

Packaging Innovation for Extending Shelf Life of Foods



AGRO-INDUSTRY
Kasetsart University

by

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Technology

“Thai Sustainable Development project: Innovative on Food Loss and Waste”
เอกสารประกอบวิทยานิพนธ์
Kasetsart University



AGRO-INDUSTRY
Kasetsart University

PACKAGING & MATERIALS TECHNOLOGY KASETSART UNIVERSITY

- Found in 1980 as the first school in Asia to offer BS, MS and PhD in Packaging
- Committed to excellence in packaging education, research and service
- Over undergraduate 500 students and 50 graduate students per year. More than 2,000 alumni to date
- Major research areas include Active and Intelligent Packaging, Biobased Materials, Food Packaging, Packaging Process and Machinery, Distribution Packaging and Package Design and Printing
- Study Abroad, Internship and Student/Faculty Exchange Programs with leading universities worldwide (Yonsei University, National University of Singapore, Tiangin University of Science and Technology, Michigan State University, Cal Poly State University, etc.)

“Synergy for the Future”

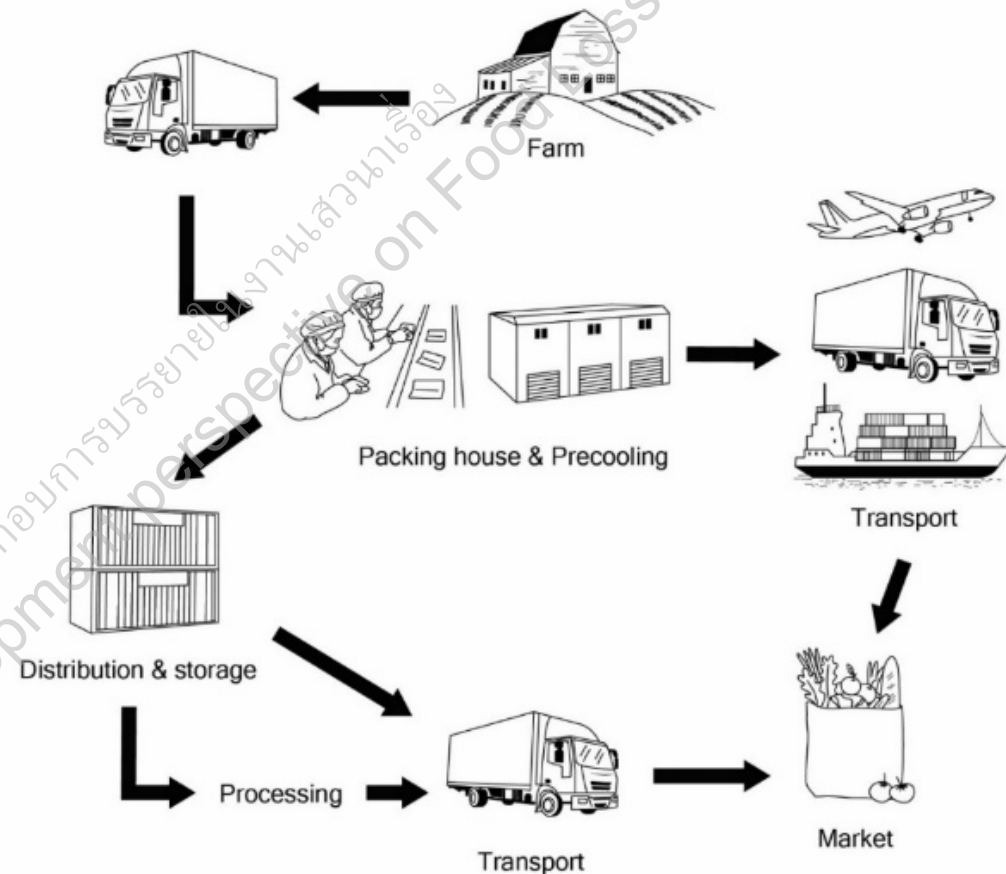
HOW CAN PACKAGING HELP REDUCING FOOD WASTE?

