Eurofins Qfresh Lab

Where Quality and Safety Meet in Food Packaging

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Presented by:

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The Qfresh Lab

JSB Group, LLC

COMPANY OVERVIEW

Eurofins is the **global leader in biological testing** with an unrivaled reputation for unbiased analysis

200,000 reliable analytical methods for characterizing the safety, identity, purity, composition, authenticity, and origin of products

Our **diverse laboratories** navigate seamlessly through a dynamic and ever-changing global marketplace

50K+ EMPLOYEES

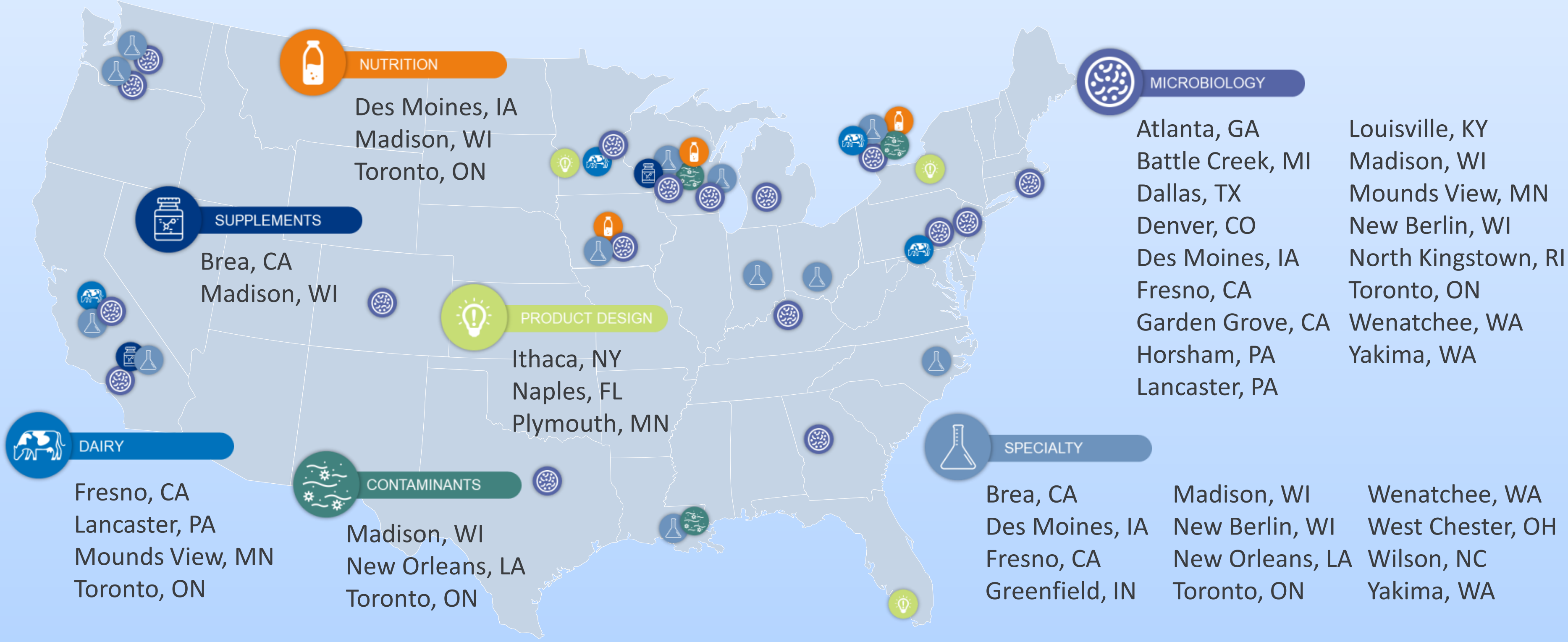
800+ LABORATORIES

50 COUNTRIES

400M+ TESTS ANNUALLY

eurofins

FOOD TESTING LABORATORIES



Who We Are

QFRESH

Qfresh Lab is a full service quality and analytical testing laboratory supporting the fresh produce industry. We offer independent testing and analytical services including:

- Respiration Rate Testing and Analysis
- Shelf-life Testing and Analysis
- Modified Atmosphere Package Design
- Food Safety Program Review and Audit
- Package Testing OTR Perforations Sustainability Integrity

Qfresh LAB

Eurofins and Qfresh Lab

- We work at the intersection of food quality and safety.
- What is the role of packaging in food quality and safety?
- Just to keep what's in, in and keep what's out, out or …
- What is different with fresh produce MAP?
- The need for combining the science of food quality and food safety!

