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International Trends in R&D in Food Processing Sector

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Outline

- Innovations & trends in new products
  - Current population trends in western countries
  - Trends in food industry & government
- Innovations & trends in new processes
- Innovations & trends in new packaging
- Industry-university-government partnerships

Innovations & Trends in New Products

- **Demographics**
  - **Aging population**
  - **Current average household size is 2. 8 persons**
  - **Will decrease to 2.4 persons by 2020**
  - **Smaller households eat out more often**
  - **Health conscious consumers**

Innovations & Trends in New Products

- **Demographics**
  - **Convenience is the key**
  - **Away-from-home food accounts for 47% total U.S. expenditures**
  - **Consumers are looking for products with better nutritional value, palatability, safety & convenience**

Trends in Food Industry

- **Development of products that are good for you**
  - **Nutraceuticals**
  - **Functional foods**
    - **Yogurt, Cranberry**
  - **Health claims on food products**
    - **Anticarcinogenic**
    - **Lowers CVD**
    - **Contains Antioxidants, Polyphenols, Flavonols**
  - **Designer foods**
  - **Organic foods**

Trends in Food Industry

- Product development to combat obesity
  - Portion control through innovative packaging
  - Product reformulation
    - Calorie reduction
    - Glycemic index manipulation
  - Consumer education
    - Nutritional education/intervention
- Globalization of the economy
  - Mergers & acquisitions
  - Outsourcing of R&D

Trends in Food Industry

- **Increasing challenges related to food safety/security**
  - **New processing/packaging technologies**
  - **Rapid detection of MO Value-added food processing**
- **Production agriculture can only go so far!**
  - **Industrial ingredients from agricultural products**
    - **Biodiesel**
    - **Biodegradable plastics**

U.S. Food Industry

- **Largest individual manufacturing sector**
- **Strategies for growth: New products *(11,000 new products per year)*, brand strengths, acquisitions & international expansion**
- **Shorter time-to-market new products**
- **Becoming more technologically sophisticated**
- **R&D emphasizes both short- & long-term goals (basic & applied research)**

Global Scenario

- Food industry has become international in scope
- U.S. food sector is blending more and more into the world food market
  - Pacific rim countries, India, China,
- International food trade benefits producers , processors & consumers
- Global R&D spending lowest among top sectors

Indian Food Industry

- $200 billion in value
  - 43% of it represents processed foods
  - Growing at the rate of 14%
  - 24% represents organized retailers
- Challenges
  - Food safety, pesticides
  - Lab testing facilities
  - Infrastructure
    - Cold storage

(NIFTEM)

Government Trends

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USDA -Nat. Inst. Food & Agric. Focus areas

- **Keep American agriculture competitive while ending world hunger *Improve nutrition & end child obesity***
- ***Improve food safety for all Americans***
- **Secure America's energy future through renewable biofuels**
- **Mitigate & adapt agriculture to variations in climate**

Government Trends

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- **Multidisciplinary & multiinstitutional NIFA projects**
- **Involve stakeholders**
  - **Farmers, industry, regulatory agencies, universities, consumers**
- **Strongly encourage tie-ins with 1890 schools**
- **MOFPI (India)**

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Innovations & Trends in New Processes

- Enhance microbial & chemical safety
- Increase food quality
  - Fresh, natural
  - Reduce processing severity through better sensors & process control
  - Use combination processes
    - HPP & low level thermal process
- Increase productivity
- Engineered foods