Key Facts

Food Loss & Food Waste

- One-third of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tons per year
- Food is lost or wasted throughout the supply chain, from initial agricultural production down to final household consumption

(FAO, 2011)



Chonhenchob, Singh, Singh (2017) Packaging and Distribution of Fresh Fruits and Vegetables, DEStech

PACKAGING FUNCTIONS PACKAGING OPTIMIZATION

“Packaging Performs Various Functions”

Containment, Protection/Preservation, Communication, Utility

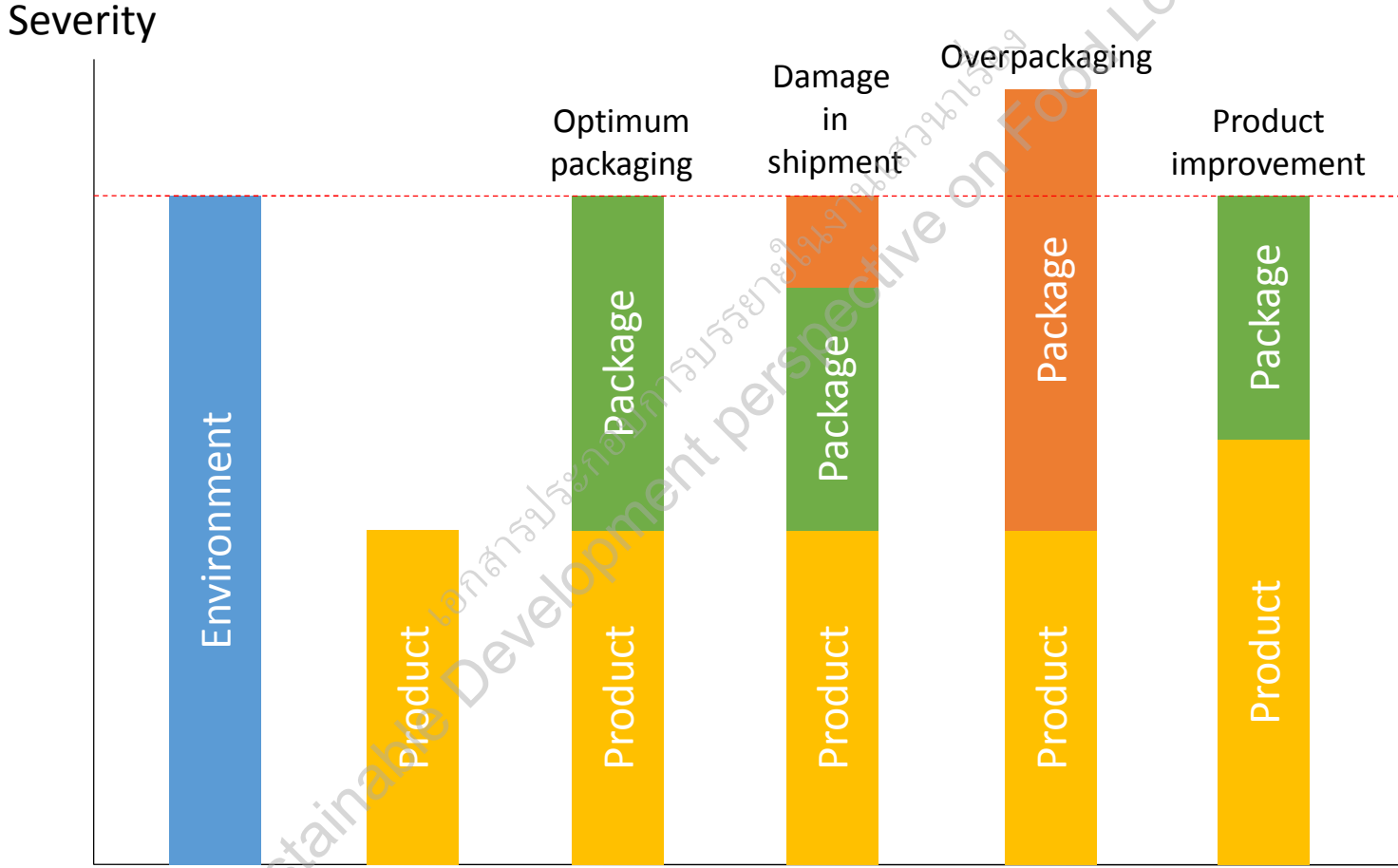
vs

“Cost”

