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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.

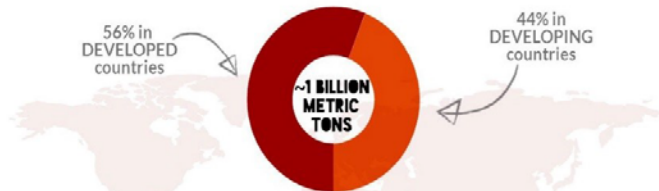
Meanwhile, one in seven Americans is food insecure.



Global Issue

1/4 TO 1/3 OF ALL FOOD PRODUCED FOR HUMAN CONSUMPTION IS LOST OR WASTED

HERE'S THE BREAK DOWN:



THOSE LOST CALORIES COULD FILL HUNGER GAPS IN THE DEVELOPING WORLD



LEARN MORE AT WWW.WORLDBANK.ORG/FOODPRICEWATCH

SOURCES: FAO AND WORLD RESOURCES INSTITUTE

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

ReFED Food Waste Baseline: Nearly 63M tons of waste per year

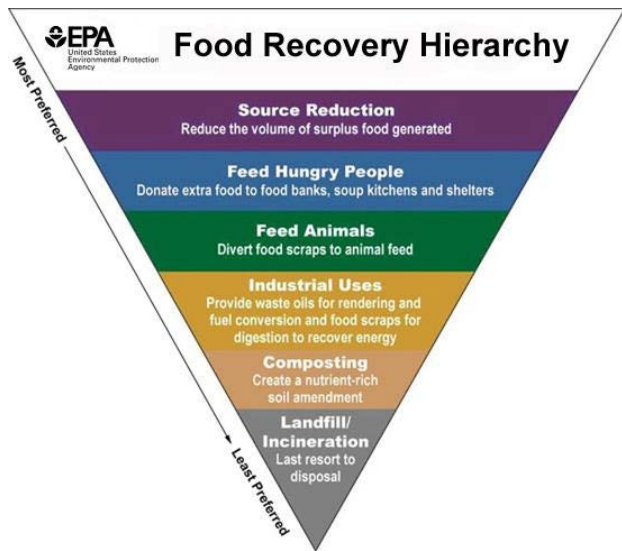


FOOD WASTED BY WEIGHT — 63 MILLION TONS (\$218 billion)



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 Administrator



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



What makes our new fruit bars SO delicious?