Food Research

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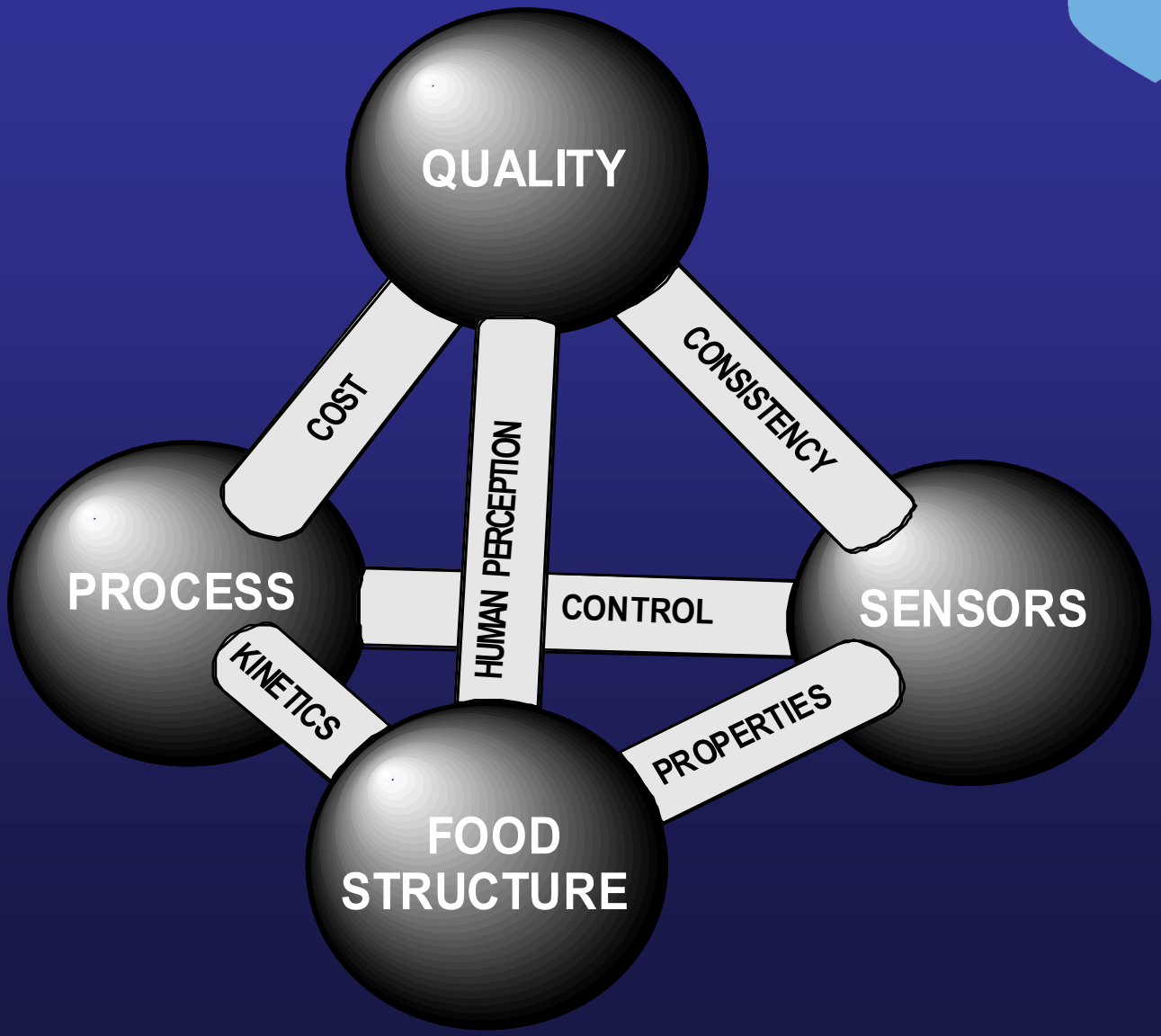
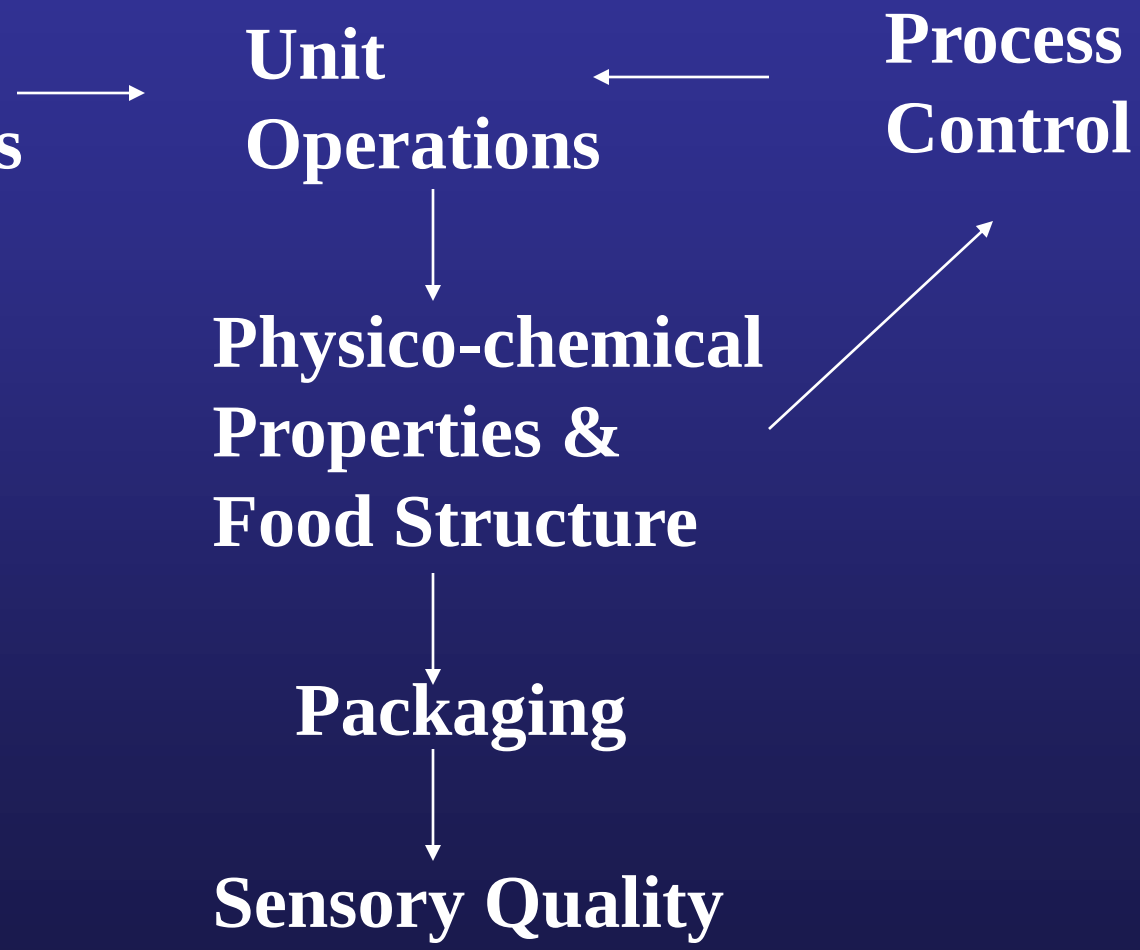