Consider the global possibilities:

- A functional, technology, marketing, branding and sustainability platform
  - Functional Protection
    - Keeps what's in in and what's out out
  - Technology Platform
    - MAP
      - Shelf Life Extension
      - Quality Optimization
      - Food safety
  - Marketing Tool
    - Branding
  - Sustainability Tool

Food Spoilage: What impacts/retards the growth of Bacteria and Oxidation

Bacteria

Temp

- Refrigerated/Frozen
- Heat/Cooking/Kill step
- Root cellar

Aw

- Hard Cheese/Soft Cheese
- Salt Cod

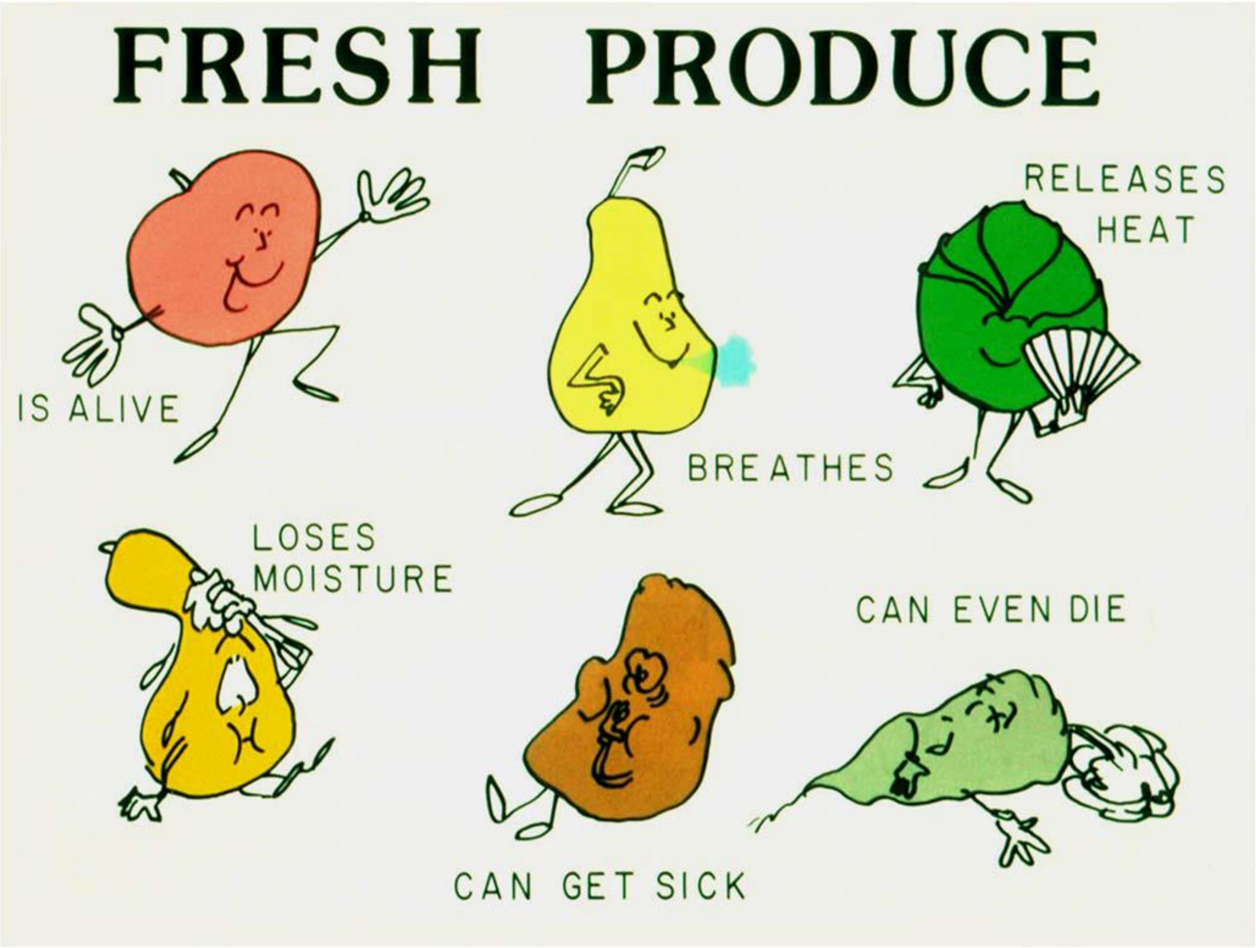
Ph

- Acidification
- Pickling

Oxidation in foods

- O2
- Light

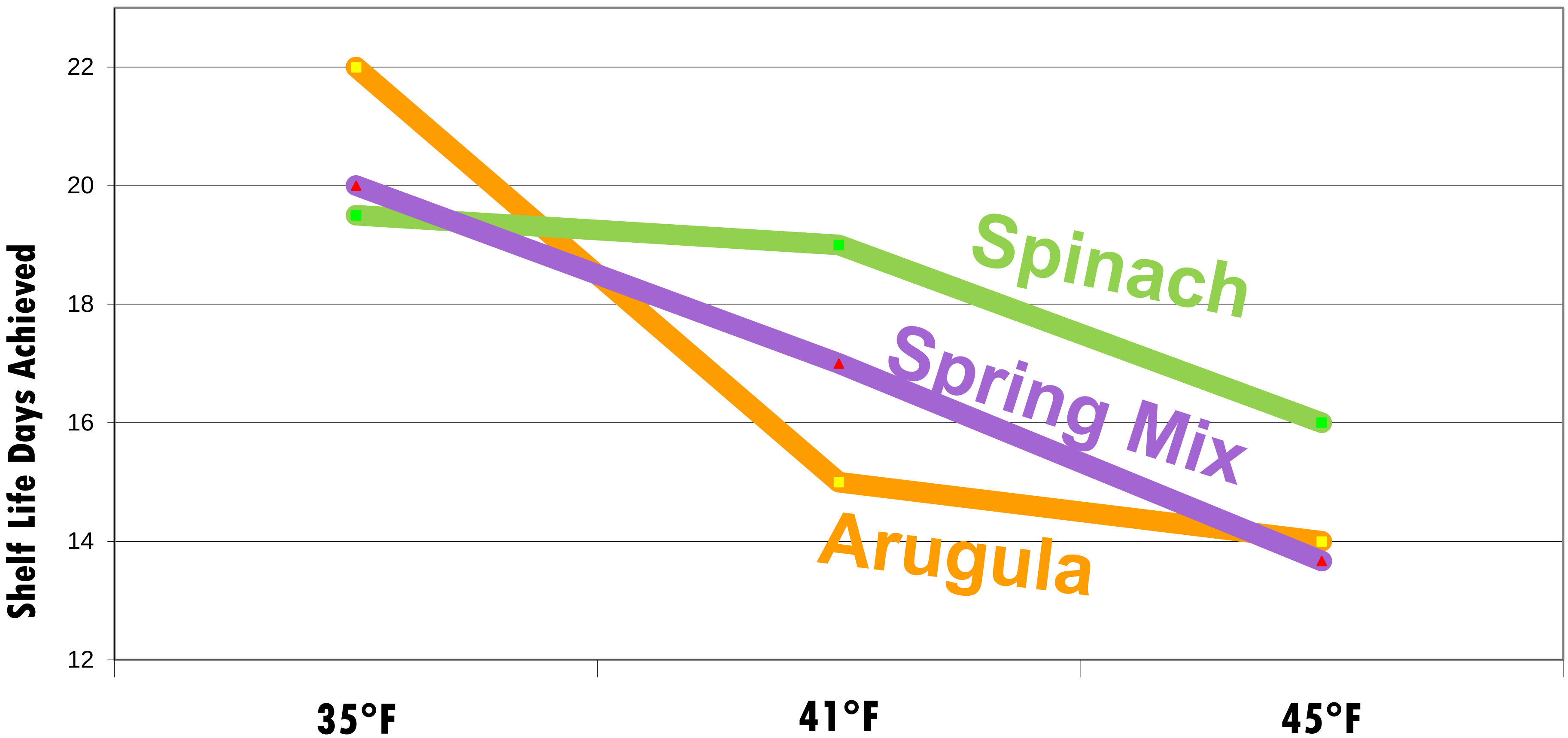
Why is Fresh Cut Different?