California
Washington
& Oregon
Fruit



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

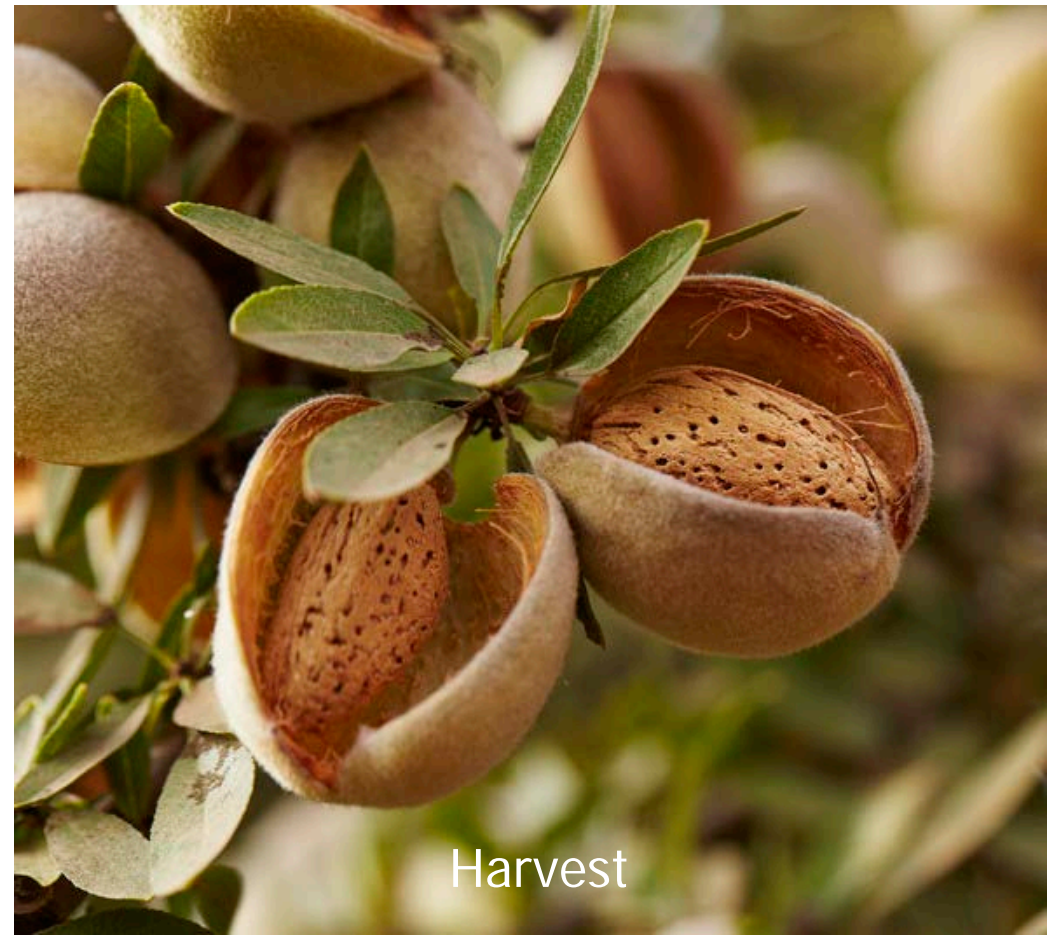
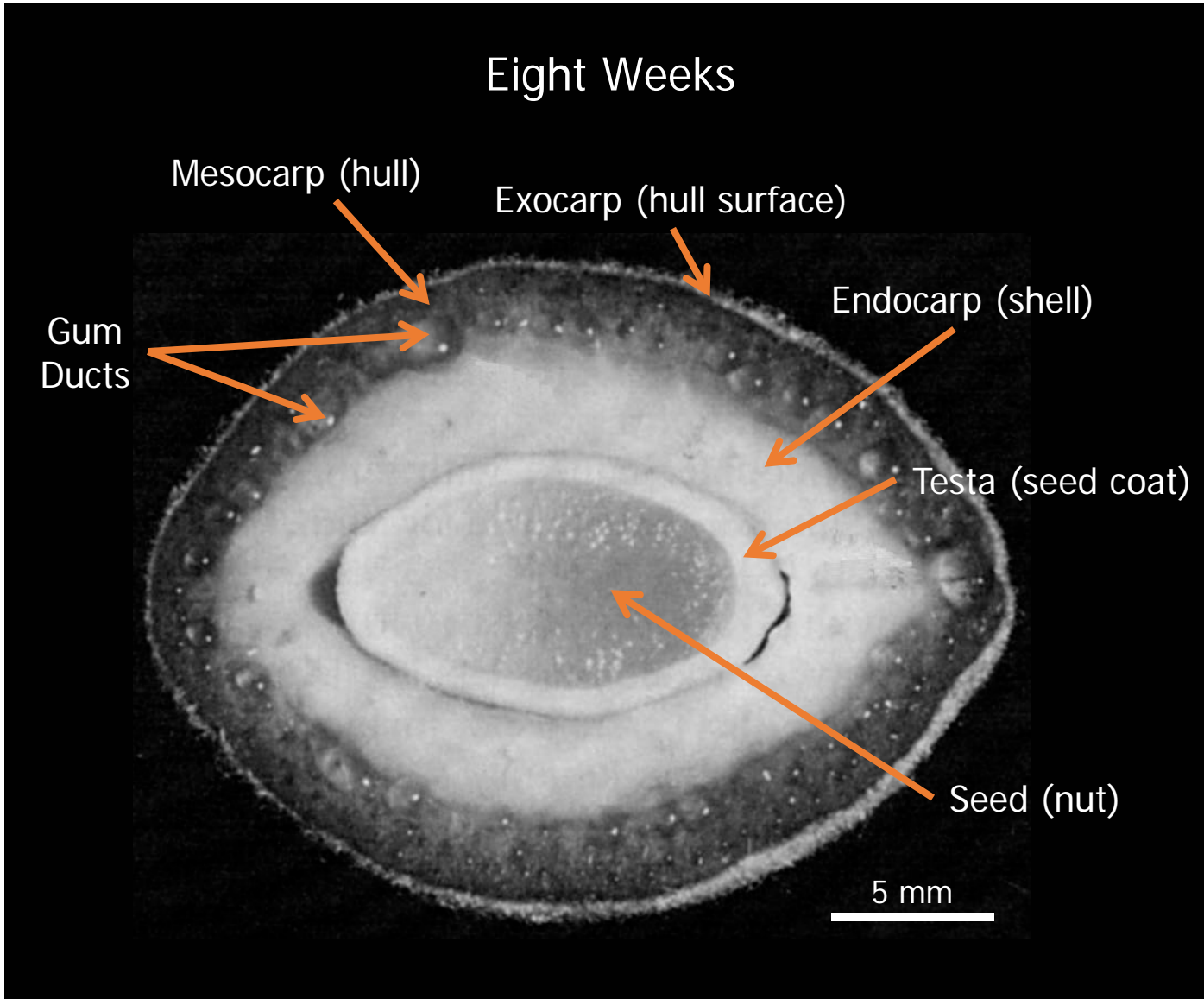
Bioproducts from Almond Shells & Hulls



