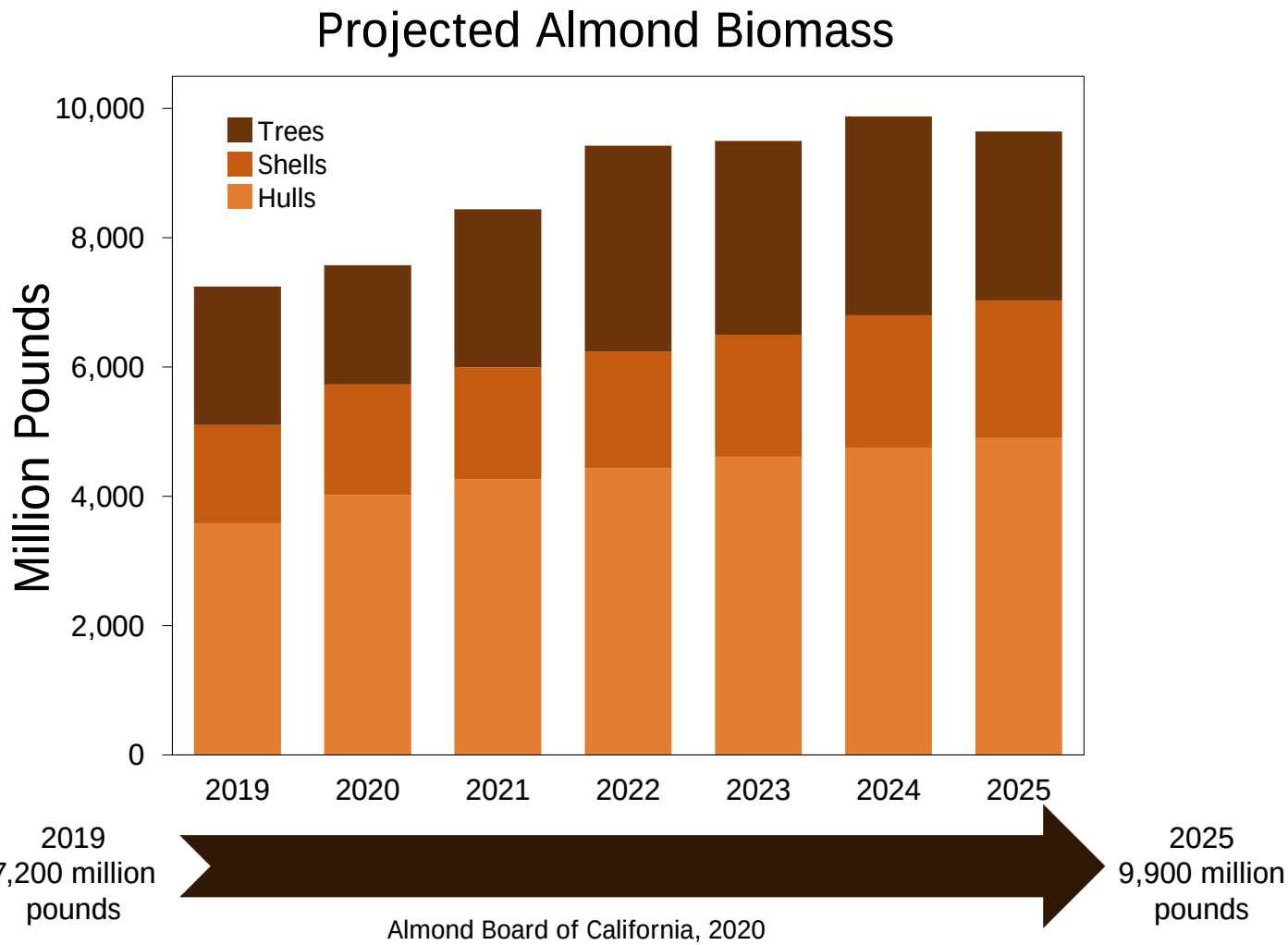


Morrison et. al 1985 Botanical Gazette 146:15

Biomass Volume Increase with Nut Tree Production Growth



Orts, et al., 2019. https://www.nutfruit.org/industry/publications/inc-magazine/articles/detail/zero-waste-in-the-tree-nut-industry-adding-value-to-coproducts