Temperature – why is it important?

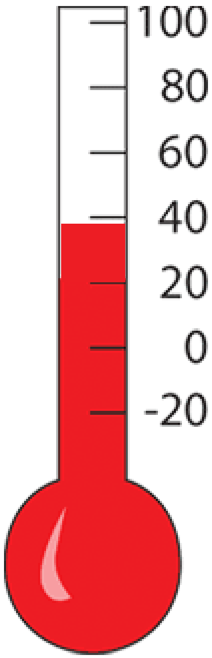
- **Rate of deterioration is proportional to temperature**
- **Higher temperature results in:**
  - Higher **respiration** & ethylene production rates
  - Increased tissue sensitivity to ethylene → *yellowing, phenolic synthesis*
  - Increased oxidative reactions → *browning*
  - Accelerated textural changes → *softening*
  - Membrane degradation → *watersoaking*
  - Other compositional changes → *flavor loss*

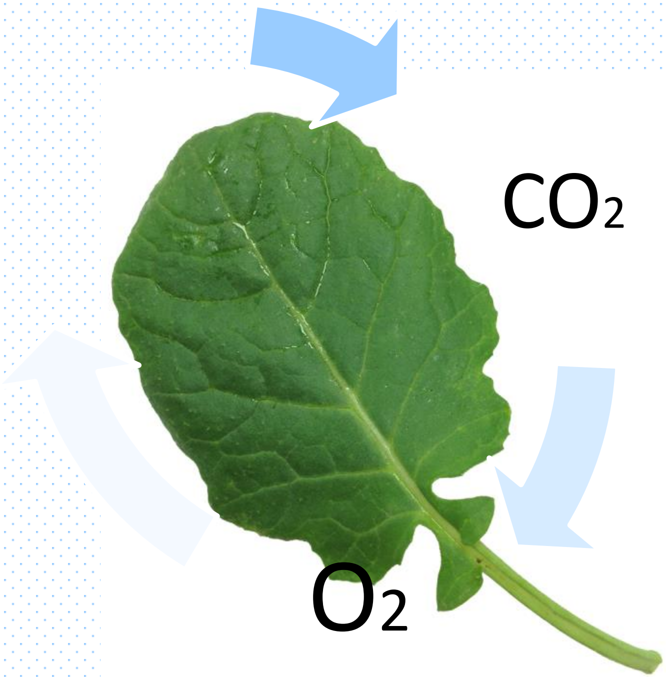
Post Harvest Physiology:
Storage Temperature Effects on Shelf-life



5°F increase in temperature = average shelf-life decreasing by approximately 3 days*

Post-Harvest Physiology: Fresh Cut Key Factors





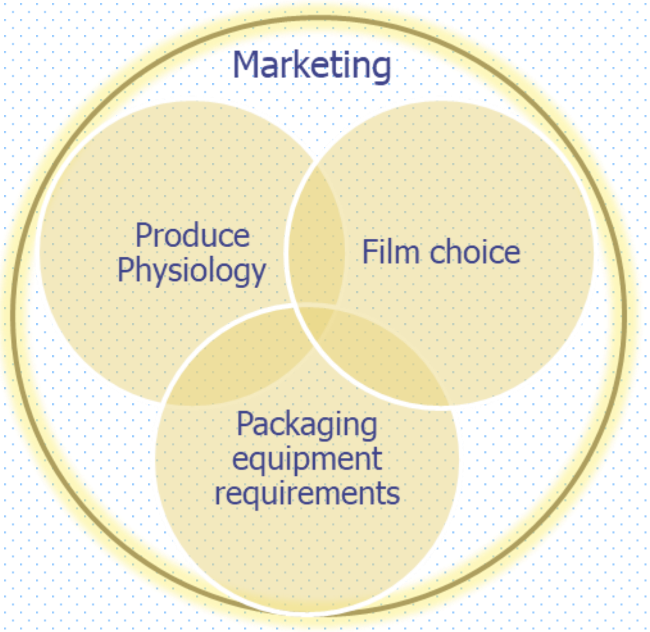
- Temperature is the most important factor
- Respiration rate: every leaf respires differently. Higher respiring leaves deplete pigments and nutrients faster increasing yellowing and decay
- Genetic properties and seed varieties influence shelf life

