Presentation Scope

With an emphasis on fresh meat color:

Describe how flexible packaging film specifications can be designed to delay the quality degradation of fresh and processed foods so as to extend shelf life.
SELECTED FOODS

- Cheese
- Produce
- Fresh Seafood
- Fresh Poultry
- Fresh Red Meat
- Cured Processed Meat
FILM RAW MATERIAL IS RESIN PELLETS
PACKAGING FILMS

Resin Pellets

Barrel

Screw

Extrusion Die

Film
PACKAGING FILMS

Monolayer Film:

Examples:
PVC (Saran®) Stretch Wrap
Poly Bags
PACKAGING FILMS

3 Layer Film:

- Barrier
- Strength
- Sealant
SELECTED FOODS

- Cheese
- Produce
- Fresh Seafood
- Fresh Poultry
- Fresh Red Meat
- Cured Processed Meat
CHEESE

- High Barrier Film
- Format is Modified Atmosphere
- Carbon Dioxide

MAP Package from HFFS Machine
PRODUCE

- Packaging Film is Permeable
- Goal is to maintain a reduced oxygen atmosphere that slows down respiration
FRESH SEAFOOD

- Permeable Films needed for safety.
- OTR > 10,000 cc/m²

Vacuum Skin Pack
FRESH POULTRY

- Permeable Films Prevent “Containment Odor”
- Shelf life > 14 days

Typical Wrapped Tray
FRESH RED MEAT

- PVC stretch film (oxygen permeable), soaker pad and foam tray.
- Shelf life < 5 days
FRESH RED MEAT COLOR CHEMISTRY

- Myoglobin, MW = 17,000
- Heme Group, MW = 620
FRESH MEAT COLOR CHEMISTRY

Note: $O_2$ = “myoglobin blooming agent”
COLOR BLOOM

O2 = “myoglobin blooming agent”
FRESH MEAT COLOR CHEMISTRY

METCURVE – PVC WRAPPED TRAY
FRESH CUT MEAT WITHOUT PACKAGING

Atmospheric Oxygen

Surface Blooms within minutes

Red surface slowly oxidizes to brown

Raw Meat
(deoxymyoglobin)
GROUND BEEF

Metmyoglobin
Brown

Deoxymyoglobin
Purple

Oxymyoglobin
Red
FRESH RED MEAT OPTIONS

PACKAGING FORMATS
1. Vacuum with Breathable Film
2. Vacuum with Barrier Film
3. MAP with High Oxygen
4. MAP with Carbon Monoxide
5. FreshCase®
1. VACUUM WITH BREATHABLE FILM
(FROZEN STEAKS)

REQUIREMENTS

- Film OTR > 5000 cc/m²/24 hr
- Raw Materials Age > 14 days
2. VACUUM WITH BARRIER FILM
(CASE READY FRESH MEAT)

High Barrier Film

Raw Meat
(deoxymyoglobin)

Time Lapse = 2 days; Shelf Life > 28 days

REQUIREMENTS
- Film OTR < 30 cc/m2/24 hr
- Raw Materials Age < 14 days
3. MAP WITH HIGH OXYGEN
(CASE READY FRESH MEAT)

- Oxygen as a Myoglobin Blooming Agent
- Shelf Life = 10 - 14 days
FRESH MEAT COLOR CHEMISTRY

METCURVE - MAP TRAY HIGH OXYGEN
3. MAP WITH HIGH OXYGEN

Barrier Film

Headspace

60-80% Oxygen

Raw Meat
(deoxymyoglobin)

Shelf Life = 10 days
PREMATURE BROWNING

60° C Internal
4. MAP WITH CARBON MONOXIDE
(CASE READY FRESH MEAT)

- CO, Myoglobin Blooming Agent
- Shelf Life > 28 days
4. MAP WITH CARBON MONOXIDE

(CASE READY FRESH MEAT)

Motherbag
MYOGLOBIN CARBOXYLATION:

Carbon monoxide, CO is a myoglobin blooming agent.
FRESH MEAT COLOR CHEMISTRY

Metcurve – Map with CO

Oxy
Met
Carboxy
Deoxy
4. MAP WITH CARBON MONOXIDE (CASE READY FRESH MEAT)

Packaging Film

0% Oxygen, 0.4% Carbon Monoxide

Headspace

Shelf Life > 28 days

Raw Meat
5. FRESHCASE®
Nitrosylated Myoglobin auto-oxidizes to brown in the presence of oxygen.
In the absence of oxygen brown is reduced to red by enzymes in the meat.
FRESHCASE® FILM EFFECT ON COLOR

Metcurve – Vac Pack with Nitrite Film

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5. FRESHCASE®
(CASE READY FRESH MEAT)

Time Lapse = 1-2 days

Stable Color Life > 28 days
5. FRESHCASE®

Conventional Film

Nitrite Containing Film

Beef Strip Steaks
5. FRESHCASE®

PORK CHOPS

Control Film  Nitrite Containing Film
NOTE:
- Nitrogen monoxide (NO) is a hemochrome blooming agent
- Nitrite (NO2) is a hemochrome stabilizing agent
PROTECTING CURED MEAT COLOR

Nitrosyl Hemochrome (Fe^{2+})

Met Hemochrome (Fe^{3+})

oxidation

reduction

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CURED MEAT WITHOUT PACKAGING

Met Hemochrome

Atmospheric Oxygen

Cooked Cured Meat
Nitrosyl Hemochrome
CURED MEAT WITH VACUUM PACKAGING
(HIGH BARRIER FILM)

Atmospheric Oxygen

High Barrier Film

Cooked Cured Meat

Nitrosyl Hemochrome
EFFECT OF BARRIER ON COLOR

Hot Dogs at 60 days
Layer of met hemochrome
CURED MEAT WITH MAP

High Barrier Film

Headspace Residual $O_2$

Cooked Cured Meat
Nitrosyl Hemochrome