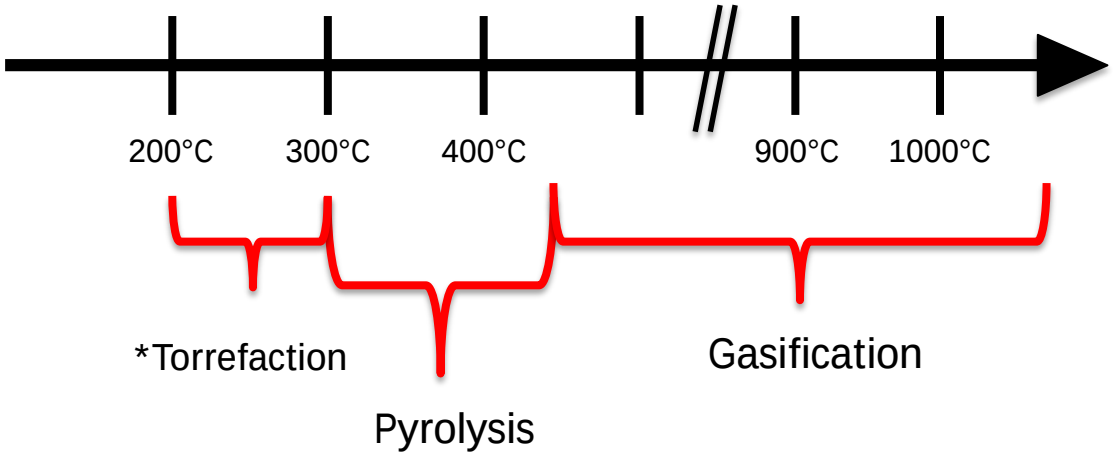


Almond Shells Heat Treatment

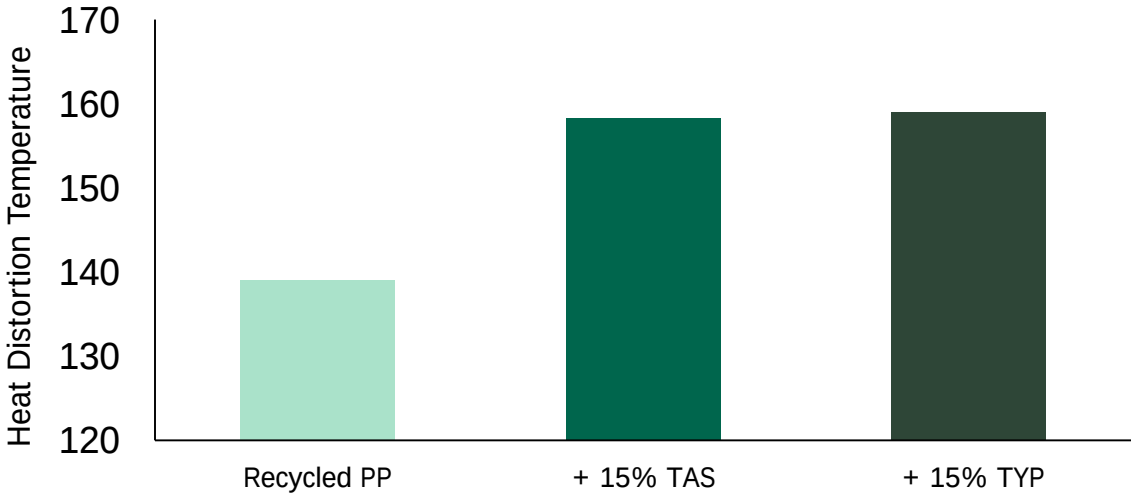
Raw Almond Shells

Biomass Heat Treatment

Makes biomass miscible with plastic



Torrefied Biomass Increases Melt Temperature



Sun-Damaged Nursery Pots

Almond Shells Heat Treatment

Torrefied Almond Shell as Additive to Recycled Plastics

+ Polypropylene

+ Polyethylene terephthalate (PET)

Material advantages of adding torrefied almond shells:

- Provides color, displacing carbon as pigment
- Increases tensile modulus, making the final product more rigid, a property often lost in recycled plastics
- Increases heat deflection temperature, meaning that the composite material is more heat-tolerant

Shipping Pallet Production

15% Torrefied Biomass plus recycled plastic at TranPak, Fresno, CA

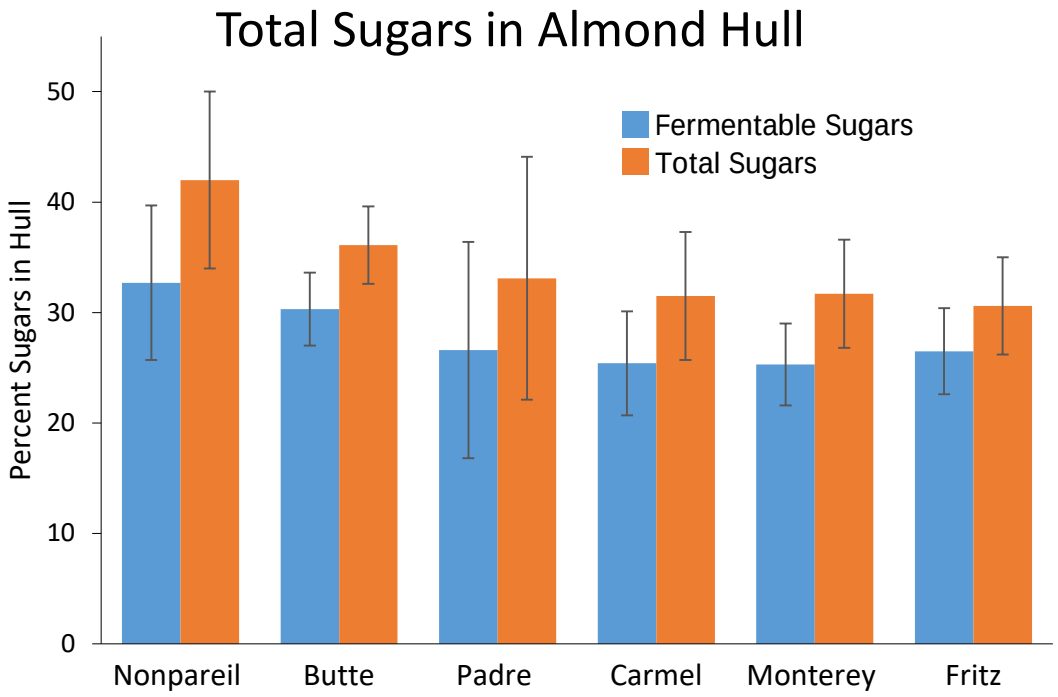
McCaffrey, et al., 2019. https://www.plasticstoday.com/packaging/sustainable-plastics-agricultural-coproducts-seven-things-know/96317074761748.