Packaging cost & Cost of damage and loss

Packaging Concept: Optimization

Functions & Costs



“Thai Sustainable Development perspective on Food Loss and Waste”

A Success of a New Package Design

- A patent is an **invention!** A new package introduction is also an **invention!**
- A success across all retail segments of a new package design is often referred to in the industry as an **“innovation.”**
- A new package to achieve the recognition of being called an **innovation**, it has to demonstrate success by an increase in market share as well as increased presence on the shelf.
- **Innovation is followed by imitation!**

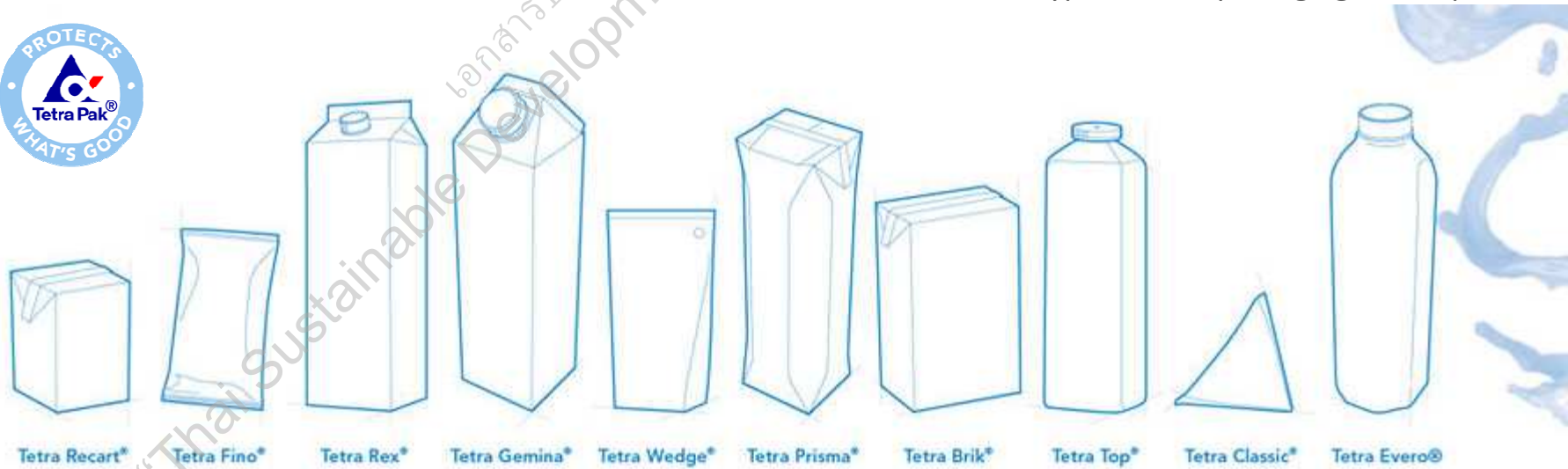
FOOD PACKAGING DEVELOPMENT



<http://www.nessaonair.com/2015/11/18/city-in-kentucky-lets-citizens-pay-tickets-with-canned-food/>



<http://www.ampaconline.com/packaging-solutions/type/flexible-packaging/retort-pouches>



Non-foil 18-oz retort pouch provides microwaveability

retort stand-up pouch packaging constructed without a foil layer. Absence of the foil layer renders the packaging microwaveable.



<https://www.packworld.com/article/food/proteins/non-foil-18-oz-retort-pouch-provides-microwaveability-sidebar>

- Supplied preformed by Alcan, Inc., the pouches are made of a clear layer of high-barrier Ceramis[®] silicon oxide-coated film, a polypropylene sealant layer, and flexographically 8-color reverse-printed polyester. The pouches are filled, sealed, and retorted, giving the finished product a one-year, non-refrigerated shelf life. Consumers cut open the pouch top with scissors or a knife.