Qfresh LAB

MODIFIED ATMOSPHERE PACKAGING PRINCIPLES

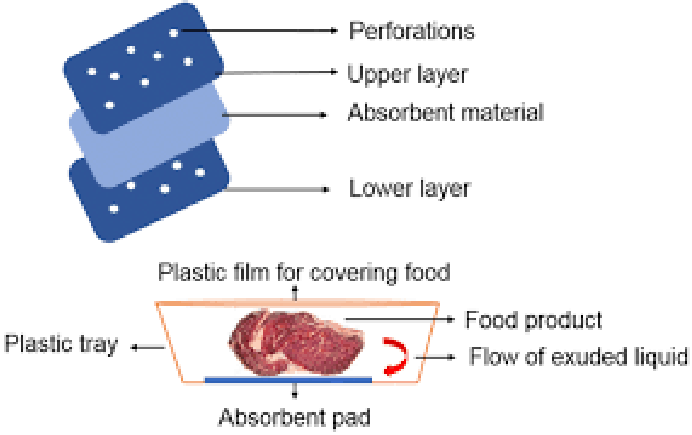
Definitions

- Controlled Atmosphere Storage (CAS)
- Modified Atmosphere Storage (MAS)
- Controlled Atmosphere Packaging (CAP)
- Modified Atmosphere packaging (MAP)
  - Passive modification
  - Active modification
    - Gas Flushing
    - Vacuum packaging
    - O2 Scavenging
    - O2 Absorption



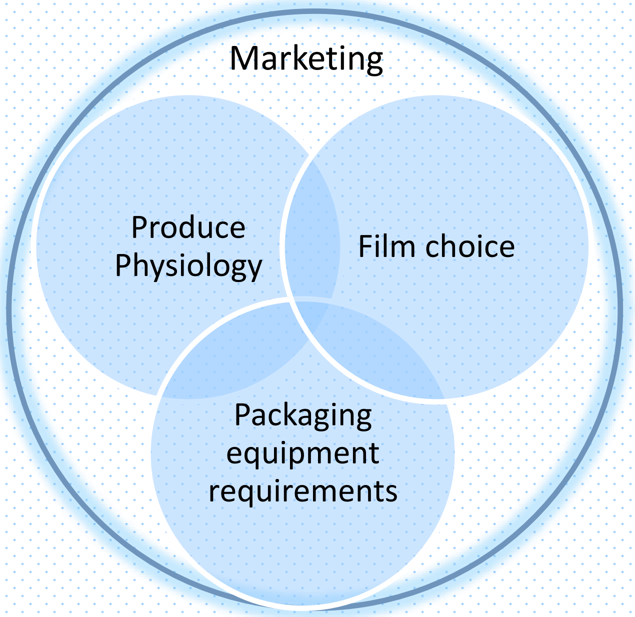
MAP as a Technology Platform

- Shelf life:
  - Absorbents
  - Pads
  - Sachet
- Food Safety:
  - Antimicrobial
  - Activated Packaging



Package Design Requirements

- Produce Physiology Requirements
- Polymer Engineering
- Converting/Filling Machine Requirements
- Marketing Requirements
  - Branding
  - Story
- Sustainability



Fundamental Truth's

- Anytime you place fresh-cut produce into a sealed package you have created a Modified Atmosphere Package.
- It may not be correct or desired and certainly not optimized; but make no mistake it is a Modified Atmosphere Package.
- This then begs the question; how do I optimize the package…

Potential Risks With MAP

(*These occur when MAP is mismanaged or poorly designed*)

- MAP can result in off-flavors or odors if anaerobic respiration (*i.e.*, fermentative metabolism) occurs
  - This can be initiated by either too low O_2 or too high CO_2
- Anaerobic atmospheres can also allow pathogenic microbes to proliferate!
- Too high CO_2 can result directly in tissue injury

➢ *MA cannot compensate for poor temperature control!!!*

Temperature and MAP

- That means produce respiration rate changes much more with temperature than does the film permeability