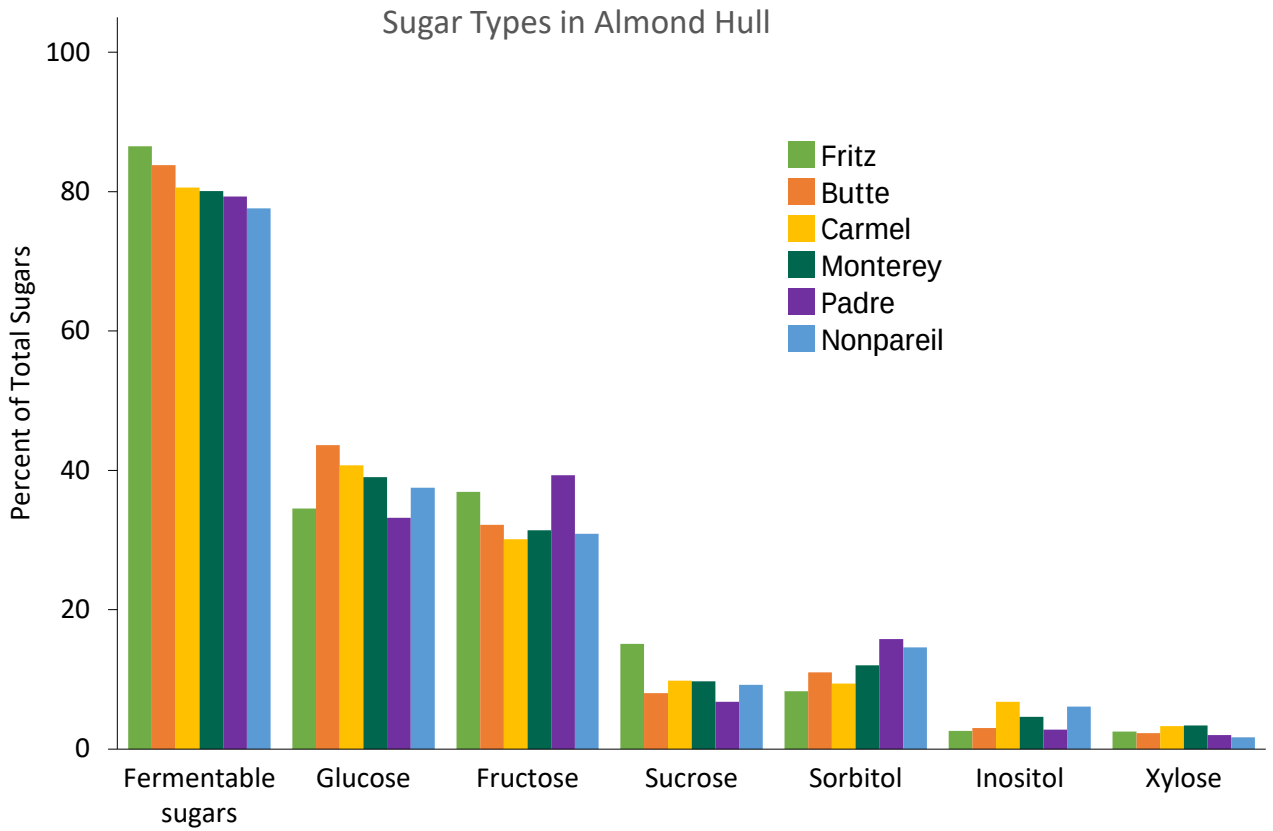
McCaffrey, et al., 2019. Industrial Crops and Products. 125:425-432. https://doi.org/10.1016/j.indcrop.2018.09.012.

Chiou, et al., 2016. Industrial Crops and Products. 86:40-48.

Almond Hulls Sugar Extraction

Sugar Beets - 15-20% Sugar



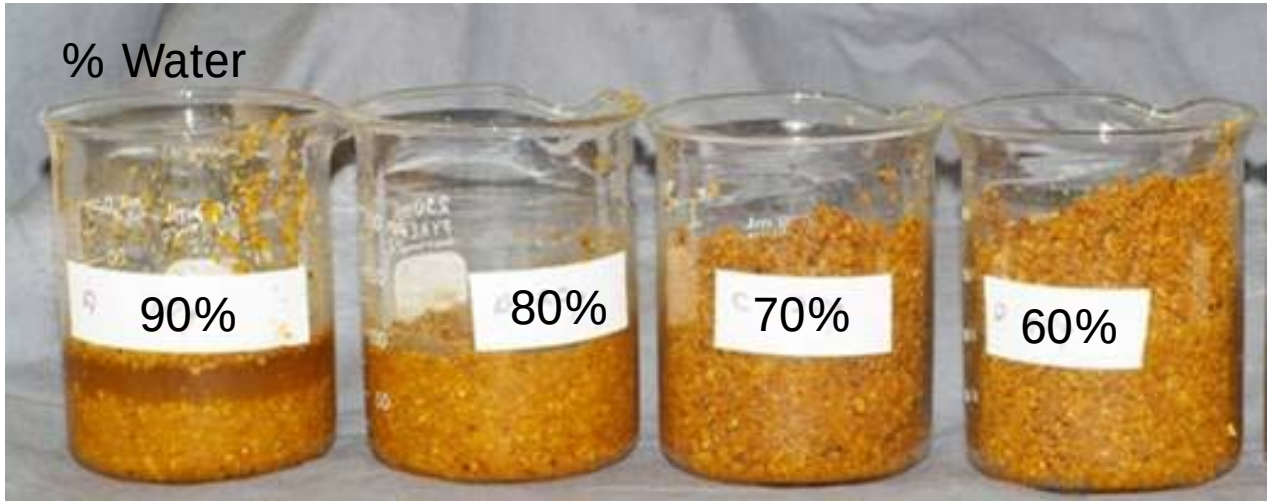


Offeman et al., 2014, Industrial Crops and Products 54 (2014) 109–114

Spent Almond Hulls

Peat – non renewable resource

Hulls absorb 4-8 times weight of water



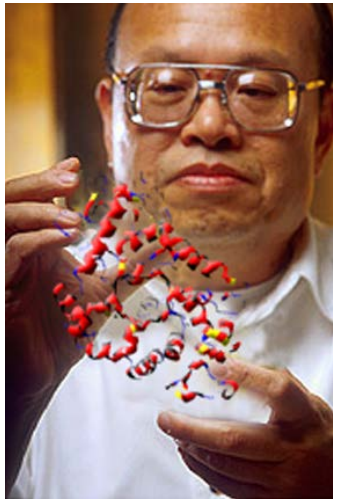
Button Mushrooms with Almond Hulls as Partial Peat Replacer

Flynn et al., 2018. http://newsroom.almonds.com/news/almond-hull-byproducts-as-a-casing-amendment-material-mushroom-cultivation

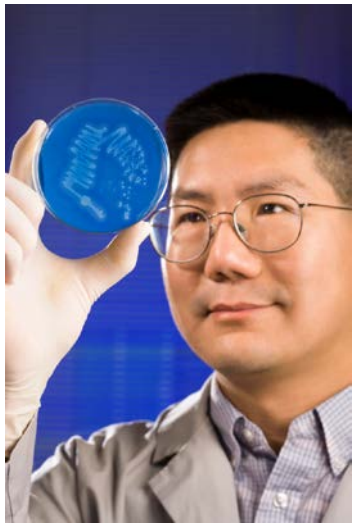
Thank you!