Delilah F. Wood
de.wood@usda.gov

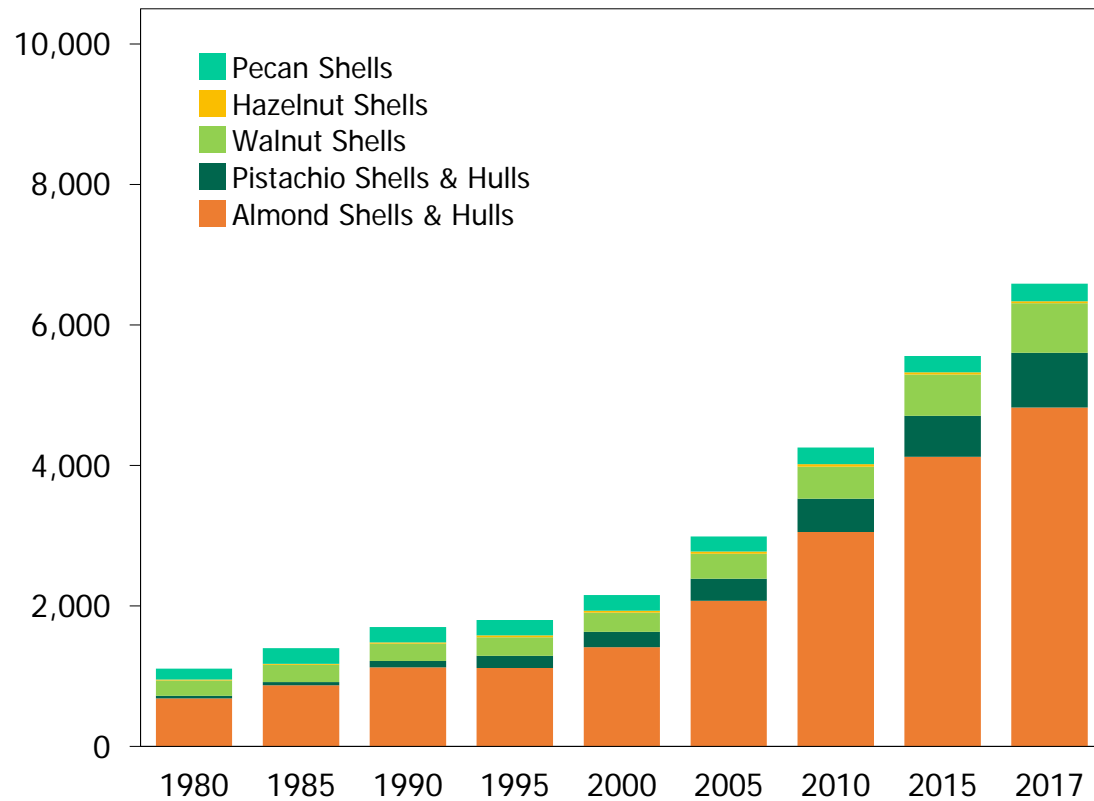


Almonds & Biomass

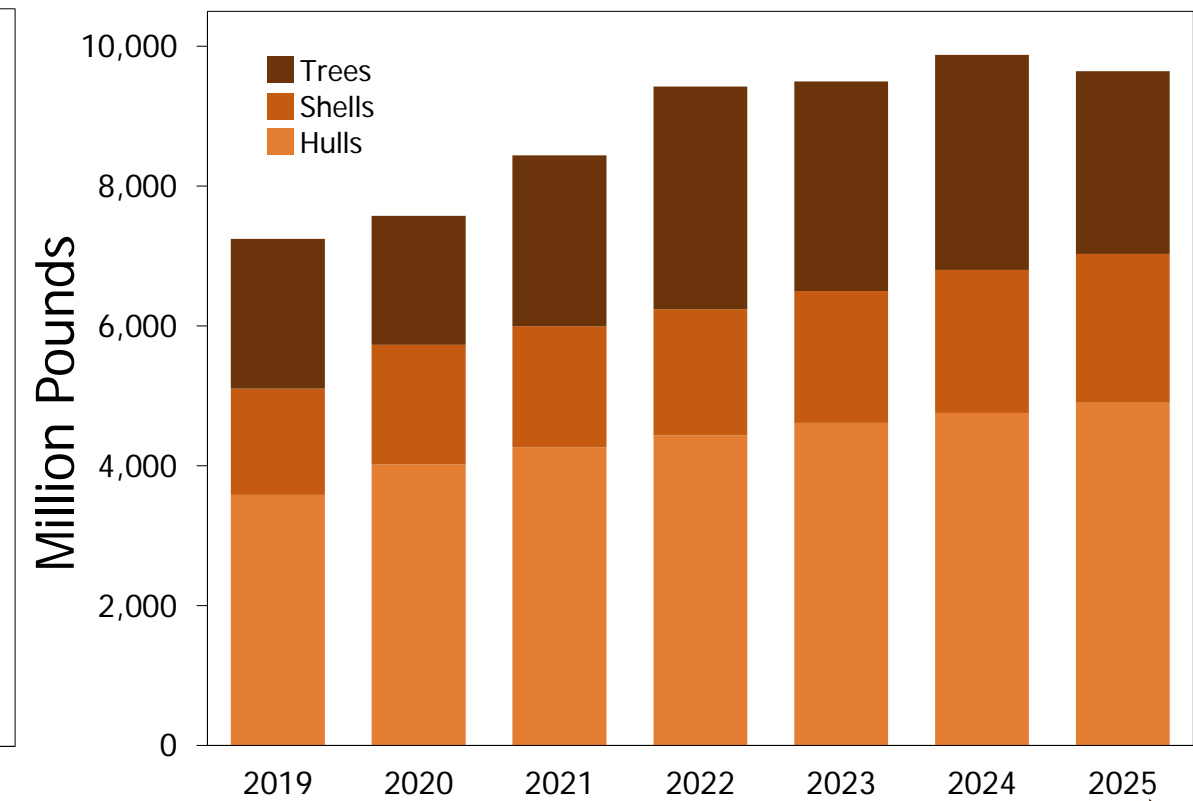


Biomass Volume Increase with Nut Tree Production Growth

US Tree Nut Biomass Production

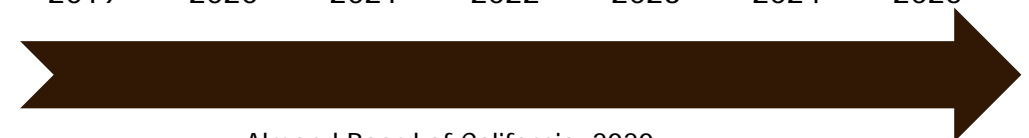


Projected Almond Biomass



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>

2019
7,200 million
pounds



2025
9,900 million
pounds

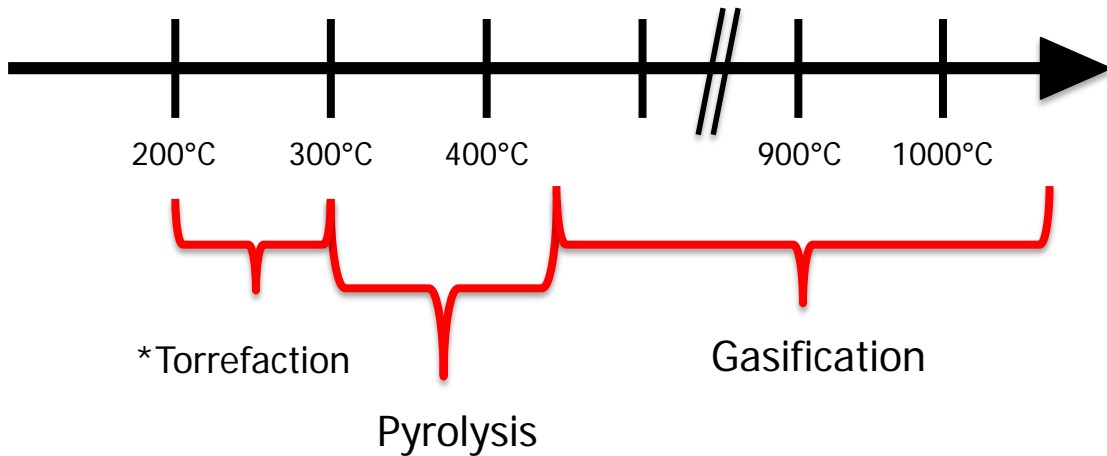
Almond Board of California, 2020

