2024

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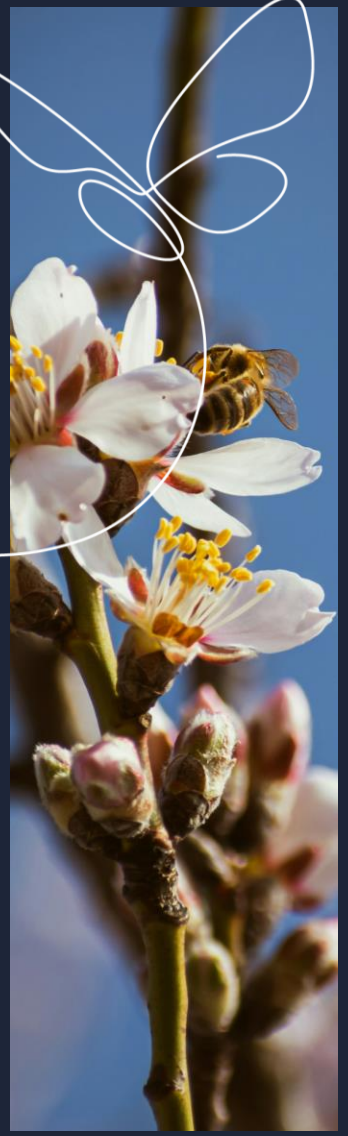

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Adding Value: Almond Hulls for New Food Uses

Moderator: Michael Kelley (CCAGA)

ALMOND BOARD OF CALIFORNIA

Session Agenda

Moderator: Michael Kelley

Guangwei Huang – Almond Board of California

Almond Hulls as a Sustainable Food Ingredient

Daniel Kurzrock – Upcycled Foods

Upcycle Inspiration

Dave Thiel – Cortez Growers Association

Commercial Hulling/Shelling Operation to Produce High Quality Hulls

Corbin Sturdivan – Wilkey Industries

Equipment and Concepts for Cleaning Almond Hulls and Recovering Meats

Sean Chandler – Chandler-Automation

Electronic Sorter to Remove Foreign Materials from Hulls

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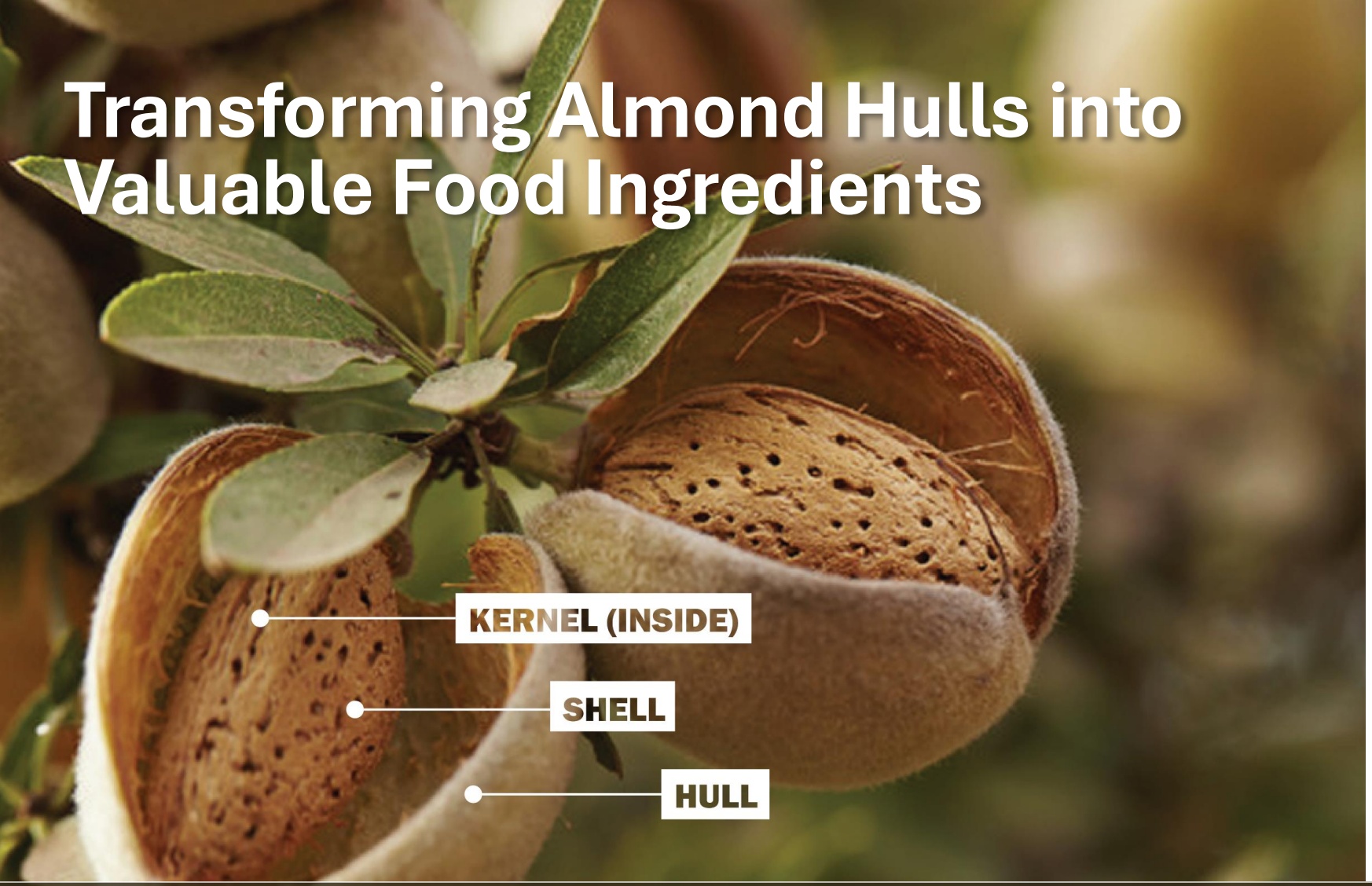
Unlocking Value

Almond Hulls as a Safe & Sustainable Food Ingredient

Guangwei Huang - Almond Board of California

Transforming Almond Hulls into Valuable Food Ingredients



Almond hulls, **making up 50% of the almond fruit**, share similarities with other *Prunus* fruits like apricots, peaches, and plums. This opens the door to their potential use in a variety of food products.