Food Material Science Approach



New Processes

- UHT & steam infusion processes
- Ohmic heating
- Microwave processing
- Extrusion cooking
- Plasma processing
- High pressure processing
- High voltahe pulsed electric field processing
- Pulsed light processing

Innovations & Trends in Packaging

Active Packaging

- Oxygen in packages aids the growth of aerobic microbes and molds.
- Oxidative reactions in packaging also result in unintended odors & flavors and changes in color or nutritional quality.
- Similarly, moisture in food packages may cause powdered products to form lumps or crisp products to soften as well as supporting the growth of microorganisms

Active Packaging

- Oxygen scavengers remove oxygen from food packages.
- Carbon dioxide emitters suppress microbial growth in products such as meat, poultry, and cheese
- Other tools include antimicrobials & ethylene absorbers.

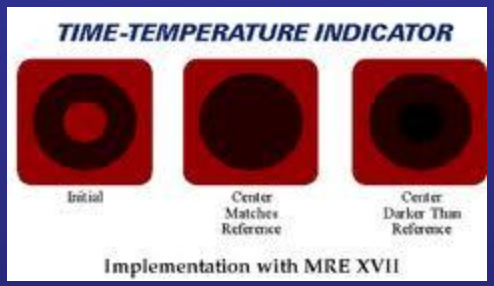
(IFT 2008)

Active Packaging

- Moisture-control agents suppress water activity, serving to remove fluids from meat products, prevent condensation from fresh produce, and curb the rate of lipid oxidation
- Maintaining humidity in packages is accomplished by humidity controllers

Intelligent Packaging

- Time temperature indicators (TTI)
- Ripeness indicators
- Biosensors
- Radio frequency identification (RFID)



Time-Temperature Indicators

OnVu time temperature indicators from Switzerland-based Freshpoint Holdings SA help to alert consumers to potential temperature abuses in the supply chain that may compromise product safety

Time-Temperature Indicators

- TTIs can play a critical role in indicating the freshness and safety of a product.
- In the case of foods that should not be frozen, a TTI would indicate whether the food had been improperly exposed to cold temperatures.
- Conversely, a TTI could specify whether foods sensitive to heat had been exposed to unnaturally high temperatures and the duration of exposure.

RFID

- Radio frequency identification provides wireless monitoring of food packages through tags, readers, and computer systems.
- RFID systems provide safety and security benefits by tracking the origin of food supplies and facilitates the traceability of food.
- Speeds stock rotation and improves tracking.

RFID

- Retail chains such as Wal-Mart and Home Depot already use RFID
- Retailers are considering ways to integrate this technology into the management of their supply chains.

Controlling Volatile Flavors & Aromas

- **Both migration and flavor scalping are unfavorable because they deteriorate food quality and reduce consumer confidence in packaged food items.**
- **The solution to these issues is packaging components that incorporate absorption and barrier controls**

Controlling Volatile Flavors & Aromas

- **Flavor and odor absorbers usurp unwanted gaseous molecules such as volatile package ingredients, chemical and microbial metabolites, respiration products, or rancid flavors and odors.**
- **High-barrier packaging reduces absorption, desorption, and diffusion of gases and liquids to maintain food quality.**

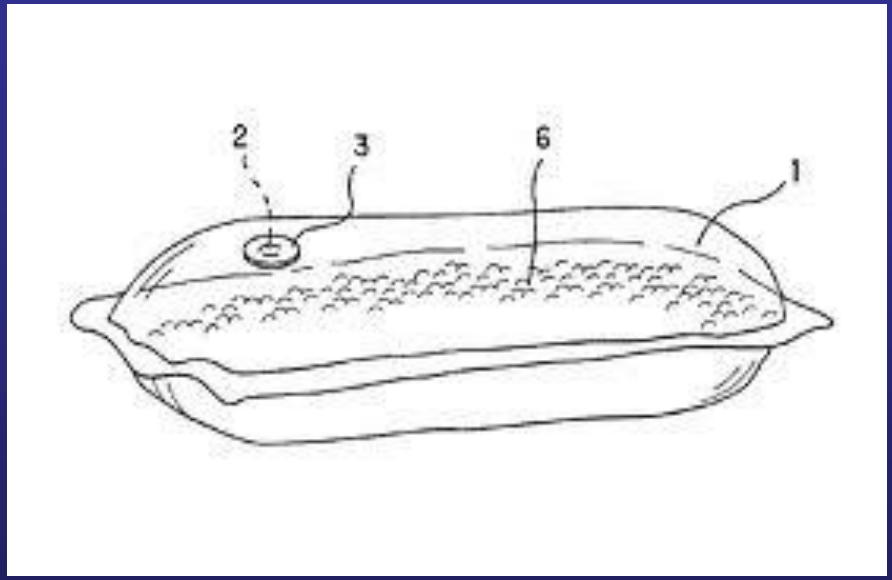
High Barrier Packaging

- High-barrier packaging reduces absorption, desorption, and diffusion of gases and liquids to maintain food quality.
- It also assists in preventing oxygen and water vapor from penetrating packages.
- Polymer blending, lamination, and metallization are all ways to enhance the barrier properties of packaging materials.
- Transparent vacuum-deposition or plasma-deposited coating of silica oxide PET films and composites of plastics with nanoparticles.