Raw Almond Shells



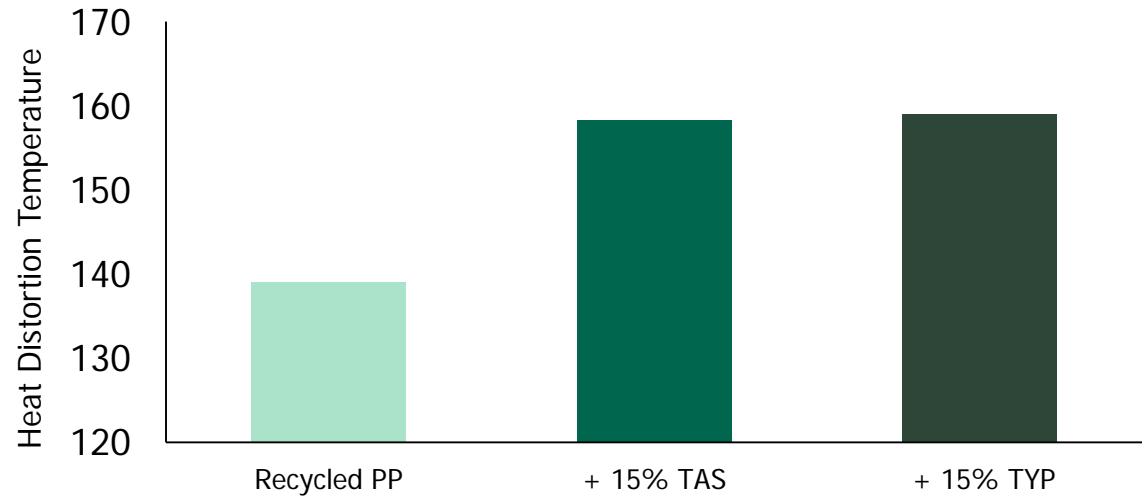
Biomass Heat Treatment

Makes biomass miscible with plastic



Almond Shells Heat Treatment

Torrefied Biomass Increases Melt Temperature



Sun-Damaged Nursery Pots



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

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 Shells Heat Treatment



Shipping Pallet Production



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