Nutritional Composition of Almond Hulls

Almond hulls are **rich in dietary fibers, sugars, proteins, phytochemicals, and minerals**, offering a **valuable nutritional profile** that can enhance the health benefits of food products.

	Kernels	Hulls
Dietary Fibers (%)	9.0 – 12.0	32.0 – 42.0
Sugars (%)	3.5 – 5.0	17.0 – 35.0
Protein (%)	19.0 – 24.0	4.0 – 7.0
Phytochemicals (g GAE/100g)	0.3 – 0.4	8.0
Minerals (%)	1.6 – 1.8	3.0 – 4.3
Fat (%)	46.0 – 52.0	1.0 – 2.5

88 – 94% Dry Matter

High Level of Phytochemicals Make Almond Hulls Unique as Health Promoting Ingredients

- **Accumulative** from long exposure of sunlight during nut drying on trees; a part of plant tissue, and a defense mechanism against environment stress, in free and bound form (monomers or polymers)
- **Extractable**, up to 8 g GAE total phenolic compounds per 100 g of DM hulls assayed, including benzoic acids, cinnamic acid, flavonoids and triterpenoids (~1%); reported extracts 4 to 5.5% of hulls
- **Nutraceutical** phenolic compounds contained in hulls: anti-inflammatory, antitumor, anti-HIV, photoprotective, antimicrobial and antibacterial effects
- **Hull extracts are bioaccessible**, shown significant antioxidative, antiproliferative activity in in-vitro studies

An et al. 2020, J Food Chem; Prgomet et al. 2017, Molecules; Wijeratne et al. 2006, J. Agric, Food Chem; Takeoka et al. 2000, 2003, J Agric Food Chem

Hull-Derived Ingredients: Functional and Health-Boosting

- Simple aqueous processes make phytochemicals in hulls bioavailable
- Hulls can be easily processed into various ingredient forms
- Hull derived powders are functional ingredients
    - Excel in oil holding and emulsifying over commercial fibers
    - Hull powder derived drinks show stronger antioxidative capacity than many commercial antioxidant rich beverage
- Health boosting
    - Aqueous hull extracts lower LDL cholesterol and protected cells from oxidative damage
    - Hull powder improved nutrient profile in food products

Are Almond Hulls Safe for Food Uses?

Historical safe feed uses

Environmental contaminant under control

Trace cyanogenic compounds (HCN)

Toxicity studies (OECD/FDA protocol) prove safety

Why are Almond Hulls for Food Uses?