Microwaveable Packaging

- **The design of the CuliDish makes it possible to microwave a meal and keep some portions cool while others get hot.**

Ventable Plastic Bags for Steaming Foods



Nanotechnology & Food Packaging

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- **Nanocomposites are materials that are made up of nanoparticle components.**
- **In food packaging, montmorillonite clay is being explored as the nano-component in a variety of polymers: polyethylene, polyester, nylon, and starch.**

Nanotechnology & Food Packaging

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- Nanocomposite plastic films block oxygen, carbon dioxide, and moisture from reaching food.
- Nanocomposite food packages are also light, strong, and heat resistant.
- Research into the development of biodegradable nanocomposite packages is under way.

Nanotechnology & Food Packaging

- **Researchers have discovered that carbon nanotubes exert powerful antimicrobial effects**
  - **Direct contact with aggregates of carbon nanotubes proves to be fatal for *Escherichia coli*.**
- **When integrated with food packaging, nanosensors can detect chemicals, pathogens, and toxins in food.**
- **For example, biosensors have been developed that detect *Staphylococcus* enterotoxin B, *E. coli*, *Salmonella* spp., and *Listeria moncytogenes*.**

Nanotechnology & Food Packaging

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- **Nanosensors can also detect allergen proteins to prevent adverse reactions to foods such as peanuts, tree nuts, and gluten.**
- **Effects of nano-sized materials on humans are still under investigation.**

Green /Sustainable Packaging

- Beneficial, safe, and healthy for individuals and communities throughout its life cycle.
- Meets market criteria for performance and cost.
- Sourced, manufactured, transported, and recycled using renewable energy.
- Maximizes the use of renewable or recycled source materials.
- Manufactured using clean production technologies and best practices
- Made from materials healthy in all probable end-of-life scenarios
- Designed to optimize materials and energy

Industry-Univeristy-Government Partnerships

Guidelines for Partnership

- **Develop mutual trust**
- **Negotiate in best faith**
- **Let patents ownership vest with university partner**
- **Grant industrial partner(s) exclusive license**
- **Be patient & understanding**

Models of Partnerships

- European Model
  - 1/3 Industry, 1/3 University, 1/3 Government
- Collaborative research
  - Co-advisors
  - Funding requirement
    - Make industrial sponsorship mandatory for grant funding (DMI)
- Industrial advisory board at university
- Consortia
  - IIT
  - CFM

Models of Partnerships

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- **Consultancy/Sabbaticals**
  - **University**
  - **Industry**
  - **Government**

Hershey-Penn State Projects Completed

- Measurement of yield stress in chocolate using the vane method (B. Baker)
- Thermal & mechanical determination of glass transition temperature in saccharide mixture (B. Kiefer)
- Moisture migration through fat-based multiphase systems (Q.Yuan)
- Oil migration in model confectionery systems (T. Motwani)

Hershey-Penn State Projects Completed

- Characterization of heat resistant milk chocolates (C. Dicolla)
- Mechanisms of development of heat resistant chocolate (Ongoing - J. Laughter)

Current Projects at Penn State

- Mechanism of destruction of *Listeria* during HPP (J. Wen)
- Controlled release of Nisin from biopolymer films (M. Lalpuria)
- Mechanisms of development of heat resistant chocolate (J. Laughter)
- Edible coatings to improve shelf-life of fresh mushrooms (A. Luttman)


THE END