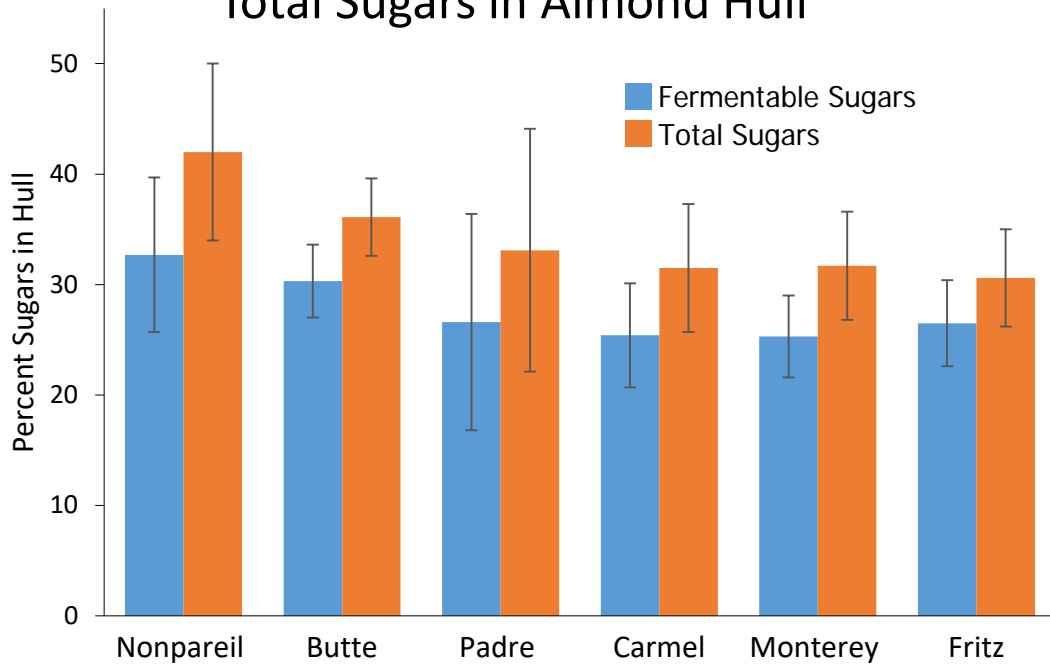


Almond Hulls Sugar Extraction

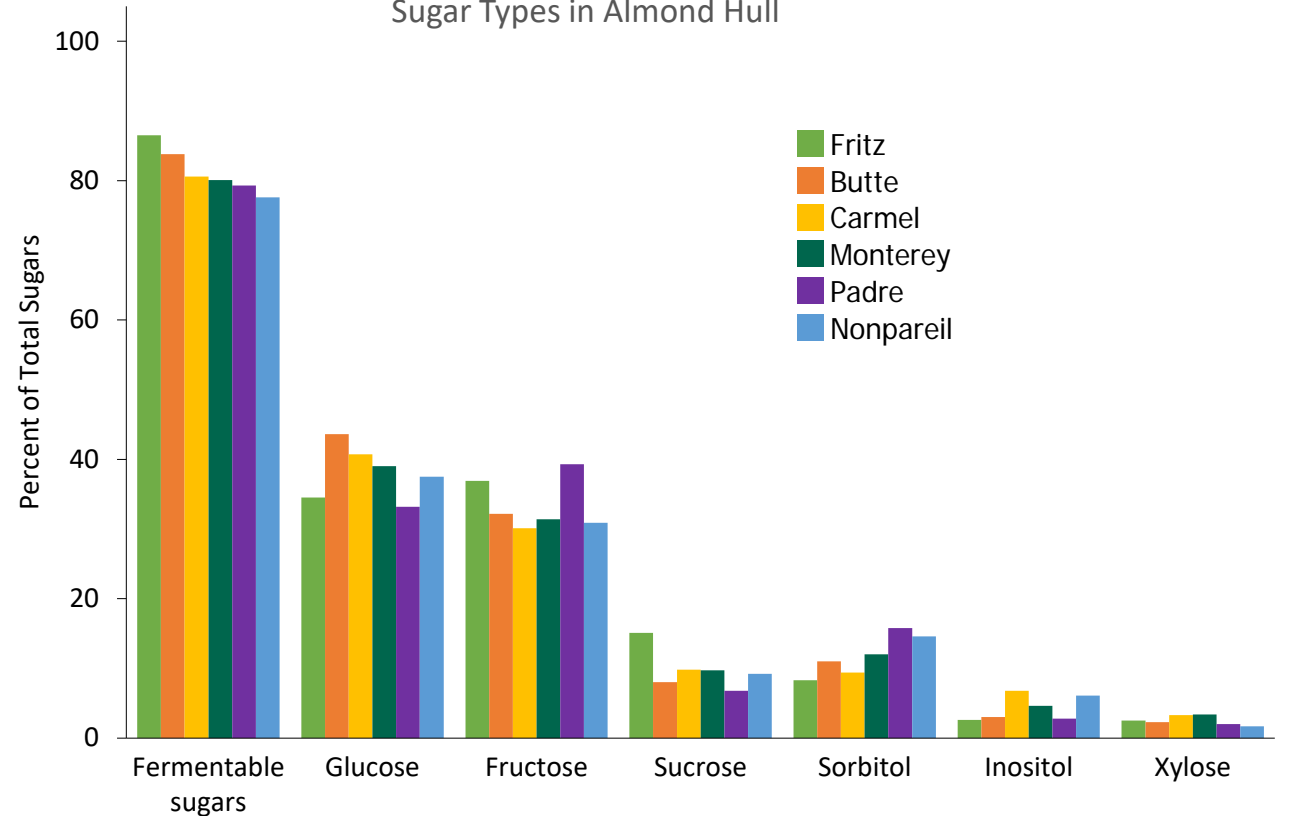


Sugar Beets - 15-20% Sugar

Total Sugars in Almond Hull



Sugar Types in Almond Hull

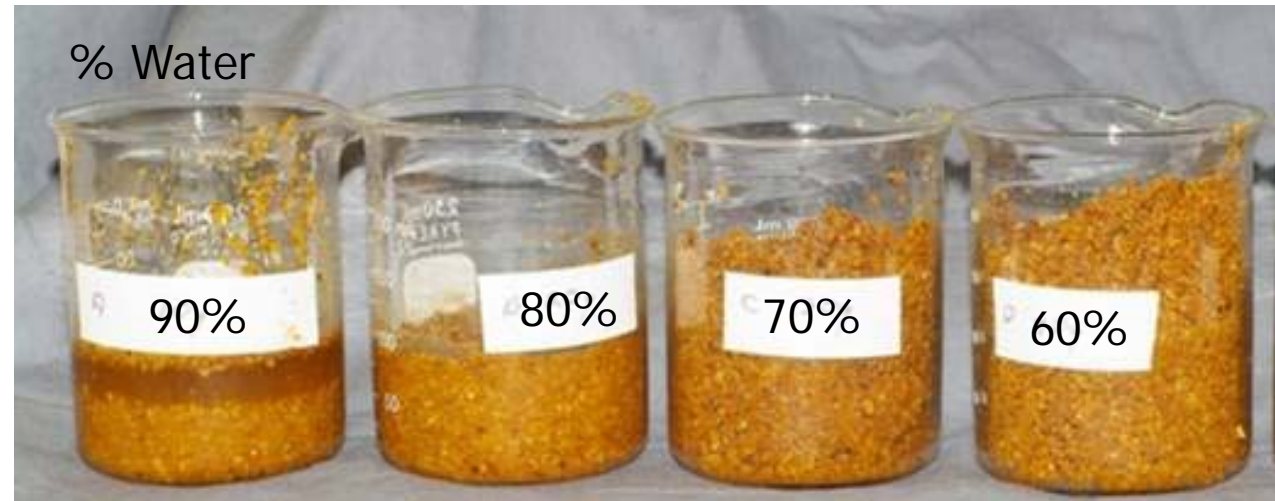


Peat – non renewable resource



Spent Almond Hulls

Hulls absorb 4-8 times weight of water



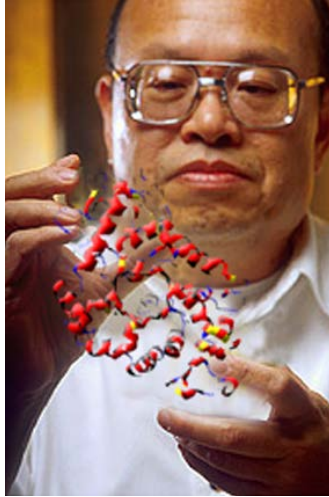
Button Mushrooms with Almond Hulls as Partial Peat Replacer



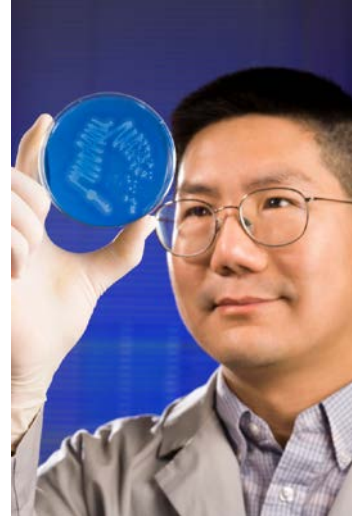
Thank you!

