MORE SUSTAINABLE FOOD PACKAGING INNOVATIONS

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Innovations for more Sustainable Food Packaging

SUMMARY OF CONCEPTS

• The entire value chain has an impact on sustainability
  • Comprehensive LCAs need to be employed so food waste-decreasing packaging can be properly assessed
  • Collection and sorting finesse is needed to reduce environmental impact of packaging

• Design Innovation results in more sustainable food packaging
  • Design for separation by consumers or recyclers
  • Design for circular economy with single structure polymers bioderived recyclable materials
  • Design for reuse of pre-consumer packaging

• Science Innovation results in more sustainable food packaging
  • Employ active packaging to extend shelf life and reduce food waste
  • Employ intelligent packaging to assess food quality/safety and reduce food waste
More Sustainable Food Packaging
WE CAN DO BETTER

Packaging can be **sustainable**, **affordable** and **convenient**
Packaging can **enable** affordable healthy and sustainable food choices
Packaging needs to **pole vault** technically and in the value chain
More Sustainable Food Packaging
WE ARE GETTING UNSTUCK

Meaningful increases in sustainable packaging and decreases in food waste are **attainable by reconsidering the value chain processes** that define how food goes from farm to fork.
More Sustainable Food Packaging
THERE IS ALIGNMENT

While not viable in the past, more sustainable packaging that reduces food waste is in harmony with:

- Urbanization
- Retail environment shifts
- Understanding of food insecurity impact
- Circular economy opportunities
More Sustainable Food Packaging
WE HAVE PACKAGING FOR MANY REASONS

What is the water activity of the product?

- < 0.60
  - No Microbial, Yeast, or Mold Growth
  - Is there a risk of microbial contamination?
    - No
      - Pasteurization
      - Irradiation
      - Antimicrobials
      - CAP
    - Yes

- 0.60 < x < 0.80
  - Yeasts and Molds can grow
  - Chilled
    - Retort
    - HPP
    - Microwave
    - Irradiation

- > 0.80
  - Microbes can grow
  - Ambiant
    - What is the distribution temperature?
  - Frozen
    - Hot Filled
    - Ohmic
    - Aseptic
    - Dehydration
RESULTS – SNAPSHOT OF TOTAL FOOD WASTE REDUCTION AS A FUNCTION OF FEASIBILITY

$0 Food Waste Dollars Saved $3billion

LOW Feasibility HIGH

- Edible antimicrobials
- Improved Water Vapor Barrier
- Resealable Packaging
- Microbial/Bio Phage released from package
- Fridge Packaging (ease of finding and storing)
- Sensors activated by CO2, Microbial, Toxins
- IoT end of shelf-life date
- In-home MAP
- Freezer Packaging (ease of finding and storing)
- Consumer Within (CWII) via Time-Temperature Indicators (TTI)
- Returnable climate-controlled shipping
- Improved Light Barrier
- Odor Absorb/Shelf Donation Packaging
- Rework Enable packaging
- Responsive packaging -, cheeselings, pH change
- Hydrogels - Oxygen, Microbial, Moisture, pH
- Superabsorbent / Regular Moisture Absorbers
- Partial Processing
- Flex-Pack
- In-store MAP
- Reduce Package Headspace
- CWII Sensors activated via pH, O2, Toxins, microbial
Design Innovation for More Sustainable Food Packaging

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OVERVIEW

RECYCLE READY PACKAGING

CHEMICALLY RECYCLABLE POLYMERS
CONSUMER SEPARABLE - DESIGN FEATURES
REVERSIBLE ADHESIVE FOR INDUSTRIAL SEPARATION
POLYMER COMPATABILIZER

SINGLE COMPONENT MATERIALS

INCORPORATION OF NANO PARTICLES
SINGLE POLYMER COMPOSITE STRUCTURE - NANO FIBERS
SINGLE POLYMER COMPOSITE STRUCTURE - SELF REINFORCED COMPOSITES
SHDPE = BI-MODAL HDPE

REDEFINE PACKAGING

CONSUMER DEFINED PACKAGING
MINIMAL CONSUMER PACKAGING - MASTERPACKS
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CHEMICALLY RECYCLABLE POLYMERS

PET
- Alcoholysis
- Energy intensive hydrolysis
- Glycolysis
- Aminolysis

Polyethylenes
- Cross alkane metathesis
- Processing converts PE and other polyolefins into liquid fuels
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BIOMASS DERIVED AND RECYCLABLE

BIO-PE

BIOMASS-DERIVED POLYETHYLENETEREPHTHALATE (PET)

POLYETHYLENE FURANOATE (PEF)

POLYTRIMETHYLENE FURANDICARBOXYLATE (PTF)

POLY(TRIMETHYLENE TEREPHTHALATE) (PTT)

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SINGLE POLYMER COMPOSITE STRUCTURE WITH NANOFIBERS

- Nanofiber-SPC (single polymer composites)
- One structure with nanovariants with higher order to improve barrier properties and enable recycling
- Replace laminate and structures with nanofibers of same material
- Produced in the same manner as SPCs
- Value chain shift from converters to optimizer of existing polymer
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**Manufacturers**
- Manufacturers separate consumer and manufacturer to retailer packaging from consumer packaging
- Longer shelf life from manufacturer to retailer
- High barrier retail packs opened when product is placed on store shelves or shipped
- Reusable tertiary packaging

**Consumers**
- Packaging for consumer focuses on shelf life needed by consumer versus entire supply chain
- Less packaging for consumer to dispose
- Lower cost primary packaging
- Potentially more recyclable primary packaging
- Less food waste
Employ active packaging to extend shelf life and reduce food waste
Employ intelligent Packaging to assess food quality/safety and reduce food waste
Science Innovation for More Sustainable Food Packaging