New Projects:

- Zero Waste Agricultural Processing
- Bioproducts and Biopolymers from Ag Feedstock
- Domestic Production of Natural Rubber and Resins



Dominic Wong

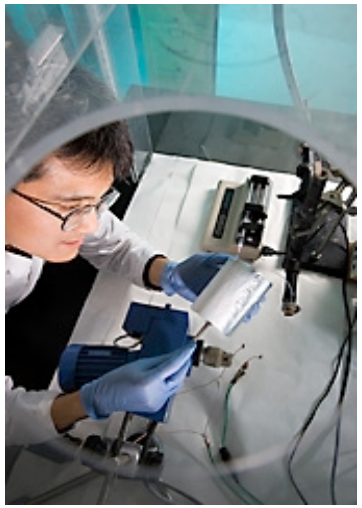


Charles Lee

Kurt Wagschal

Grace Chen

Bill Orts



Bor-Sen Chiou

William Hart-Cooper

Colleen McMahan

Delilah Wood

Greg Glenn

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Food Loss and Waste: Innovations Mushroom Stalks and Edible Straws

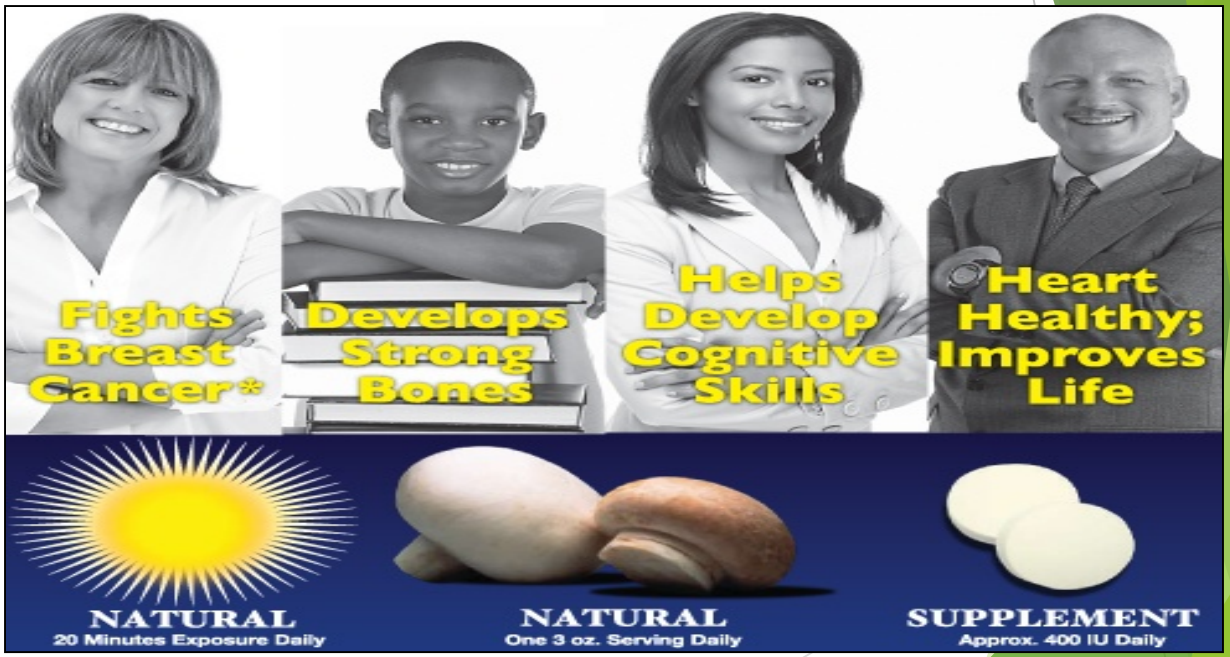
Tara H. McHugh

Center Director

USDA. Agricultural Research Service

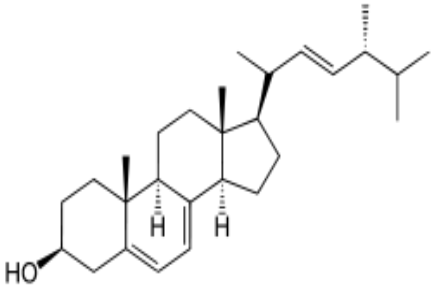
Western Regional Research Center, Albany, CA

Innovative Mushroom Processing to Develop a Novel, Value-Added Source of Vitamin D



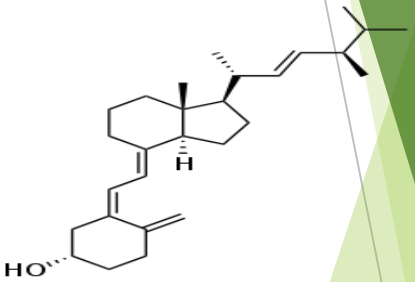
CHEMICAL CONVERSION

Ergosterol



UVB

Vitamin D2



Ultraviolet B Processing
Uvitron Unit

Ultraviolet Light Technology for Vitamin D Mushrooms - CRADA

Novel Ultraviolet B Process Being Used Nationwide on All Mushroom Varieties by #1 Mushroom Producer in U.S.
***Processes 250 millions pounds annually*.**

Novel Ultraviolet B Process To Treat Mushroom Waste

Remaining Question – Human Bioavailability?