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



Food Loss and Waste: Innovations Mushroom Stalks and Edible Straws

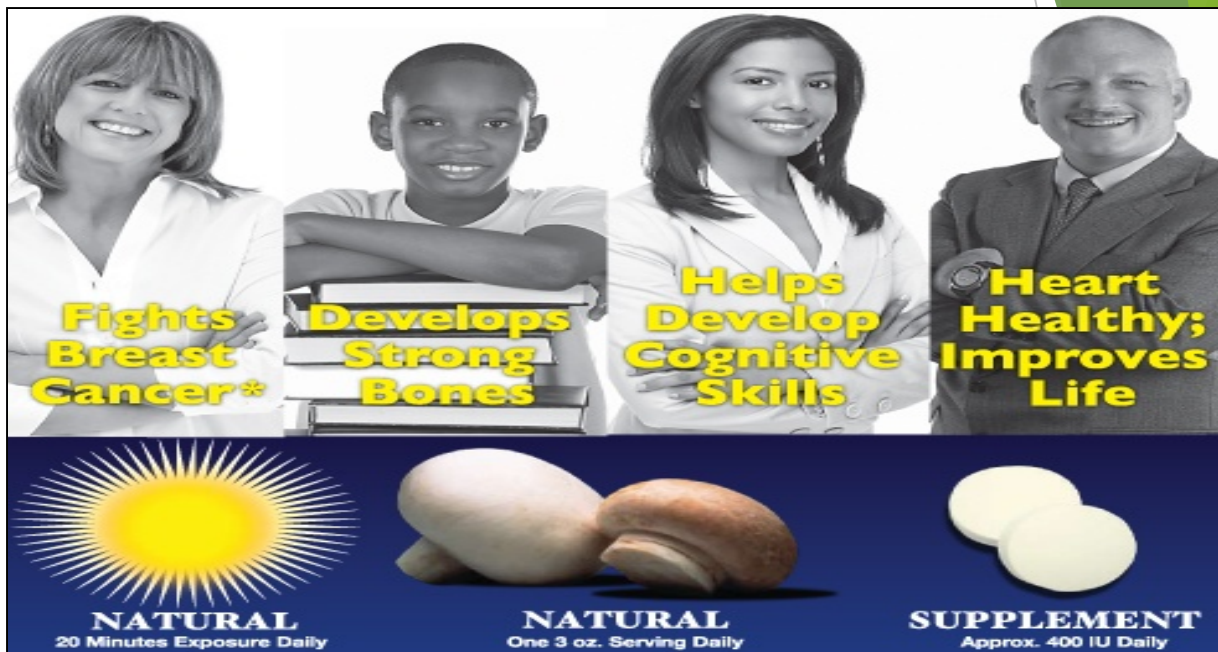


Tara H. McHugh
Center Director

USDA. Agricultural Research Service
Western Regional Research Center, Albany, CA



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



Fights Breast Cancer*

Develops Strong Bones

Helps Develop Cognitive Skills

Heart Healthy; Improves Life

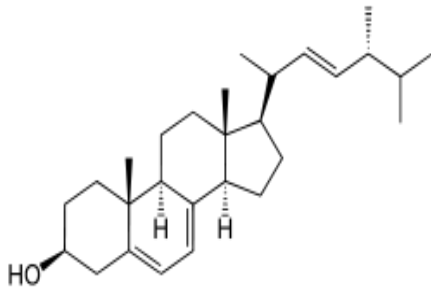
NATURAL
20 Minutes Exposure Daily

NATURAL
One 3 oz. Serving Daily

SUPPLEMENT
Approx. 400 IU Daily

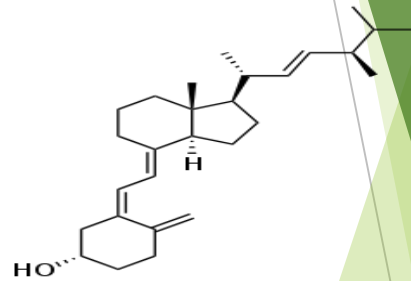
CHEMICAL CONVERSION

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

MONTEREY[®]
MUSHROOMS

JUST MUSHROOMS

ORGANIC MUSHROOM POWDER
With Natural Vitamin D2

USDA ORGANIC

Net Wt. 8oz. (227g)

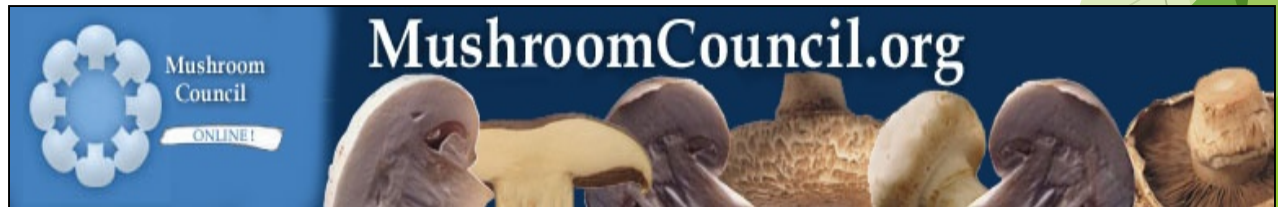
Nutrition Facts		
Serving Size: 1 scoop (5g)		
Servings per container 45		
Amount per serving		
Calories 20	Calories from fat 0	
% Daily Value*		
Total Fat	0g	0%
Saturated Fat	0g	0%
Trans Fat	0g	0%
Cholesterol	0g	0%
Sodium	0.15mg	0%
Total Carbohydrate	3g	1%
Dietary Fiber	1g	4%
Sugars	1g	
Protein	3g	

Vitamin A 0% • Vitamin C 2% • Calcium 0%
Iron 2% • Vitamin D2 1,000 IU's 250%
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.