- Thus, a MAP cannot maintain beneficial atmospheres when products are exposed to temperatures outside the design parameters
  - For example, (lower) storage/transport temperatures *versus* (higher) retail display temperatures

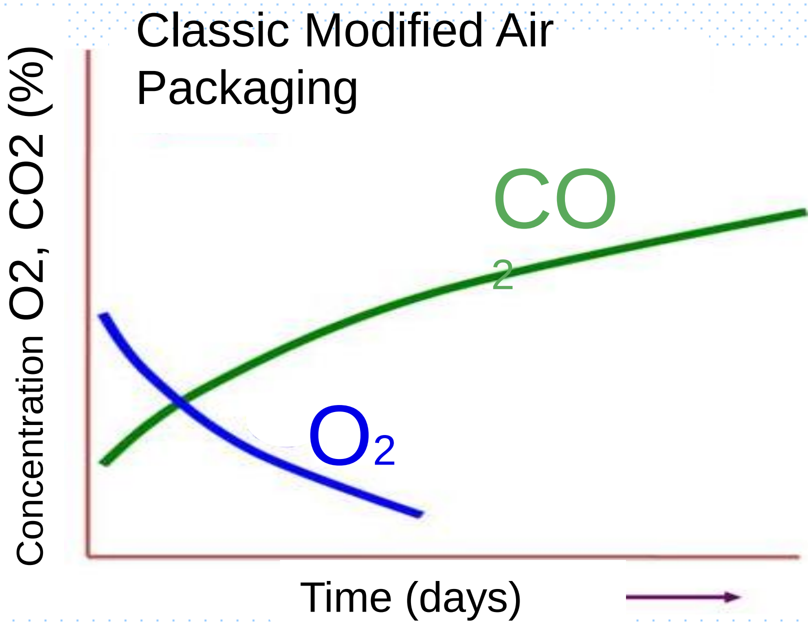
Produce Physiology

$OTR = RR_{O2} \bullet T \bullet W/A \bullet (O_2atm - \underline{\mathbf{O_2pk}})$

Desired atmosphere in the package (O_2 pk)

- ✓ Information available from CA/MA literature & companies such as QFresh Lab
- ✓ Need to consider oxygen and carbon dioxide tolerances
- ✓ Calculations are much more complicated with mixed products in the bag
- ✓ Atmospheres in the package should be measured during shelf life
- ✓ <u>Avoid anaerobic respiration</u> i.e. when O_2 becomes so low that fermentation occurs and ethanol and acetaldehyde form
  - ➢ Flavor
  - ➢ Shelf-life (damages membranes)
  - ➢ Appearance

Respiration rate quantification and analysis



MAP:

- Slows down respiration and senescence rates
- Slows down chlorophyll and nutrient degradation and enzymatic activity

Types of MAP:

- Active MAP- Gas Flush used to purge excess oxygen prior to seal
- Passive MAP- No gas flush