Charles Stephensen
Acting Center Director
ARS, Western Human Nutrition Research Center

FOOD WASTE

Undersized or Blemished Produce

Convert to Puree and Process into Healthy Foods

NewGemFoods™

Casting Technology CRADA

USDA

Casting Technology for Fruit and Vegetable Edible Films

NewGemFoods™

$8.5M Sales
Equating to consumption of over 15M servings of fruits and vegetables.

Edible Packaging Opportunities – Wraps and Straws

500M Straws Used Daily in U.S.

Prolonging Freshness with clamshells

Jinhe Bai, Xiuxiu Sun,
Anne Plotto, Elizabeth Baldwin

Horticultural Research Laboratory
Fort Pierce, FL

Small fruit/berry food loss

Estimated over $3B in U.S. in 2018

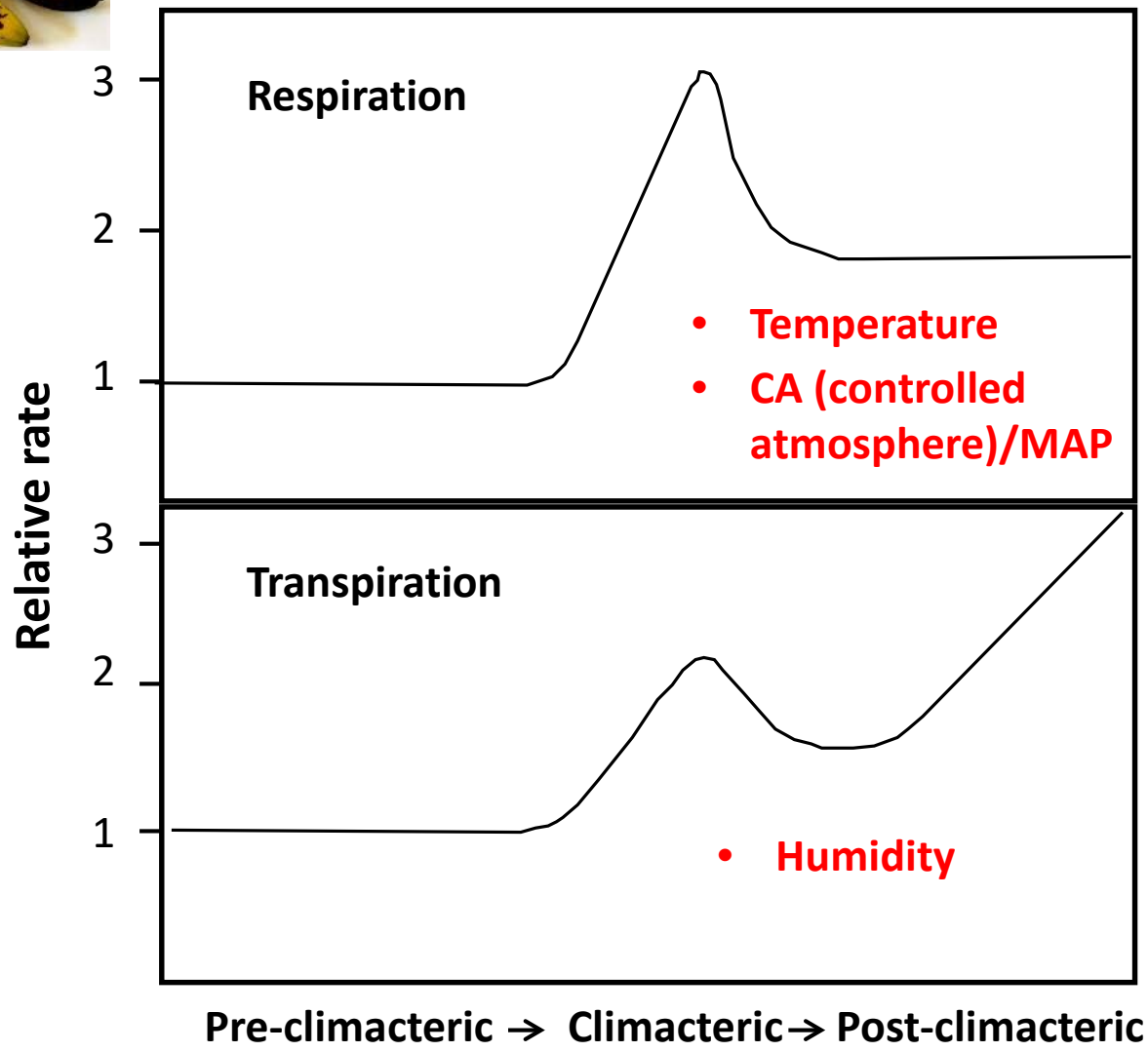
Fresh market value $11B; Retail food loss 9.3% ($1B); Consumer food loss (kitchen) 19.4% ($2B)

https://www.cookinglight.com/ PHOTO: GETTY: CARSTEN SCHANTER / EYEEM

https://www.3dstreaming.org/3d-media/videos/7883-rotting-fruits-decay-time-lapse-3d-full-hd-fast-and-reverse-version.html