RICH IN DIETARY FIBER AND PHYTOCHEMICALS

EASILY PROCESSED INTO FUNCTIONAL INGREDIENTS

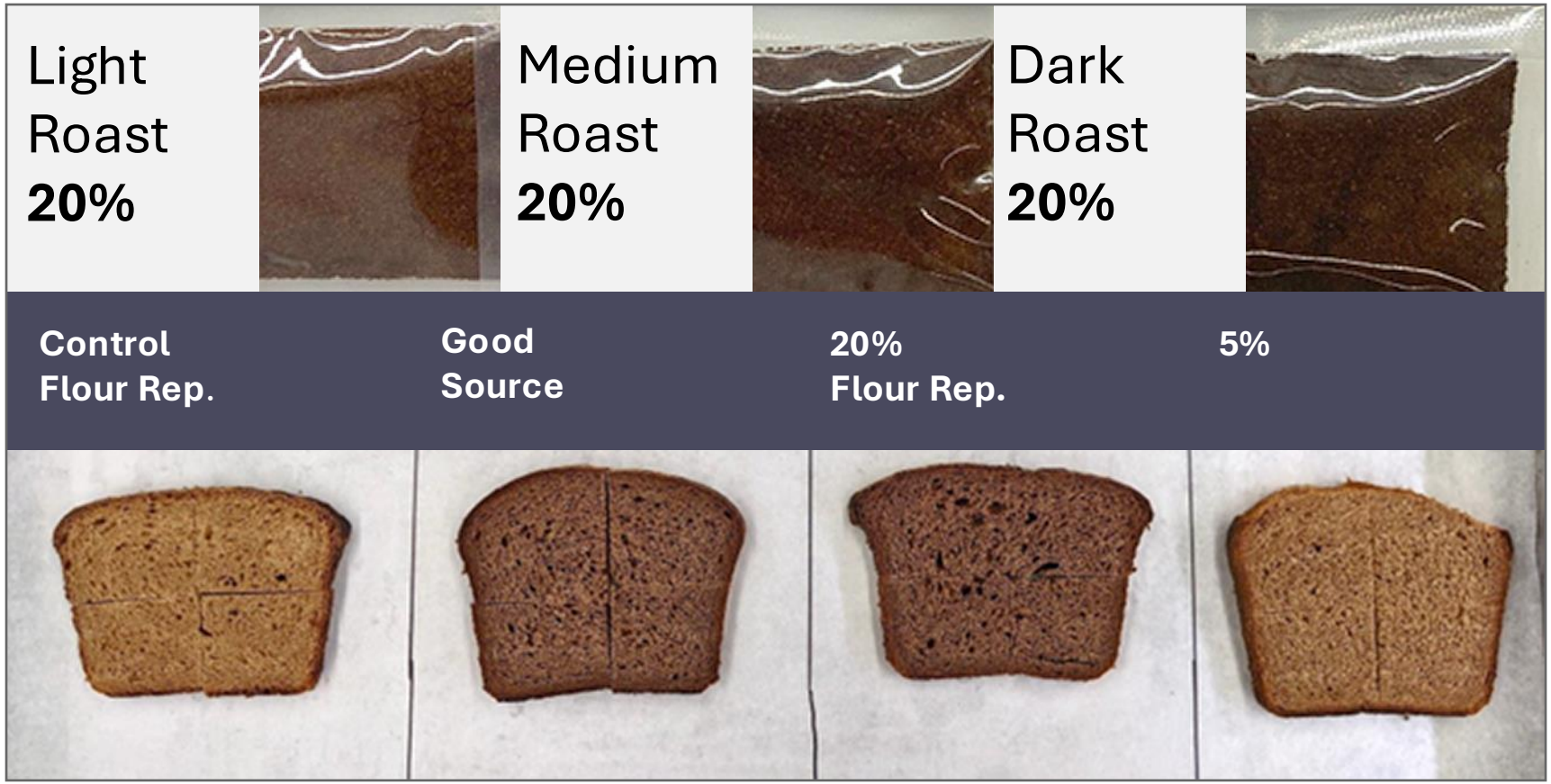
UNLIMITED APPLICATION POTENTIALS

SUSTAINABLE AND STEADY SUPPLY

High Fiber Bar and Antioxidant Beverage – Special Treat for Tea Break

MATTSON
WE MAKE FOOD HAPPEN

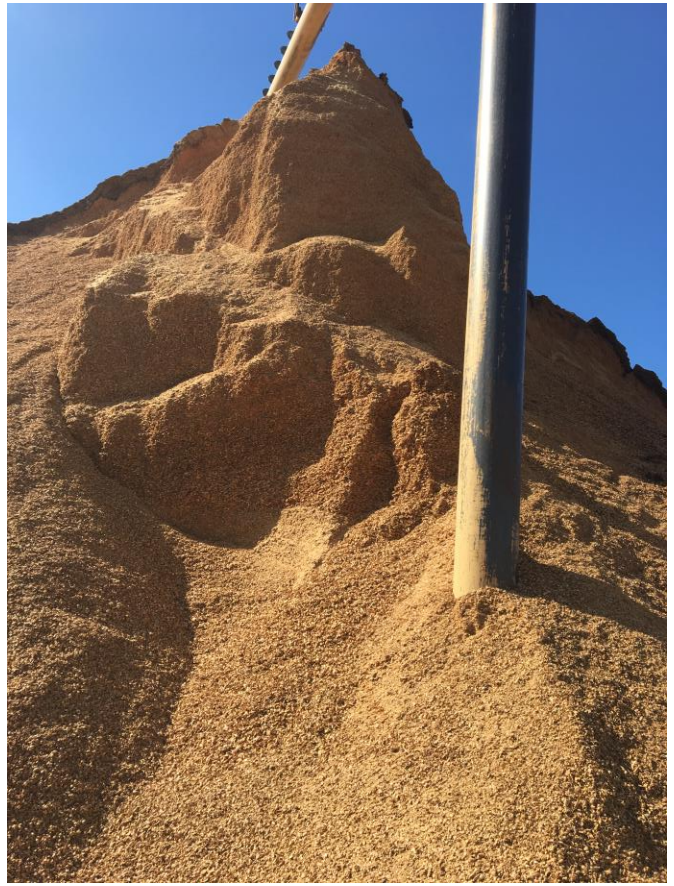
Adding 10% or More Hull Powder Qualifies Foods for Upcycled Claims



MATTSON
WE MAKE FOOD HAPPEN

Current Utilization of Almond Hulls

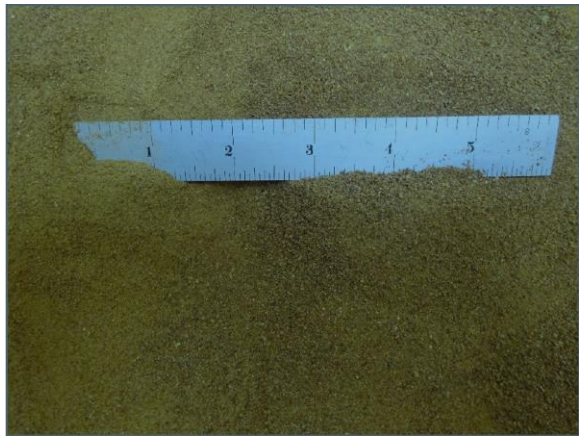
Almond hulls are primarily used as a low-value feed supplement for dairy cows. They are often mixed with other residues, but their potential as **a high-value ingredient** for human food remains largely untapped.



Roadmap to Commercialization

Complete	Complete GRAS dossier/self-assessment and file FDA notification
Acquire	Acquire high quality hulls for food uses
Explore	Explore milling options and produce hull flour
Promote	Promote sustainable future

Milling Exploration (Urschel, Buhler, Finesse Mills)



Acquire High Quality Hulls

Sourcing: variety, hulling operation, meat recovery station

Existent Equipment for Hull Sorting: sifter, aspirator, electronic sorters

Collaborators and Stakeholders: Satake, Wilkey Machinery Inc, Buhler, Chandler Automation

Handling: storage and minimal specification for food uses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Speaker: Daniel Kurzrock (Upcycled Foods)

UPCYCLING 101

U.S. food manufacturers generate over 13 million tons of food waste annually—

90% of which caused by byproducts and processing inefficiencies.[1]

1. ReFed, 2023

Food waste is top of mind; consumers want brands and retailers to do more

98%

of global consumers are trying to reduce food waste.[1]

61%

feel brands, stores, and supermarkets should do more to help reduce waste.[2]