Consequence of incorrect or no MAP

MAP (Micro-perforated), no yellowing at day 17

NO MAP (Macro-perforated), 100% yellowing at day 17

Combination meals

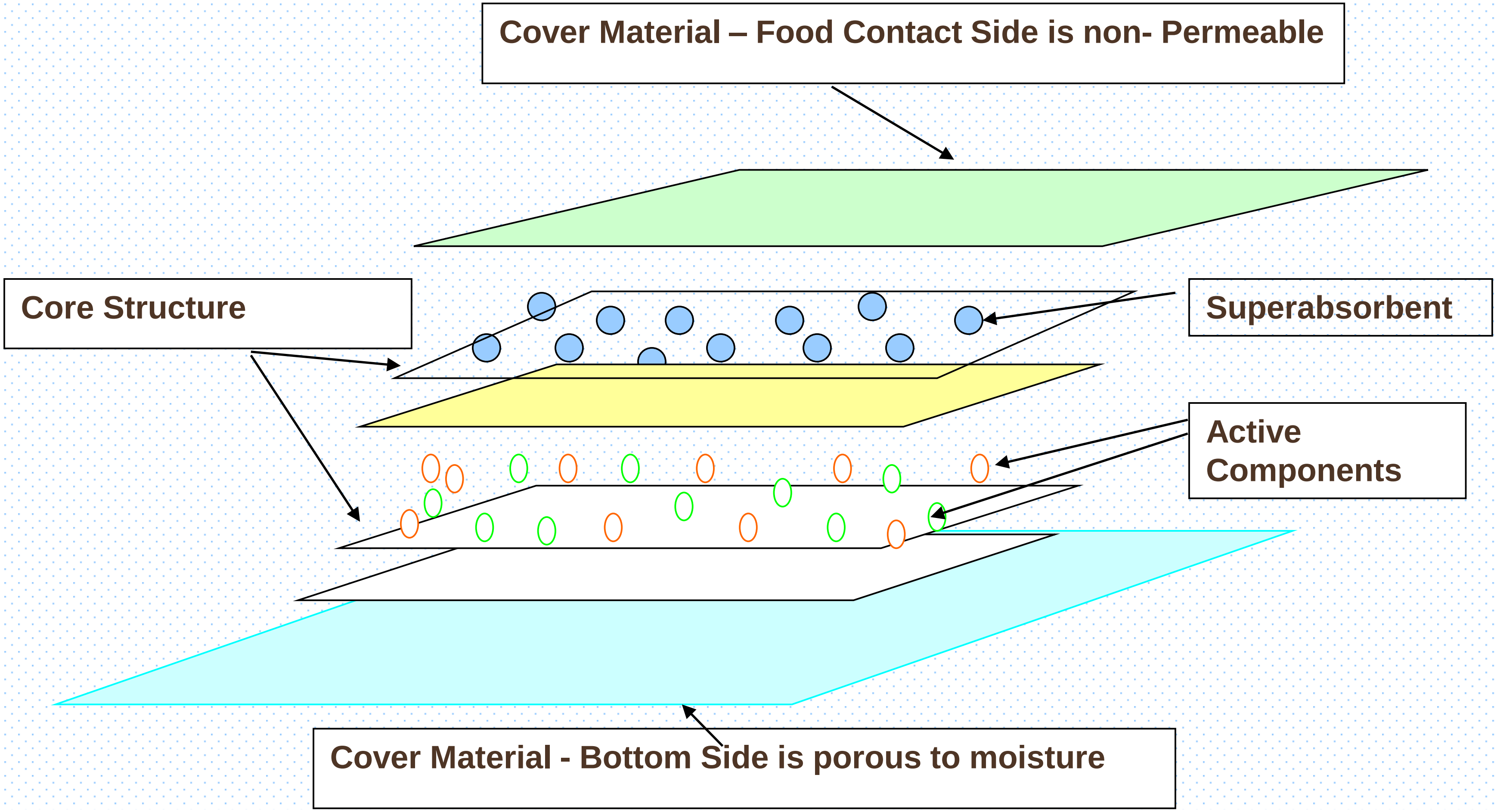
Conditions of Use defined in the Regulations

For food-contact substances (FCSs) cleared by a food additive regulation, any temperature restriction on intended use is generally specified by reference to the Conditions of Use as defined in Title 21 Code of Federal Regulations (C.F.R.) Section 176.170(c), Table 2, which are as follows:

- Condition of Use A, High temperature heat-sterilized (e.g., over 212º F)
- Condition of Use B, Boiling water sterilized
- Condition of Use C, Hot filled or pasteurized above 150º F
- Condition of Use D, Hot filled or pasteurized below 150º F
- Condition of Use E, Room temperature filled and stored (no thermal treatment in the container)
- Condition of Use F, Refrigerated storage (no thermal treatment in the container)
- Condition of Use G, Frozen storage (no thermal treatment in the container)
- Condition of Use H, Frozen or refrigerated storage: Ready-prepared foods intended to be reheated in container at time of use
- Then in April 2006, FDA expanded its list of Conditions of Use to include Conditions I (Irradiation) and J (Cooking at temperatures exceeding 250º F),