“Toward Sustainable Development perspective on Food Loss and Waste”

HEINZ PACKAGING

You Choose -
Dipper? Squeezer?
Both? Dip & Squeeze™ fits the way you use Heinz® Ketchup.

Easy Dipping
Dip & Squeeze™ is all set for dipping, so you don't have to squeeze your Heinz® Ketchup into a different container.

More Ketchup
There's more to love with Dip & Squeeze™. You get three times as much Heinz® Ketchup as in a regular 9g packet.

Squeeze With Ease
Dip & Squeeze™ gives you pinpoint accuracy. So you can put delicious Heinz® Ketchup exactly where you want it.

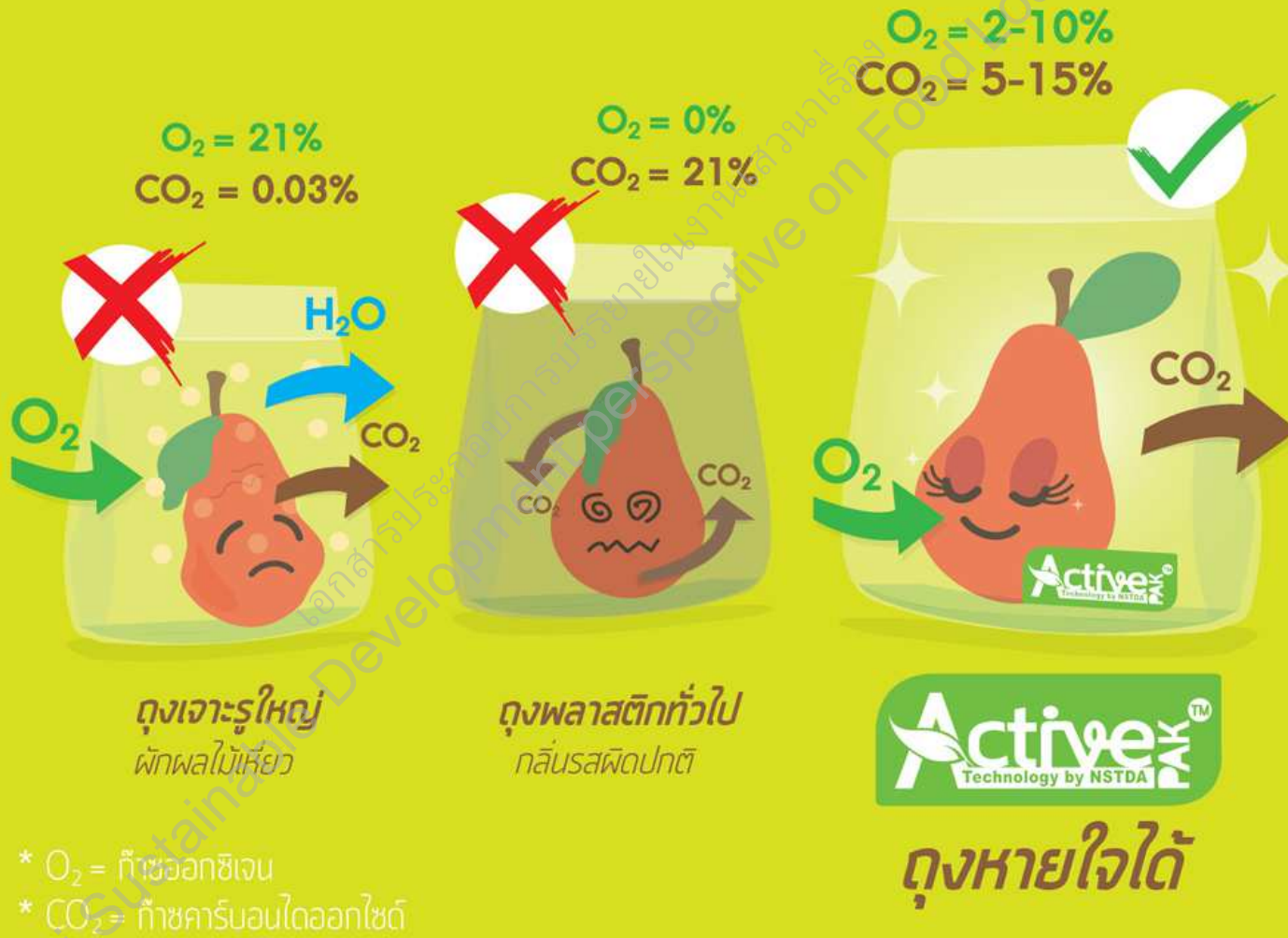
GROWN, NOT MADE™



นวัตกรรมบรรจุภัณฑ์ ActivePAK ถูกหายใจได้

ยืดอายุการเก็บ
รักษาความสด
ลดของเสีย

Active PAK™ ทำงานอย่างไร?



<https://www.mtec.or.th/activepak/>

ศูนย์เทคโนโลยีโลหะและวัสดุแห่งชาติ (เอ็มเทค)



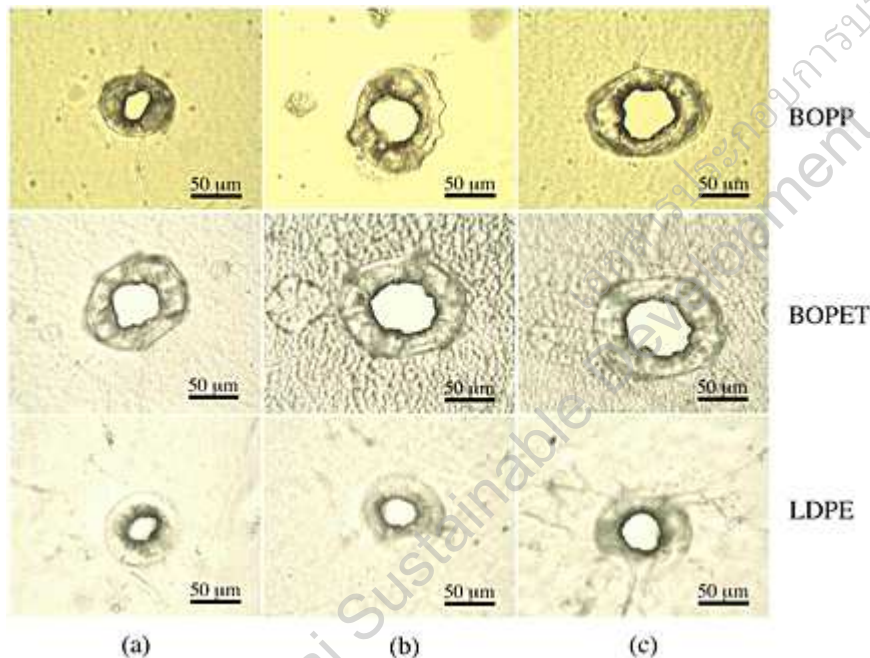
Equilibrium Modified Atmosphere Packaging EMAP Film