57%

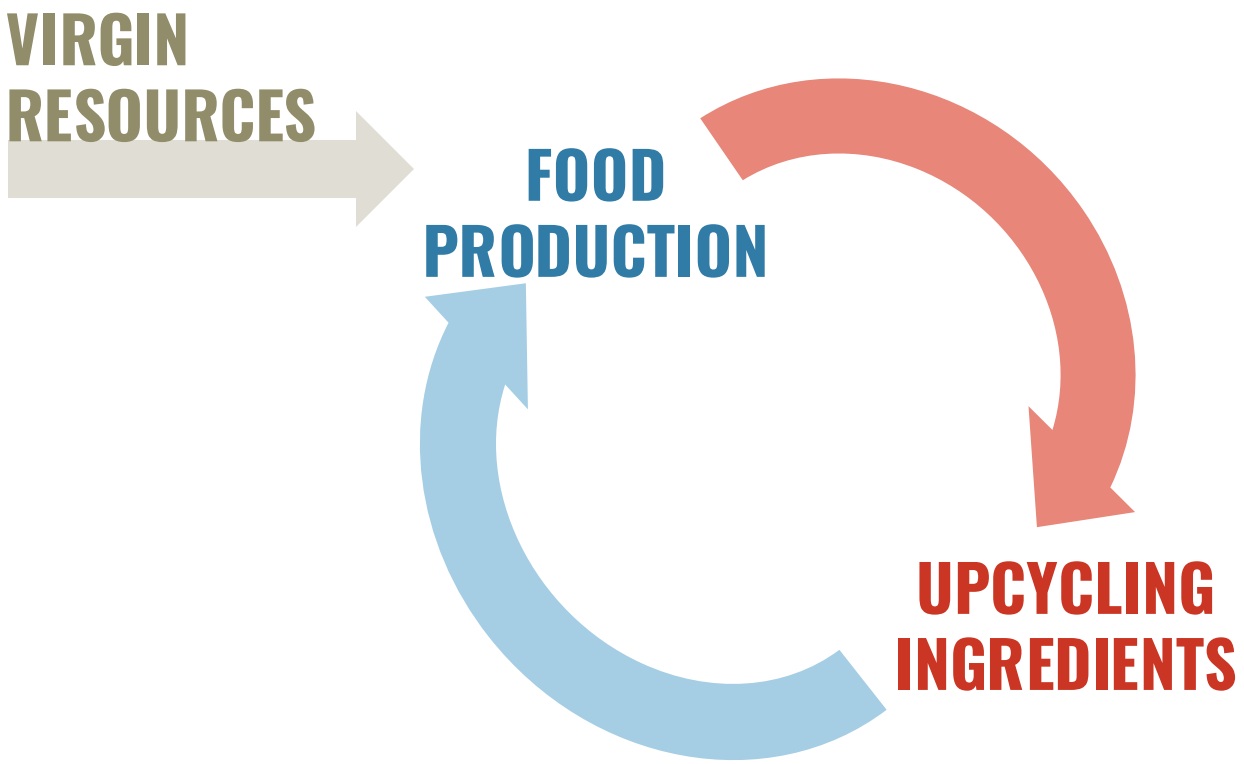
feel disappointed in these entities for not caring enough about the issue.[2]

Sources: 1. Kerry, 2023. 2. Capgemini Research Institute, 2022.

Upcycling reduces the use of virgin resources, maximizing existing ones

Water | Energy | Nutrition

Upcycling in the Circular Economy



Through upcycling, positive environmental & social impact can drive net financial benefit

$2.78B

Net Financial Benefit of Investment[1]

ANNUAL US IMPACT POTENTIAL[1]

1.93M Tons
Food Waste Diversion

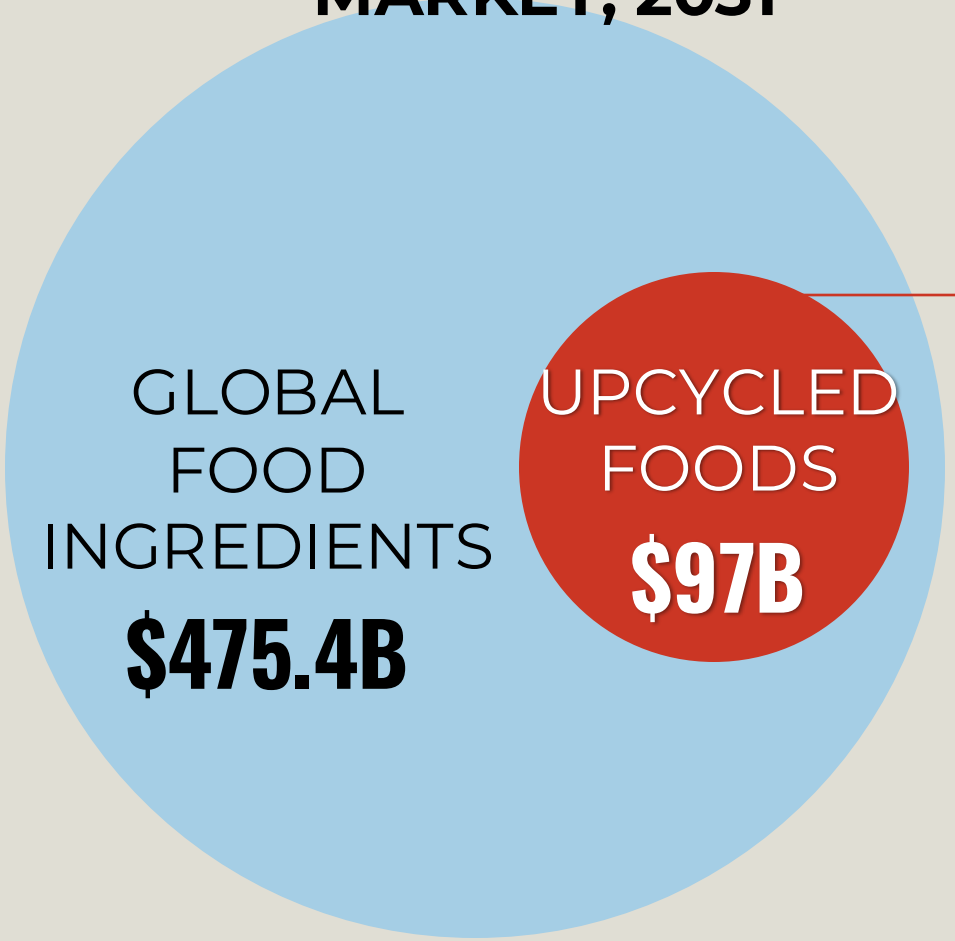
6.26 Metric Tons CO2e
Emissions Reduction

543B Gallons
Water Savings

2.93K
New Jobs

Source 1. ReFed.org, accessed March 2024

PROJECTED GLOBAL INGREDIENT MARKET, 2031[1]



Demand for upcycled foods is growing

Upcycled foods are projected to become 1/5 of the global food ingredient market by 2031.

Source 1. Allied Market Research, 2021.

Product growth and media coverage signal upcycling as a major movement

FOOD navigator-usa.com

food network magazine

freshdirect

CBS NEWS

CNN

61%

average annual growth of global product launches with mention of “upcycled” or “rescued” between 2018-2019 to 2022-2023.[1]

“***Upcycling, it resembles what we saw a decade ago with the natural organic and clean-label products (which) eventually became huge mainstream markets [...] When we look at upcycling we think it could evolve similarly***.”