Data from: USDA-NASS, 2018

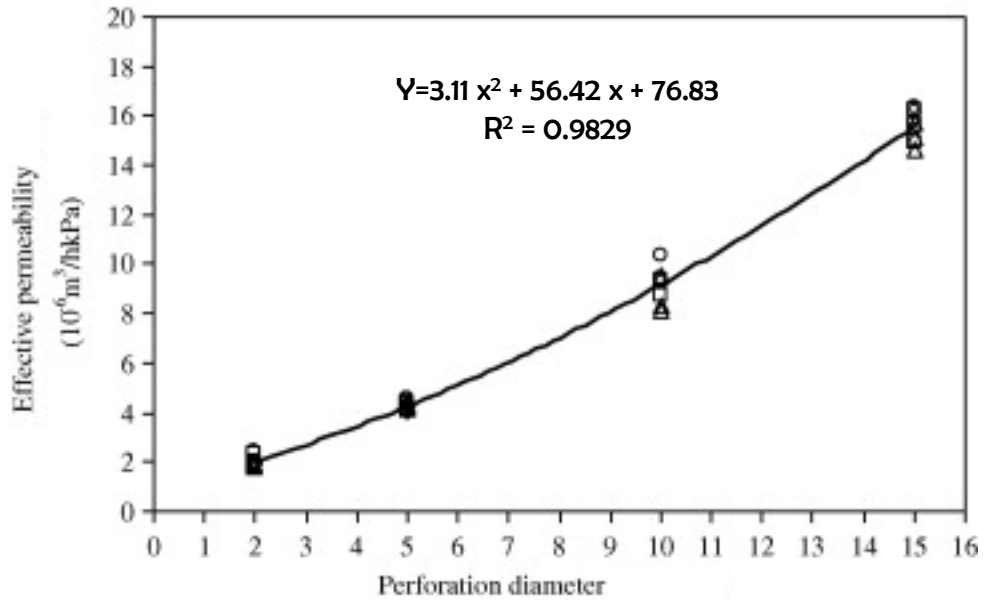
Humidity is one of the key factors in fresh fruit preservation, which has been underestimated

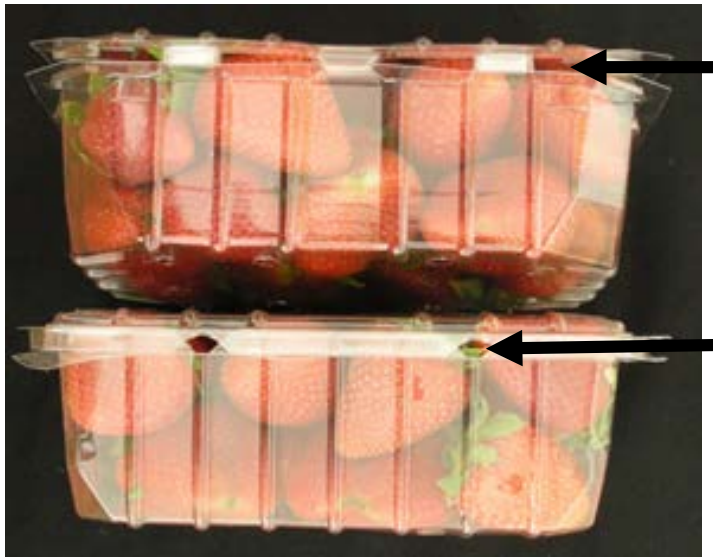


- In a CA system, preventing water loss has proved to be more important and cost-effective than controlling the gaseous environment (Ben-Yehoshua, 1989; Burg, 2004; Rodov et al., 2010)
- Apples (Lentz and Rooke, 1964) and bananas (Wardlaw and Leonard, 1940) lose water at a significant rate even when the relative humidity (RH) of the surrounding air is 100%.
- Many research reports describe the RH as 85-95%, implying that humidity is not a problem or that if greater than 85%, there is no problem. There is little data on whether there is the difference in produce response to RH of 90%-95% compared to 85% for example?

Adapted from Burg, S.P. 2004. Postharvest physiology and hypobaric storage of fresh produce. p240

Super simple technology – reduce perforation/openings





Commercial clamshell with wide vents

New clamshell with 84% reduced vents

- The model was built based on mathematics/aerodynamics
- Field tests were run in > 10 fruits, > 10 years in three countries

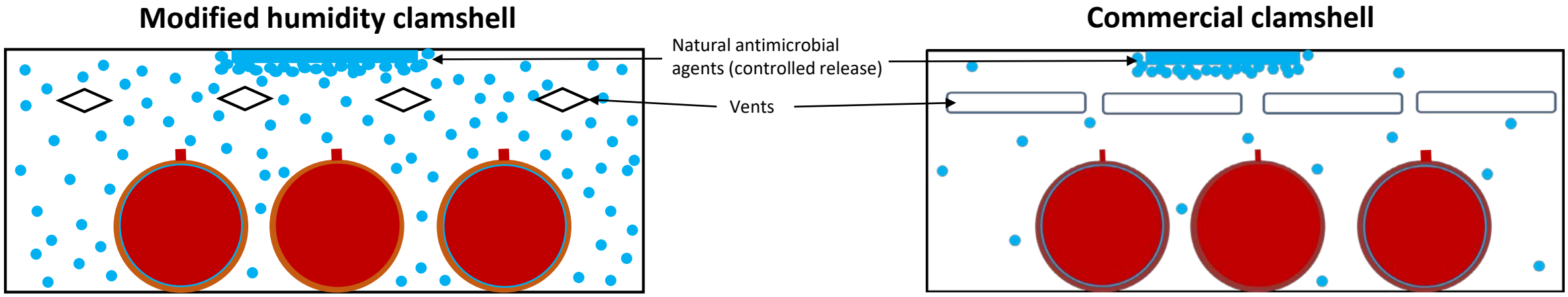
Conclusion: Water loss in the commercial clamshells was 1.2–4.5-fold more than for the new clamshell

Several Reinforcements:

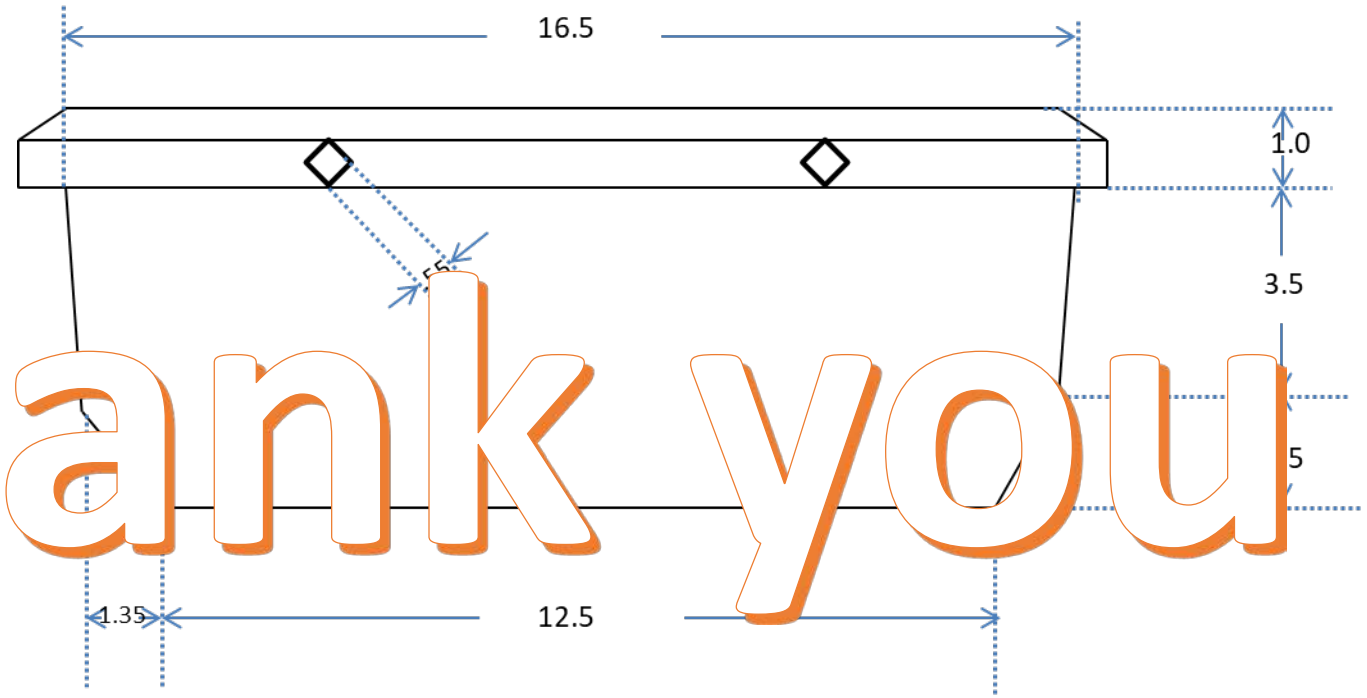
www.mnn.com

- Compostable packaging - adding citrus juice processing waste and other waste pectin to plastic polymers
- Antifog processing – prevent condensation caused contamination
- Combine packaging with controlled-release natural antimicrobial agents