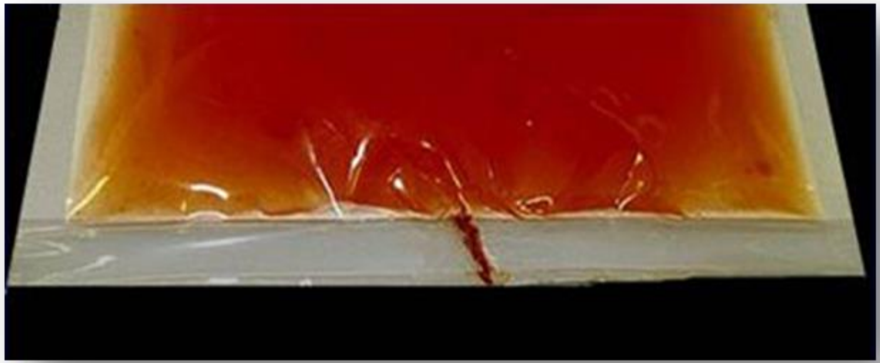
Active Packaging

New Possibilities with Smarter Materials



Factors that can impact efficacy of high barrier packaging

- Leakers
- Pinholes
- Cracking
- Crazing
- Abrasion



Corollary Packaging Truths

- Temperature Control
- Cold Chain Management
- Incoming Product Quality
- Post-harvest Technology
- Leakers
- Gas Flushing
- Static Environment
- One Product Fits All

- Choosing the packaging the week before launch guarantees a non-optimized package


GRAPE


ORGANIC ORGANIC ORGANIC ORGANIC
naturipe
Organic
BLUEBERRIES
1 US DRY PINT
551 ml
Open
COMPOSTABLE

Sustainable Packaging… the ‘-abilities’

- Recyclable
- Renewable
- Compostable
  - Industrial
  - Consumer
- Degradable
  - Oxy
  - Bio
  - Land Fills

"Green Polymers"

- Bio based materials such as Polyactic Acid (PLA), polyhydroxyalkanoate (PHA), polynucleotides, polyamides, polysaccharides, polyoxoesters, polythioesters, polyanhydrides, polyisoprenoids and polyphenols are potential candidates for substitution of synthetic plastics
- Nature & More first to market with new sugar cane packaging
- Cellophane

Assessing Biodegradability of Biobased Polymers

- Two key steps occur in the biodegradation of polymers. First, a **depolymerization or chain cleavage step** (hydrolysis and/or oxidation may be responsible) converts the polymer chain into smaller oligomeric fragments. The hydrolytic or oxidative processes may be promoted biotically (in biological pathways) and abiotically (in nonbiological pathways), with oxidation usually a slower process than hydrolysis.
- The second step (**known as mineralization**) occurs inside the cell, where oligomeric fragments are converted into biomass, minerals and salts, water and gases such as CO_2 and CH_4. The biodegradation of plastics depends on both environmental factors (i.e., temperature, moisture, oxygen and pH) and the chemical structure of the polymer or copolymer.
- Complete biodegradation of the product is commonly measured through respirometric tests such as in ASTM D5338, which is equivalent to ISO 14852.
- It comes as a surprise to many people to learn that certain natural materials do not meet these standards, for example, a leaf will not naturally biodegrade within the time frame allotted by either D6400 or EN13432.

Polymers from Food Products

A growing number of entrepreneurs and researchers are working to turn foods like mushrooms, kelp, milk and tomato peels into edible — if not always palatable — replacements for plastics, coatings and other packaging materials.

Their efforts come as food and beverage companies are not only looking for biodegradable containers — Nestlé Waters and Danone recently announced a joint project to make water bottles from wood — but also joining in the growing effort by governments, restaurateurs and consumers to reduce waste, which contributes to the greenhouse gases enveloping the planet.

The United States Department of Agriculture, for instance, is giving new meaning to the notion of pizza with extra cheese: A team at its research laboratory in Wyndmoor, Pa., has developed a material from milk prote[…] that can be used to line pizza boxes, encase cheese or create, say, soluble soup packets that can simply be dropped in hot water.

Packaging of Fresh Food

- Optimally designed packaging plays a critical role
- The fundamentals must be covered
- At the end of the day what are the customer requirements and what creative technologies can be brought to bear to address those requirements
- We supply a technical support service that happens to include packaging
- Packaging must be an integral part of the entire new product development process
- The technology and supply of packaging is a global effort in a global market

Putting It All Together/ Conclusions

- Thorough Understanding of Requirements and Desired Results
- Matching Requirements to Properties
- Understand the Language
- Selecting the Proper Package
- Designing the Proper Package
- On-going Quality and Testing

Contacts

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