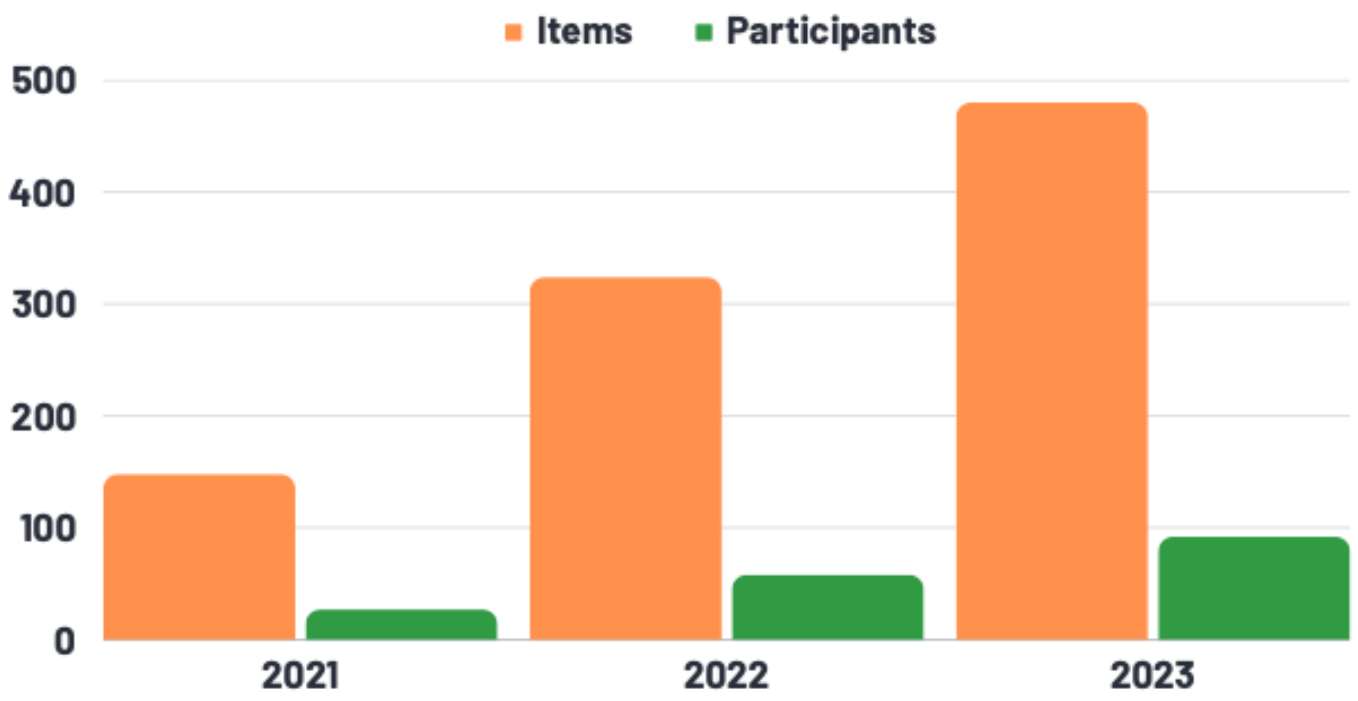
- Eric Markin, Mesirow Investment Banking Director[2]

Mesirow

Sources: 1. Prepared Foods, February 2023. 2. The Food Institute, May 2023.

Surging Upcycled Certified™ items and sales indicate mainstream opportunity

GROWTH OF CERTIFIED ITEMS & PARTICIPANTS[1]