Foodengineeringmag.com

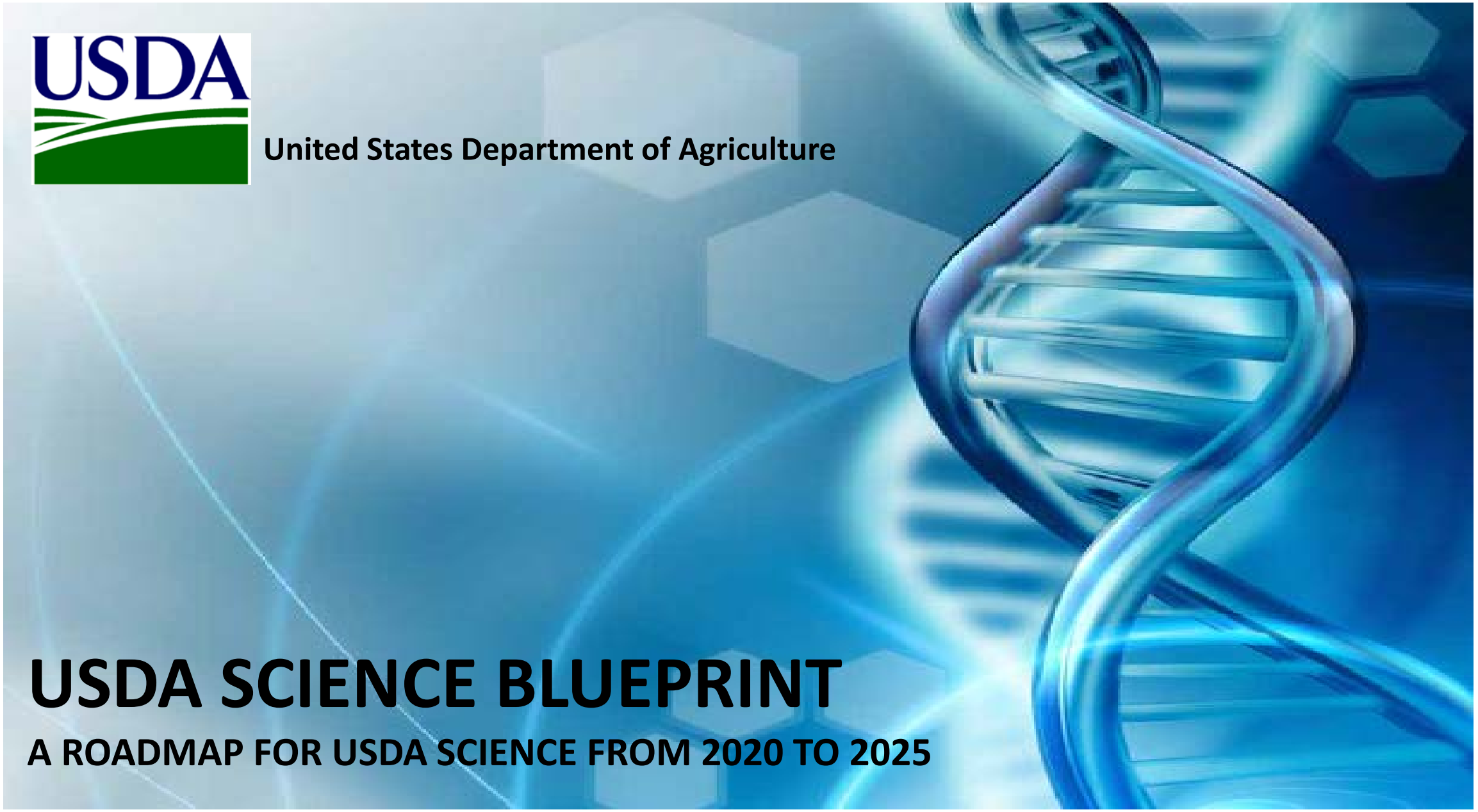


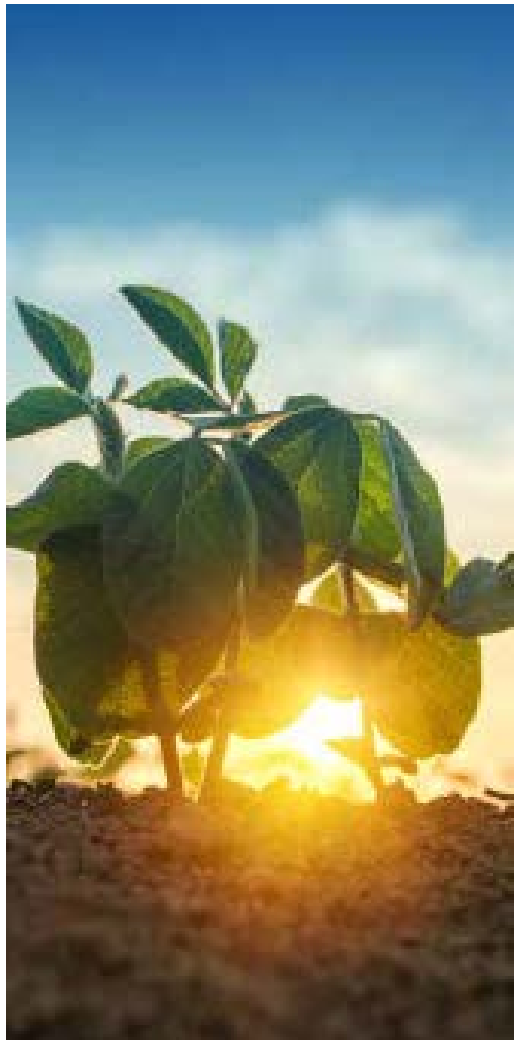
Integrated packaging technology combining humidity control and slow release antimicrobials to prolong freshness and improve safety of small fruits and berries



Thank you ☺

	FRONT		BACK	
Position	Measure (cm)	Area (cm^2)	Measure (cm)	Area (cm^2)
Lid	16.5 x 1.0	16.5	16.5 x 1.0	16.5
Bottom -upper	[(16.5+15.2)/2] x 3.5	55.475	[(16.5+15.2)/2] x 3.5	55.475
Bottom -lower	[(15.2+12.5)/2] x 1.5	20.775	[(15.2+12.5)/2] x 1.5	20.775
Gross outer surface area		92.75		92.75
Aperture surface area	(0.55 x 0.55) x 2	0.605		0


USDA
United States Department of Agriculture
USDA SCIENCE BLUEPRINT
A ROADMAP FOR USDA SCIENCE FROM 2020 TO 2025

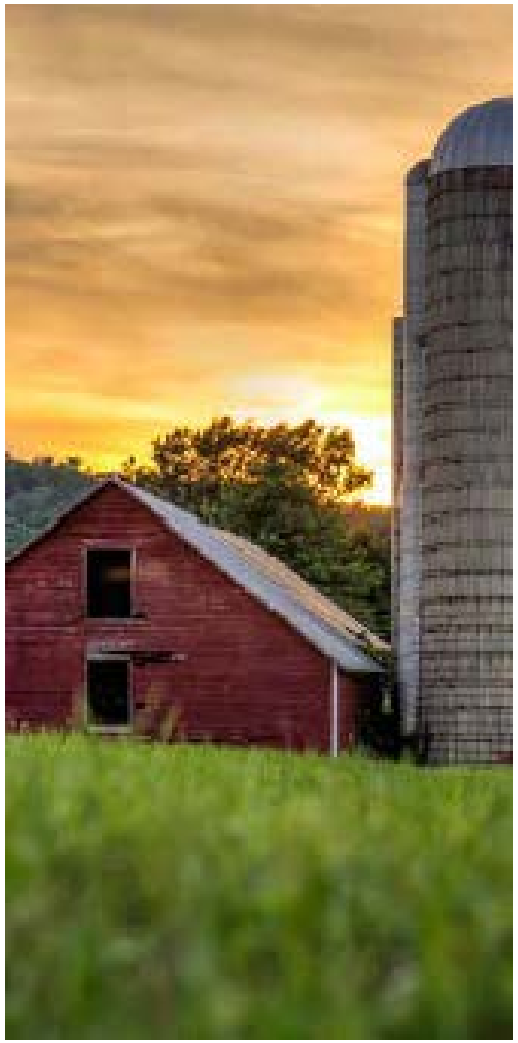


Agricultural Research Service

National Institute of Food & Agri.

Economic Research Service

Forest Service



National Agri. Statistics Service

Office of the Chief Scientist

THEMES

1. Sustainable Ag Intensification
2. Ag Climate Adaptation
3. Food and Nutrition Translation
4. Value-Added Innovations
5. Ag Science Policy Leadership

THEME 04 Value-Added Innovation

- **1st Objective**
- **Strengthen food processing, manufacturing, new uses and marketing through new technologies, innovation, and data analysis to create jobs and economic opportunities in rural America.**