ACTIVE PACKAGING

- **MAP**
  - ATMOSPHERE CONTROLS
    - HIGH BARRIER PACKAGING
    - OXYGEN SCAVENGERS
    - OXYGEN ADDITIONS
  - MOISTURE & ODOR CONTAINMENT
    - MOISTURE ABSORBERS OR EMITTERS
    - PURGE ABSORBERS
    - ODOR ABSORBERS OR EMITTERS
    - HYDROGELS
  - ANTI-MICROBIALS
    - REACTIVE PACKAGING
      - ANTIMICROBIALS
    - EDIBLE ANTIMICROBIALS
  - FLOW MANAGEMENT
    - CONTROLLED DIFFUSION
    - MICROWAVE SUSCEPTORS

- **Flow Management**
- **Moisture & Odor Containment**
- **Anti-Microbials**
- **MAP**
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ACTIVE PACKAGING: O2 absorbing sachets and CO2 emitters

- Oxygen related spoilage is the primary cause of food spoilage

- Sachets are **drop-in solutions** to absorb O2, release CO2, ethanol, ethylene that to decrease food waste with minimal environmental impact

*Values are given at sale in thou*

- Food $294,043
- Milk $653,261
- Meat $477,755
- Fruits $477,755
- Beverages $366,369
- Other $81,406
- Total $2,351,000

Food Forum

Claire Sand, PTR
Microbial growth is a major food safety issue

Edible antimicrobials can eliminate and keep microbial activity low extending the shelf life and making foods safer with less traditional packaging

* Values are given at sale in thousands
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INTELLIGENT PACKAGING

CWI

UV - CONSUME WITHIN (CWI) INDICATOR
CO2- CONSUME WITHIN (CWI)
AFTER OPENING- CONSUME WITHIN (CWI)

FRESHNESS INDICATOR

TTI - ONVU
TI - THERMOTRACE

MICROBIAL INDICATOR

TOXINS & VEGETATIVE CELLS SENSOR
VOC & TVB-N SENSOR
MICROBE SENSOR
PH FLUORESCENT DYE SENSOR

OXIDATION INDICATOR

H2S SENSOR
O2 SENSOR

TEMPERATURE INDICATOR

TTI - TOPCRYO
TTI TIMESTRIP & TIME STRIP COMPLETE
TTI - THINFILM™ SMART LABEL
TTI - FRESHCHECK
TTI - CHECKPOINT
TTI - MONITOR MARK

TTI - FRESHPOINT
TTI - THERMAX
TTI - RF WIRELESS
TTI - ULTRA CONTACT&WIRELESS
TTI - FREEZEWATCH
TTI - THERMOTRACETI - ONVU ICE
TTI - WARMMARK
TTI - TECTROL CHECK
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INTELLIGENT PACKAGING: CWI

- Activates when package is opened
- **Consumer activated**
- Mechanism, beyond time, is undefined
- NOVAS Freshness Indicators
- Insignia Technologies
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INTELLIGENT PACKAGING: CWI

• Activation methods vary
  • CO₂ drops below certain limit
  • Aluminum layer dissolves
  • Amount of volatile gases
  • Hydrogen sulfide release
  • Presence of the bacteria
  • Change in pH
Most degradative food reactions are a function of both time and temperature and provide an accurate depiction of product safety and quality to decrease food waste.

CWI TTIs provide direction for the actual date of consumption after purchase by consumers with minimal environmental impact.
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Focused compelling food packaging expertise

Claire Sand is a Global Packaging Leader with 30+ years of broad experience in the food science and packaging spectrum. She leads food packaging efforts involving packaging solutions to food waste and more sustainable packaging, as well as provides compelling technology business cases and implementation roadmaps to ease the path of innovative technologies. Dr. Sand is Owner and Founder of Packaging Technology and Research, LLC and an Adjunct Professor at the University of Minnesota, Michigan State University and CalPoly as well as Food Technology's monthly Packaging columnist. She is an IFT Fellow, serves on numerous Editorial Boards, is the author of the Packagings Value Chain, and is cochair of panfoodwaste. Claire has held previous positions in basic research, development market research, and marketing in Germany, Colombia, and Thailand and at Total Quality Marketing, Nestle, General Mills, Kraft Heinz, Safeway, and in academia. Dr. Sand holds a doctorate degree in Food Science and Nutrition from the University of Minnesota and MS and BS in Packaging from Michigan State University.

“I am passionate about leading efforts to reduce climate change by shrinking food waste with more sustainable packaging.”

- Solutions using Strategy, Technology, Consulting, Coaching, and Technology Evaluations
- Learn from PTR with presentations and articles at http://www.packagingtechnologyandresearch.com/thought-leadership.html
Strategic Direction

Paper Company

60+ PRODUCTS
Identified OTR and MVTR requirement within 30 categories

1-5 YEARS
Built R&D pipeline to direct existing and new material development using new switching drivers

1 PACKAGE
New chilled ready meal patented package launched to replace CPET

Science Advisor

Niche Food Company

2x SHELF LIFE
Using product, process, MAP and barrier technologies

12% LOWER
Packaging costs by optimizing packaging materials

3 PACKAGES
Launched C-Store and Club Store packaging

Technology Advisor

Frozen Food Company

5 QUICK
High impact / low effort solutions to reduce freezer burn

4 SOLUTIONS
Analyzed to refine go/no go on freezer burn solutions using nano-edible coatings, alternative packaging and HPP

1 ASLT
Protocols to increase product confidence and shorten time to market

Executive Mentoring

Polymer & Additive Company

30+ YEARS
Helping executives apply their business acumen by bridging the gap between management and science

4 ACQUISITIONS
Resulted from strategic technology assessment that identified and screened prospective opportunities

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