Micro-perforated film

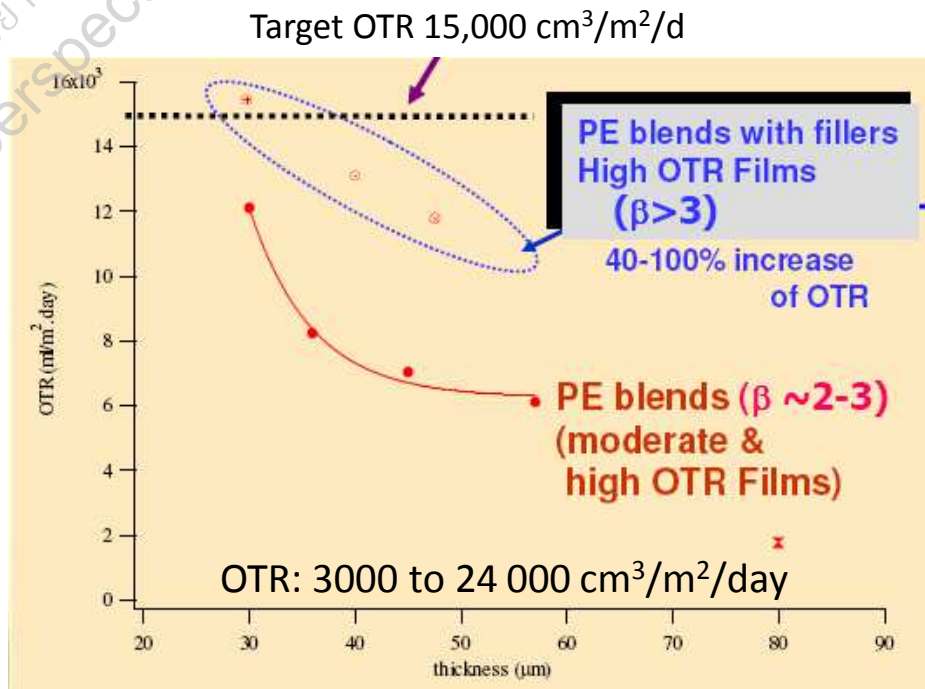
- Biaxially oriented polypropylene (BOPP)
- Designed perforations made by a Nd:YAG laser (532 nm wavelength) with diameter of 50-70 μm
- The number of perforations could be varied to get desired OTR (10,000 $\text{cc}/\text{m}^2/\text{day}$ or 600 $\text{cm}^3/\text{package}$)

Non-perforated film

- A blown film of polyethylene blends
- Resin compositions varied to obtain films with different oxygen transmission rates (OTRs)
- Desired film properties achieved by controlling processing parameters: cooling temp, blow-up ratio and take-up ratio



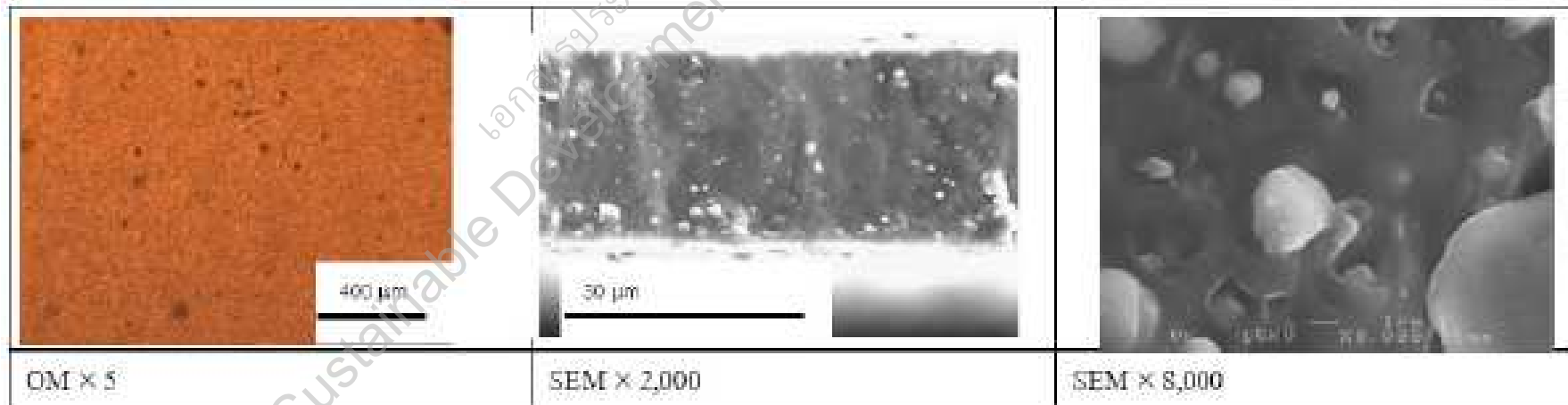
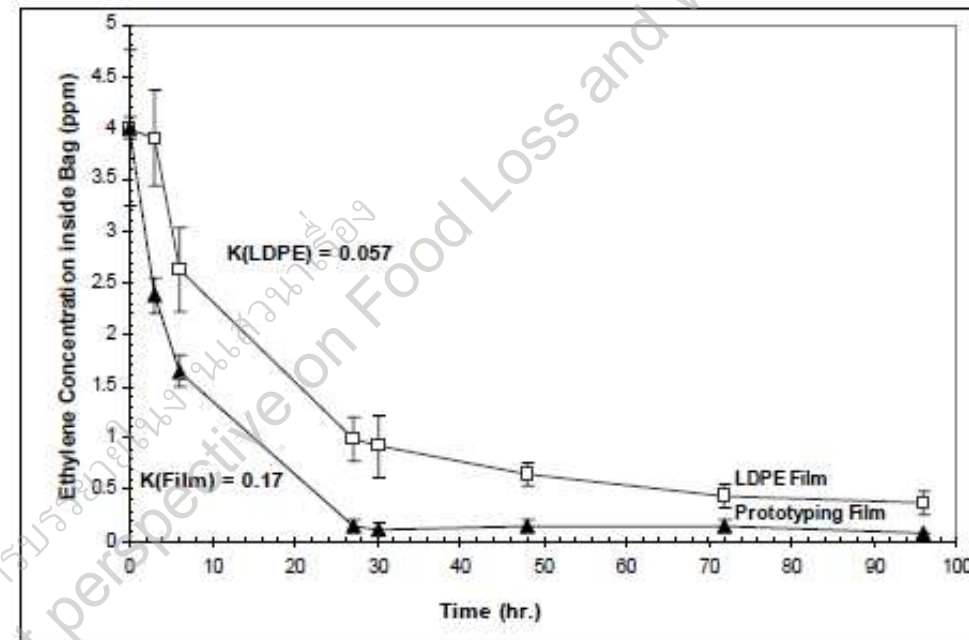
Winotapun et al., 2015