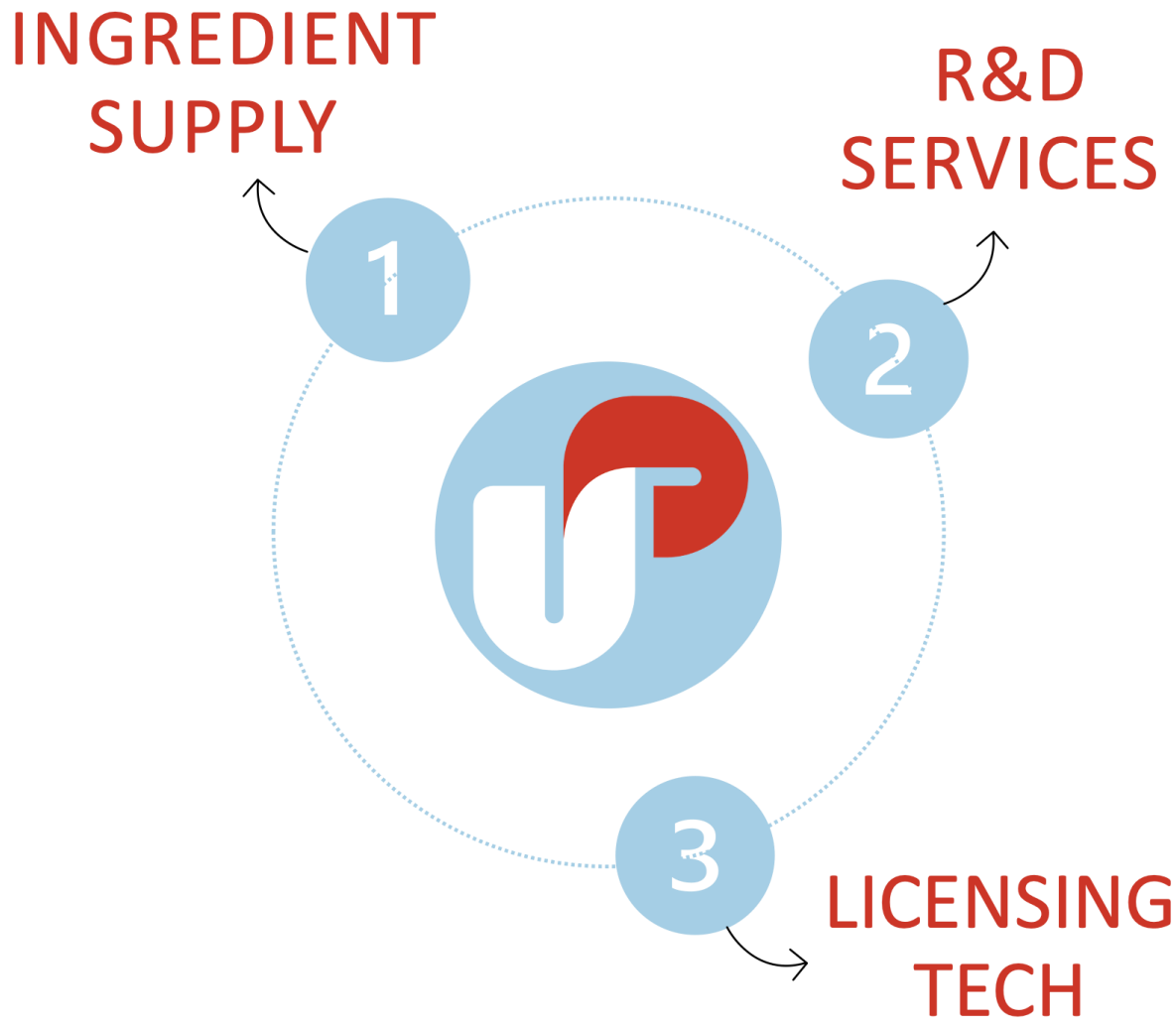


133%

USD sales growth between 2021 – 2023

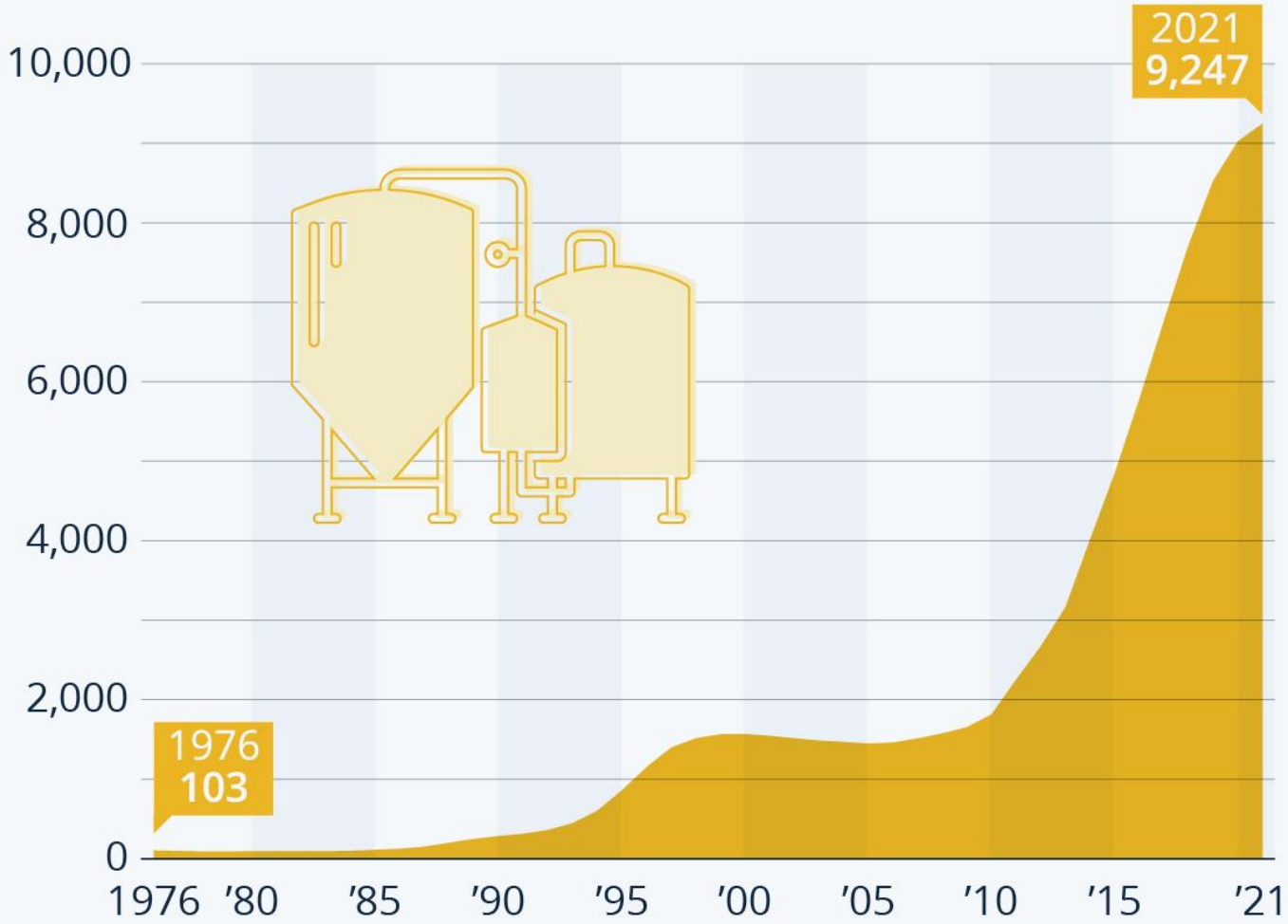
Sources: 1. SPINS, 2023. 2. Upcycled Food Association, 2023.

Upcycled Foods, Inc. offers the industry better ingredients made through innovation that turn waste into profit and impact.



America's Brewery Boom

Number of breweries in the U.S. from 1976 to 2021



Source: Brewers Association

statista


POWERED BY
UPCYCLED SUPERGRAIN

1

INGREDIENT SUPPLY

Wholesale upcycled ingredients to food manufacturers.