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



Casting Technology CRADA



Casting Technology for Fruit and Vegetable Edible Films



\$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

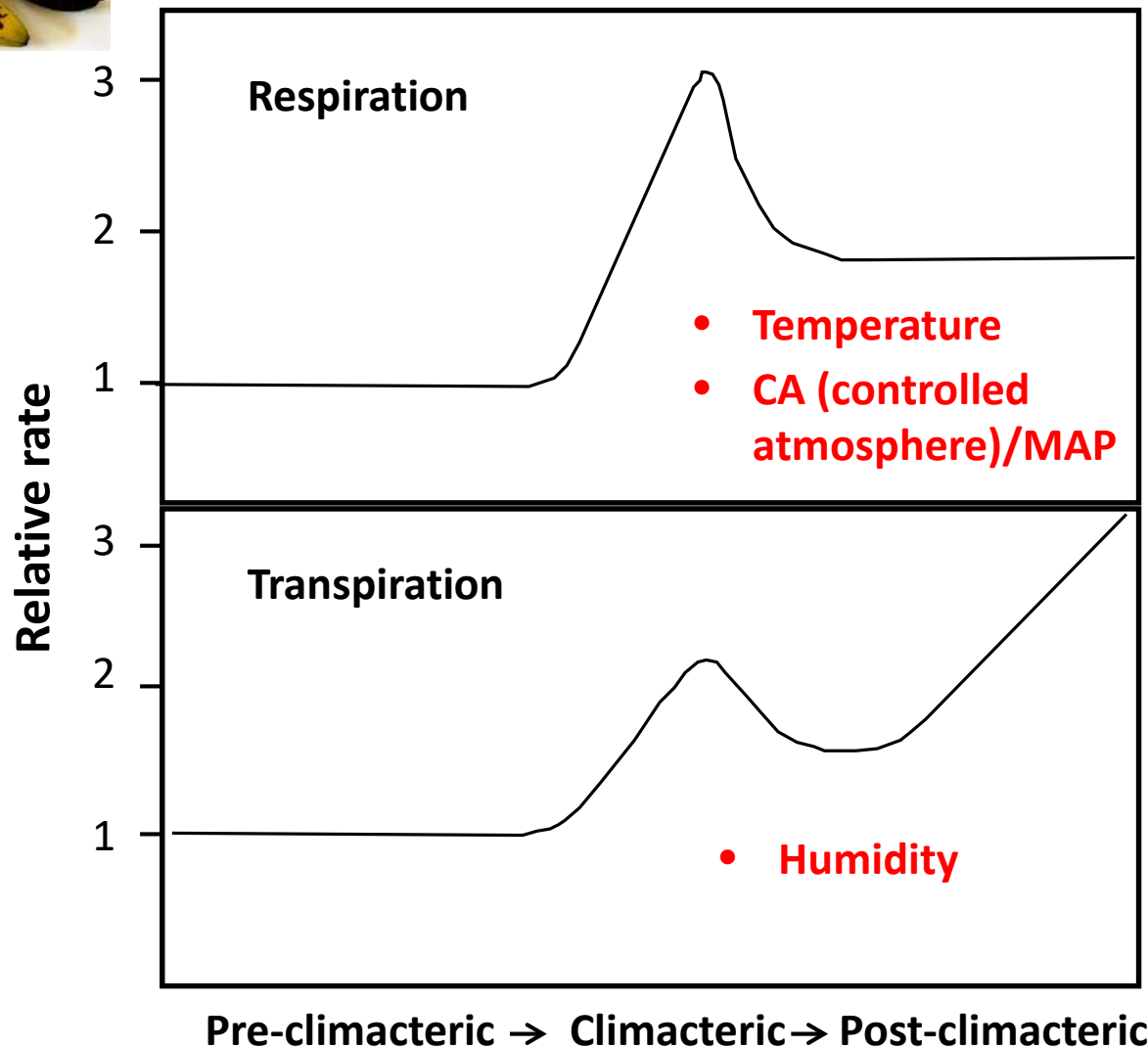
Data from: USDA-NASS, 2018



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

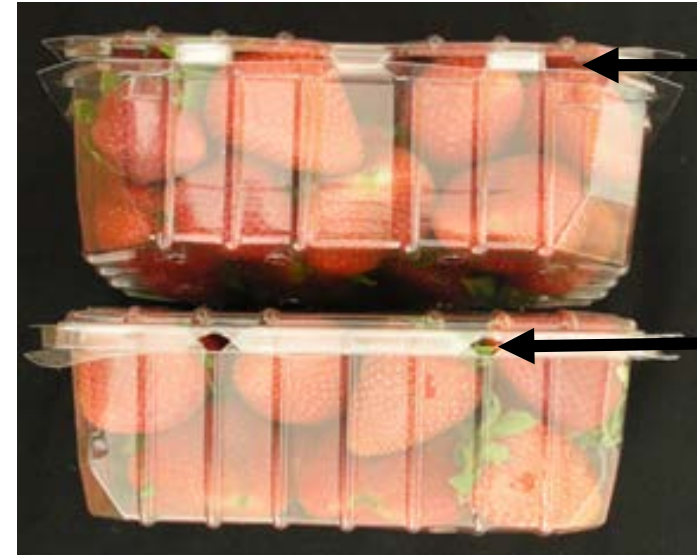
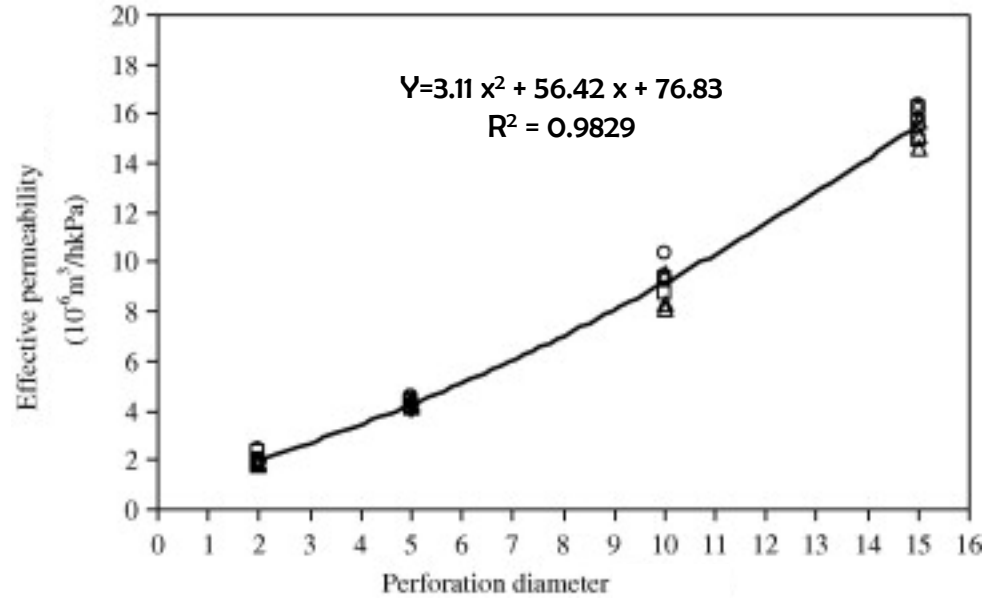