Boonruang et al., 2012

Ethylene Permeable Film

- 'Mixed matrix' membrane concept by dispersing fine particles of mordenite framework inverted (MFI)-type zeolites in the matrix of a highly ethylene-permeable polymer blend (LDPE/SEBS)
- Major component: LDPE & Block copolymer: styrene-*b*(ethylene-*ran*-butylene)-*b*-styrene)
- 5 – 10 wt% zeolite-filled 70LDPE/30SEBS



EMAP of Mango

Films	EMA	EMA (days)	Shelf life (days)	Limiting factor
Non-perforated ethylene-absorbing highly gas-permeable film (HNPE)	4 kPaO ₂ + 5 kPaCO ₂	10	40	Senescence, Decay
Non-perforated highly gas-permeable film (HNP)	4 kPaO ₂ + 5 kPaCO ₂	10	35	Senescence, Decay
Microperforated highly gas-permeable film (HMP)	9 kPaO ₂ + 17 kPaCO ₂	10	30	Senescence, Decay
Common non-perforated polyethylene film (LNP)	n/a 1 kPaO ₂ + 10 kPaCO ₂	n/a	5	Fermented Off-odor & Off-flavor
Control (open air)	n/a	n/a	20	Decay
HNP – Simulated fluctuated temp	1.7 kPaO ₂ + 6.5 kPaCO ₂	3	10	Fermented off-odor and off-flavor
HMP – Simulated fluctuated temp	1.7 kPaO ₂ + 25.9 kPaCO ₂	5–10	10	Fermented off-odor and off-flavor