PORTFOLIO:

Barley
- ReGrained SuperGrain+® Original
- SG+ Protein
- SG+ Fiber

Cocoa
- Cacao Fruit Syrup
- Cacao Husk Tea
- NoCocoa+ Powder

Coffee
- Coffee Leaf Tea
- Coffee Fruit

Grape
- Wine Raisins®
- Grape Pomace Puree

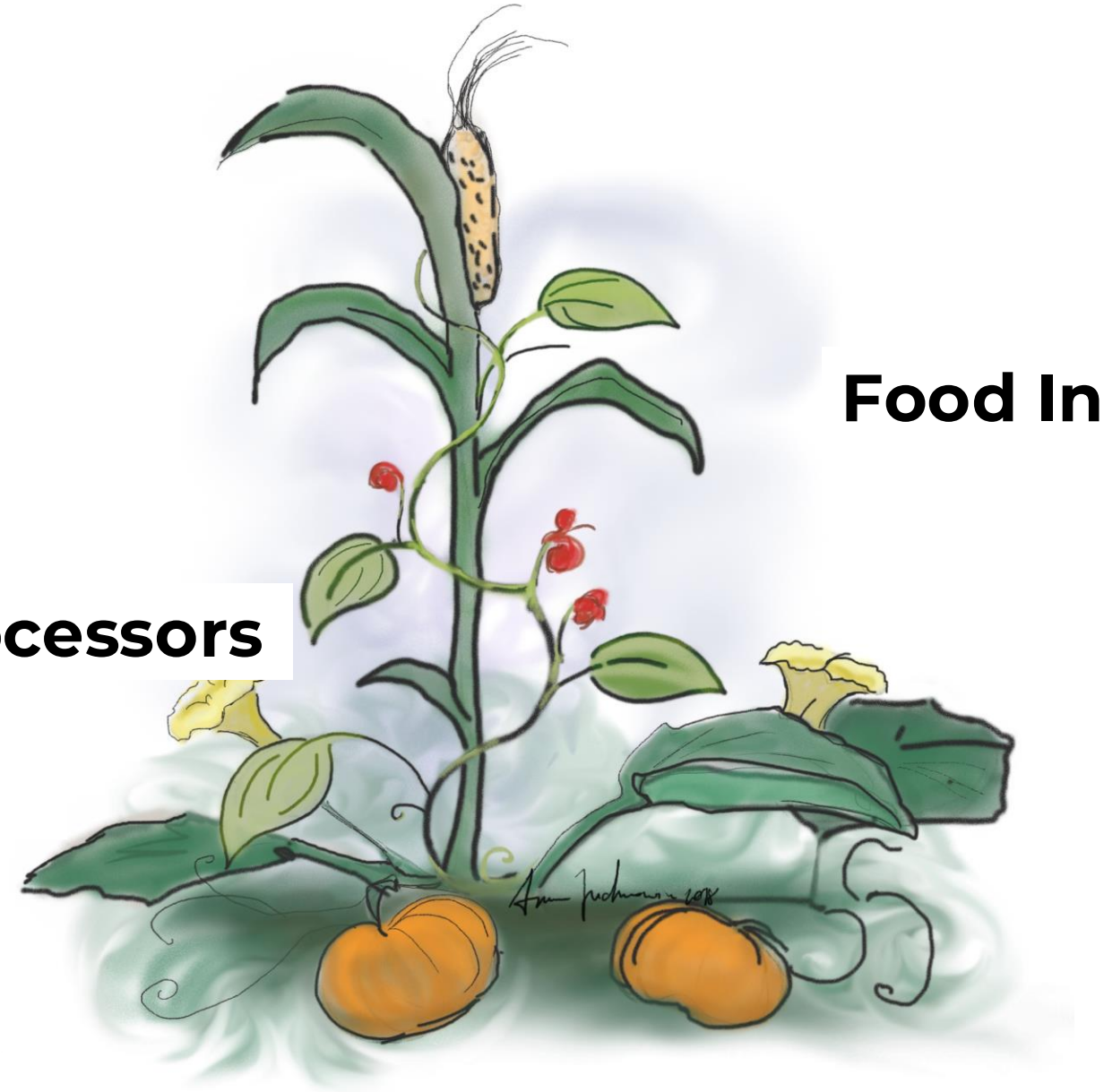
Date
- Syrup
- Paste
- Sugar

Misfits Market · Kroger · Whole Foods Market · Atoria's Family Bakery · DeIorios · Carrington Farms · Kerry · puratos Food Innovation for Good · Griffith Foods

ALMOND UPCYCLING POTENTIAL

+ Enhance the overall sustainability and circularity of operations
+ Unlock new revenue streams
+ Reduce disposal costs
+ Align with growing consumer and industry demands
+ Strengthen industry reputation in sustainability
+ Create partnerships and collaborations that drive technological advancements and market expansion

OPEN INNOVATION & COLLABORATION



Food Innovators

Processors

Researchers

Growers

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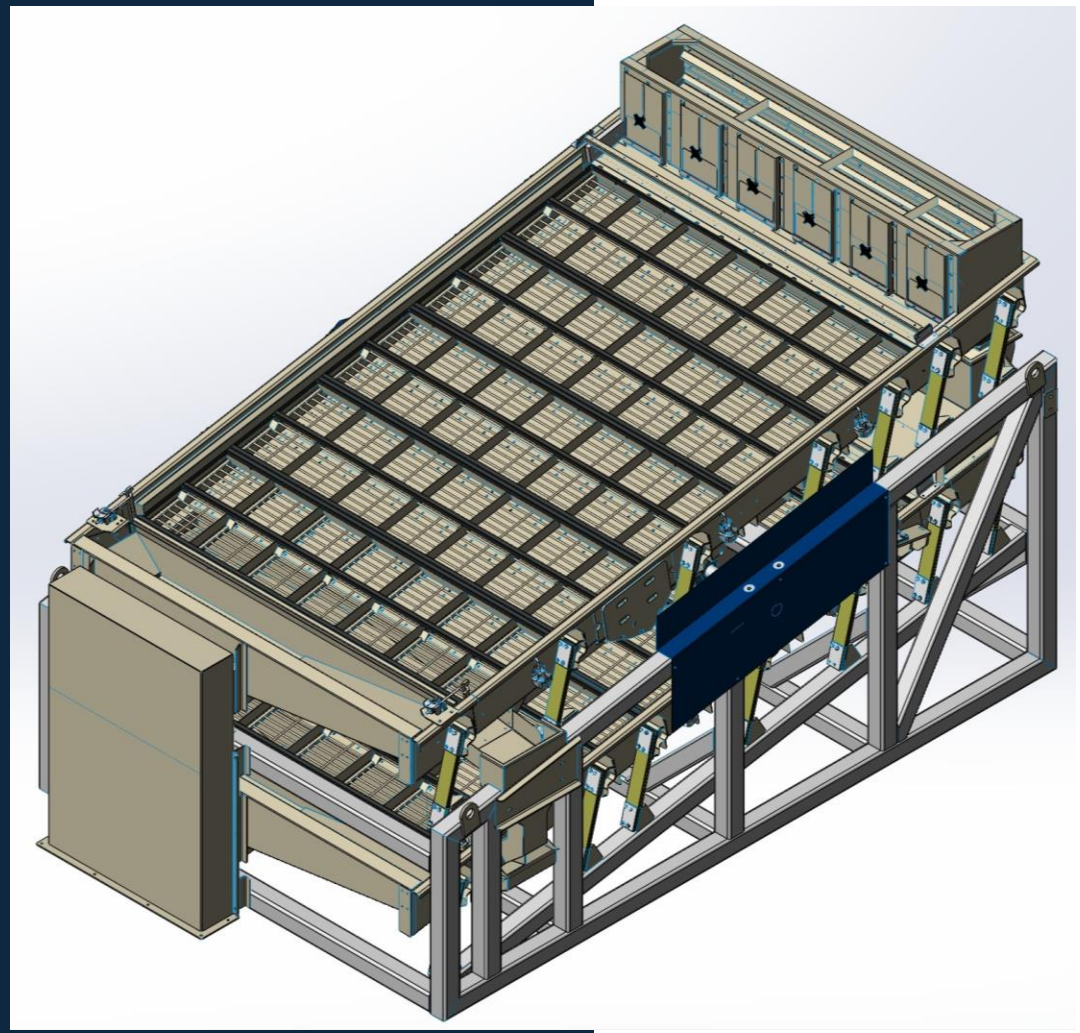
Equipment and Concepts for Cleaning Almond Hulls and Recovering Meats