Humidity is one of the key factors in fresh fruit preservation, which has been underestimated



- 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?

Super simple technology – reduce perforation/openings



- 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:

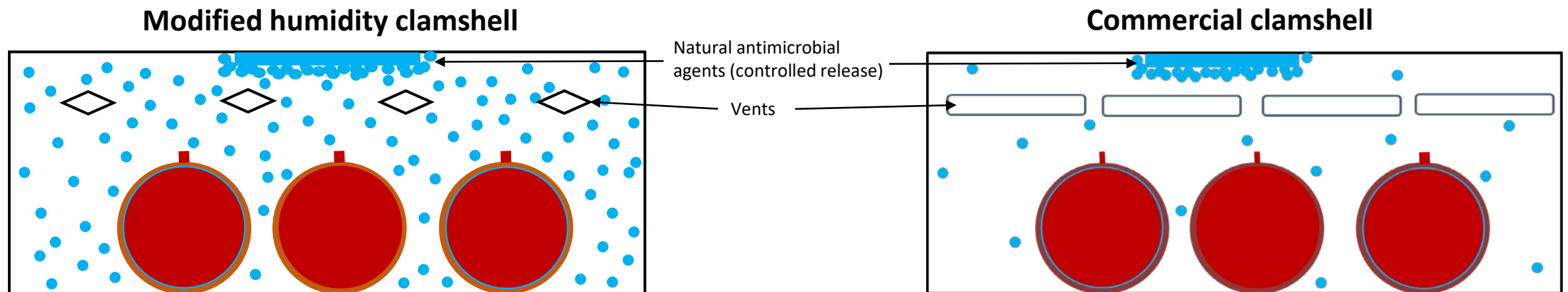
- Compostable packaging - adding citrus juice processing waste and other waste pectin to plastic polymers
- Antifog processing – prevent condensation caused contamination
- Combine packaging with controlled-release natural antimicrobial agents



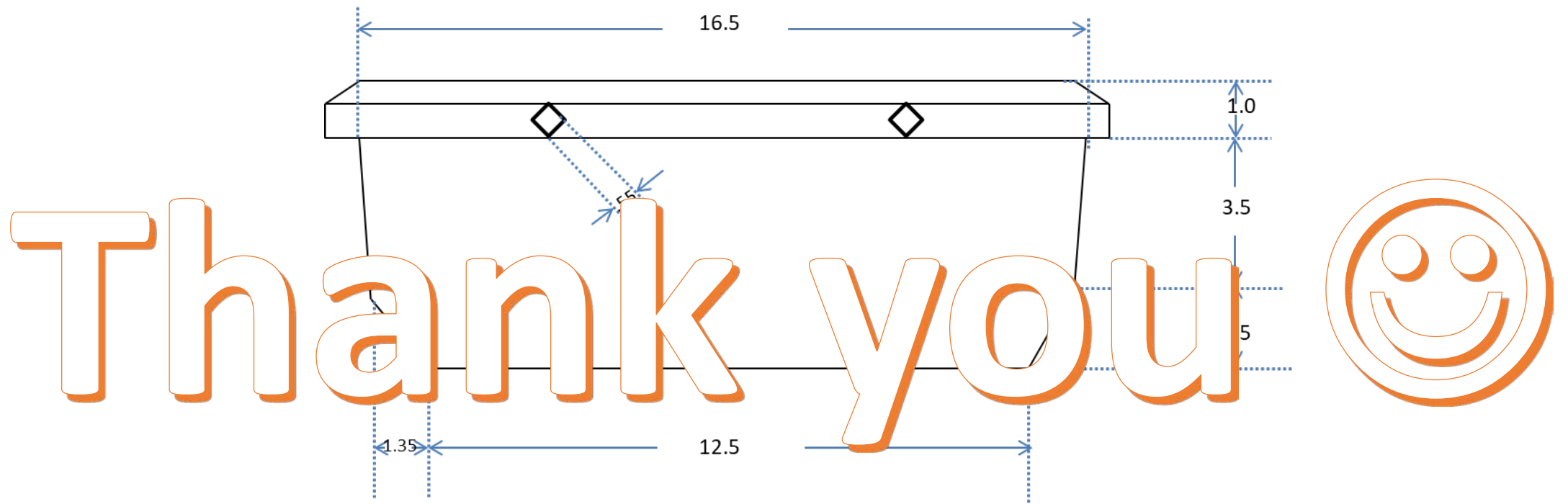
www.mnn.com



Foodengineeringmag.com



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



	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	$[(16.5+15.2)/2] \times 3.5$	55.475	$[(16.5+15.2)/2] \times 3.5$	55.475
Bottom -lower	$[(15.2+12.5)/2] \times 1.5$	20.775	$[(15.2+12.5)/2] \times 1.5$	20.775
Gross outer surface area		92.75		92.75
Aperture surface area				
	$(0.55 \times 0.55) \times 2$	0.605		0



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.**