Advances in Meat Packaging

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General Overview

- Where have we been?
- Current shortcomings?
- Managing meat color
- What “Advances” are needed?
- Some intriguing possibilities
What’s Right/Wrong Here?

Over-wrapped Trays

- Leaky, messy packages
- Poor appearance and image
- Short shelf life
- Sub-optimal functionality

Over-wrapped Trays

- Ease of application
- Controlled weight loss
- Enhanced appearance
- Protected palatability
- Marketable package
- Economy

Meat Package Types

- None
- Bag in a box
- Paper

All good if done properly, BUT LIMITED ATTRIBUTES

Meat Package Types

- Overwrap - oxygen permeable
- Vacuum - oxygen impermeable
- Modified Atmosphere Packaging

All used extensively,
LONGER SHELF LIFE

Vacuum Packaging

- Very good for subprimal cuts
- Requires good temperature control
- Bloom and Purge can be problems

Another Solution:

- Modified Atmosphere Packaging
  and / or
- Case Ready Meats

An Evolution, Not Revolution

Types of MAP

- “Vacuum”
- Oxygen/Carbon dioxide/Nitrogen
- High Oxygen
- Low Oxygen - must scavenge $O_2$
- Peelable Films
- Gas Exchange System
- Individual cuts or Master bag

Packaging Needs for Meat

- Attractiveness
- Product weight control
- Easy to handle / manage
- Meat color
- Meat flavor
- Shelf-life
- Antimicrobials
- Product safety
- “Green”

So, what needs to “ADVANCE”?

Need Package Diversity

- Fresh vs. Frozen
- Fresh vs. Cured
- Raw vs. Cooked
- Intact muscle vs. Restructured
- Dried vs. Marinated
- Species differences
- Irradiation

Meat Color & Color Stability

- Most important visual trait
- Drivers of retail sale
- Discoloration: Cost - millions
- Packaging needs to stabilize the color

Maintaining meat’s red color has been a more persistent challenge than retarding microbiological spoilage....

The Colors of Meat

Deoxymyoglobin DMb Fe**

Oxygenation

O2 Uptake and MMb Reduction

Very low O2

Oxymyoglobin OMb Fe**

+ CO

Carboxymyoglobin COMb Fe**

Metmyoglobin MMb Fe***

Drivers for Advancements?

- Consumer’s demand
- Match advances of other foods
- Minimal processed foods
- Increased regulatory requirements
- Market globalization
- Increased concern for food safety
- Recent threats of food bioterrorism

Yam et al., 2005
Drivers for Advancements?

- Convenience
- Individualized culture
- Indulgence

- Changing lifestyles
- Natural and healthy

Should We Think Outside or Inside the Box?
Clockwise Color of Meat

You MUST work the clock!

Modified Atmosphere Packaging

Removal or replacement of the atmosphere surrounding the product before sealing.

Vacuum  Low-Oxygen MAP  High-Oxygen MAP

Types of MAP

- Anaerobic: \( \text{N}_2/\text{CO}_2 \)
- Aerobic: \( \text{O}_2/\text{CO}_2 \)
- Anaerobic: \( \text{CO}/\text{CO}_2/\text{N}_2 \)

Which is Most Promising?

MAP

Can’t science, quality and product safety overcome consumer issues?

N₂/CO₂

Anaerobic

O₂/CO₂

CO/CO₂/N₂

## Two Red MAPs

<table>
<thead>
<tr>
<th></th>
<th>NoOx-CO MAP</th>
<th>HiOx MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shelf-life</td>
<td>Longer</td>
<td>Shorter</td>
</tr>
<tr>
<td>Color-life</td>
<td>Longer</td>
<td>Shorter</td>
</tr>
<tr>
<td>Flavor stability</td>
<td>Very good</td>
<td>Limited</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Good</td>
<td>Limited</td>
</tr>
</tbody>
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ActiveTech™ MAP – R3

Ultra-low O$_2$ with CO
1. PVC Overwrap
2. O$_2$ Scavenger
3. 0.4% CO Flush

PVC packages are removed from the 0.4% CO prior to display

Packaging “Advances” Must Consider:

- Properties of meat
- Package polymer & tray traits
- Plant processing
- Operations scheduling
- Safety
- Regulatory issues

Package Considerations

- Film Design
- Barrier
- Anti-fog/Anti-grease
- EZ Open
- Re-closable
- Microwaveable
- Freezable
- Ovenable
- Irradiation-ability
- Compartments

- Tray design
- Size
- Shape
- Color
- Draw depth
- Foam or plastic
- Open or closed cell
- Soaker pad type
- Labeling

Meat Considerations

- State (raw or cooked)
- Time after harvest
- Conditions at harvest
- Temperature of storage
- Anatomical location
- Intact or minced
- Meat-to-Gas ratio
- Exposure to light, heat
- Anaerobic or aerobic
- Other conditions

Processing Considerations

- Blooming time and conditions
- Residual $O_2$
- Gas mixtures – $CO_2$, $N_2$, $O_2$, $CO$, $Ar$, $He$, $O_3$
- Enhancement and ingredients
- Oxidative stability
- Headspace requirements and tray options
- Merchandising and productivity
- Labeling, pre-pricing, dating
- Freight, cube, transport issues
- Illumination sources
- Film and tray compatibility

Operational Considerations

- Postmortem age of whole muscle cuts
- Injected and enhanced products
- Slicing bone-in products
- Bone discoloration
- High or low $O_2$ meat color during transit
- Package seal integrity
- Pre-pricing/dating
- Freight, cube and tray size issues
- Productivity measurements

Productivity Considerations

- Packaging machine maintenance
- Gas mixer or vacuum calibration
- Denesting trays and/or packaging
- Seal time and temperature parameters
- Vacuum level
- Loading and unloading
- Rework
- Inventory management

Active / Intelligent Packaging

System where the product, the package, and the environment interact in a positive way to extend the shelf life.

- Often NANO-Technology
- Integrity indicators.
- Temperature indicators.
- Fluorescent oxygen sensors
- Biosensors
- Freshness indicators
- Radio Frequency ID

Packaged in Nano Materials

Time-temperature sensing

http://www.cibasc.com/med-photos_onvu-meat_nr_print.jpg

Bio-based Materials

- Replenishable agricultural feedstocks
- Animal sources
- Marine food processing industry wastes
- Microbial sources
- Film-forming
- Plasticizers
- Functional additives
- Edible coatings

Bio-based Packaging

Palm Fiber

Bagasse

Corn based tray
Sugar based cups

Molded fiber

Earthshell Wrap

Whey Coating

Biodegradable polyester

Anti Pathogens

Packaging Advances May Be:

Creative
Innovative
Functional
Value adding
More expensive
Challenging to use
Necessary to compete
Some - more trouble than they are worth
Thanks for Listening

Clockwise Color of Meat

DMb

OMb

MMb

You MUST work the clock!

The Best Kept Secret

MAP

Anaerobic

CO/CO₂/N₂