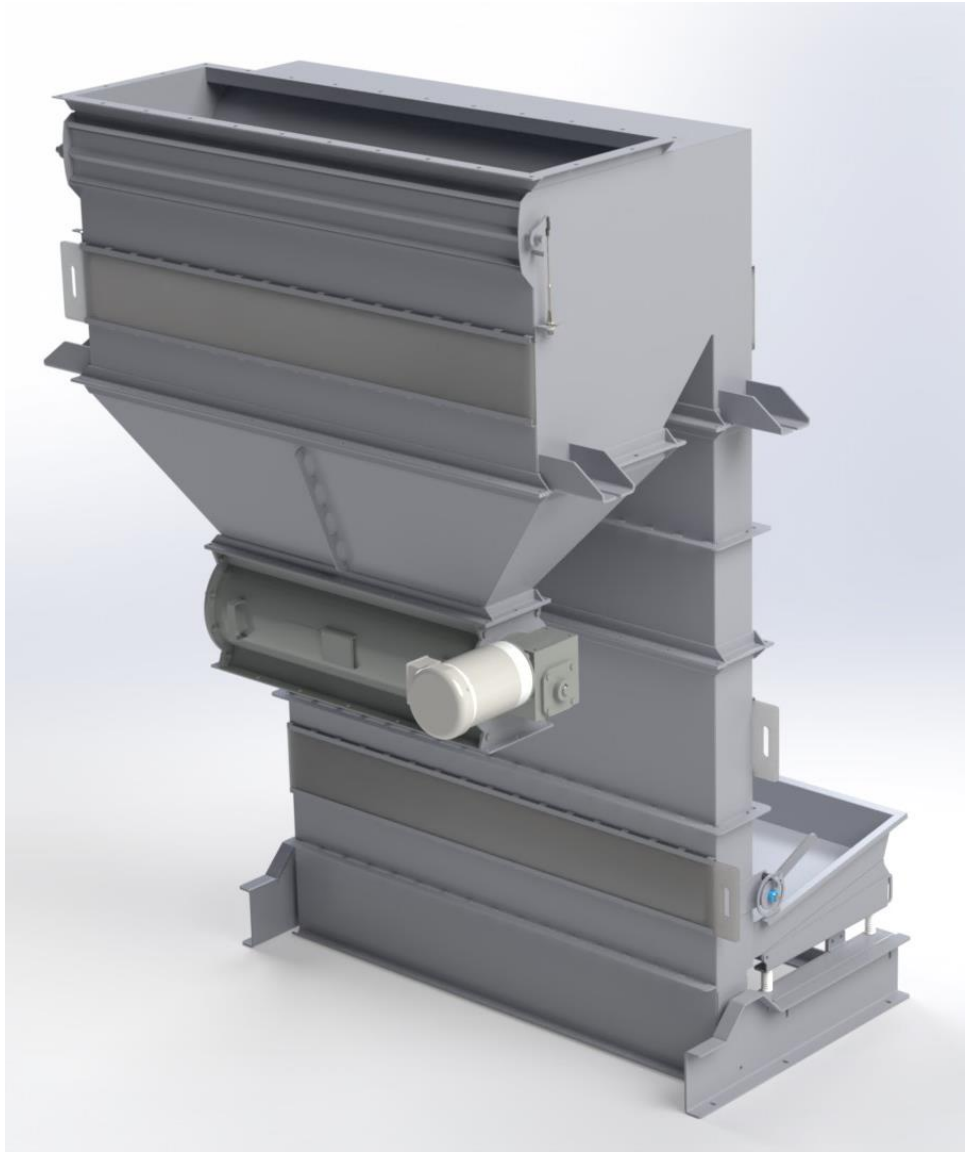
The Material:

Mixture of hulls, shells, sticks

and other foreign material.



SCREENING



AIR ASPIRATION

Traditional Hull Cleaning System

Components Include:

- Aspirator to remove shell from hull

- Detwigger deck to remove sticks from the hulls

- Some systems may have an additional aspirator

System Includes:

- Shell Aspiration
- Detwigger for sticks
- Screen to sift fines from the hulls
- Double aspiration of fines to reclaim meats/hash
- Optional aspiration of scalped hulls

Expanded Hull Cleaning System with Meat/Hash Recovery

REMOVED SHELLS BY ASPIRATION

REMOVED STICKS BY DETWIGGER

Added Benefit of Screening Hulls – Recovered Meats

MEATS IN THE HULLS REPRESENT 1.3% OF THE TOTAL HULL WEIGHT

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Q&A

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