Boonruang et al., 2012

ACTIVE PACKAGING

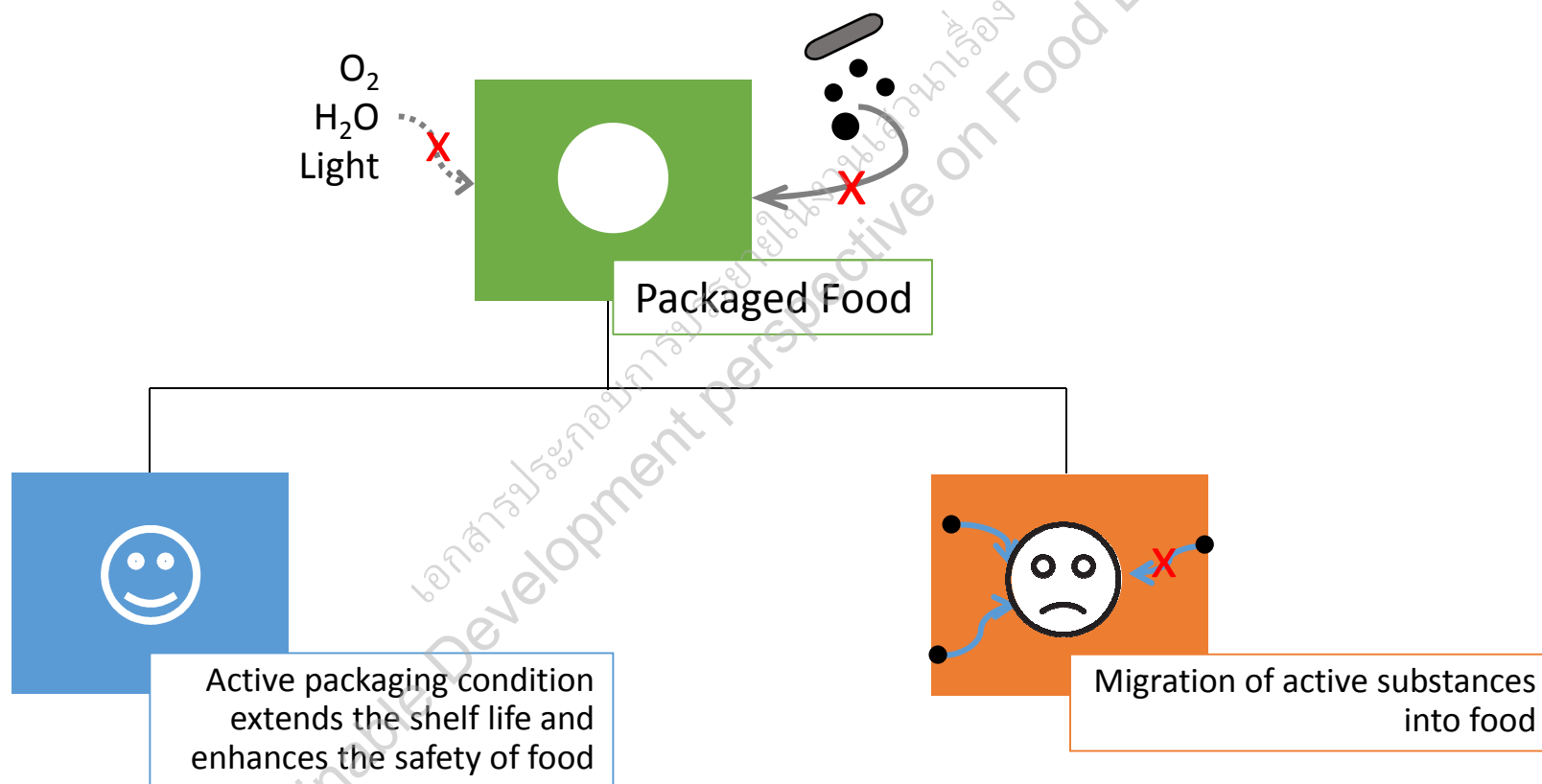
Active packaging performs additional functions to enhance quality and safety of food

System	Substances used
Moisture controllers	Polyvinyl alcohol encapsulation, silica gel, clay-based
Oxygen scavengers	Iron powder, ascorbic acid, photosensitive dye, catechol, polymeric immobilized yeast, glucose oxidase, ethanol oxidase
Carbon dioxide releasers/scavengers	Iron oxide/calcium hydroxide, ferrous carbonate/metal halide, calcium oxide/activated charcoal and ascorbate/sodium bicarbonate
Ethylene scavengers	Potassium permanganate impregnated on silica gel or clay based (e.g. zeolite, activated carbon)
Antimicrobial releasers	Organic acids, bacteriocins, fungicides, enzymes, sulfur dioxide (SO ₂), chlorine dioxide (ClO ₂) and ethanol, essential oils
Antioxidant releasers	BHA, BHT, TBHQ, vitamin C, vitamin E



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ROLES OF ACTIVE PACKAGING IN FOOD QUALITY & FOOD SAFETY



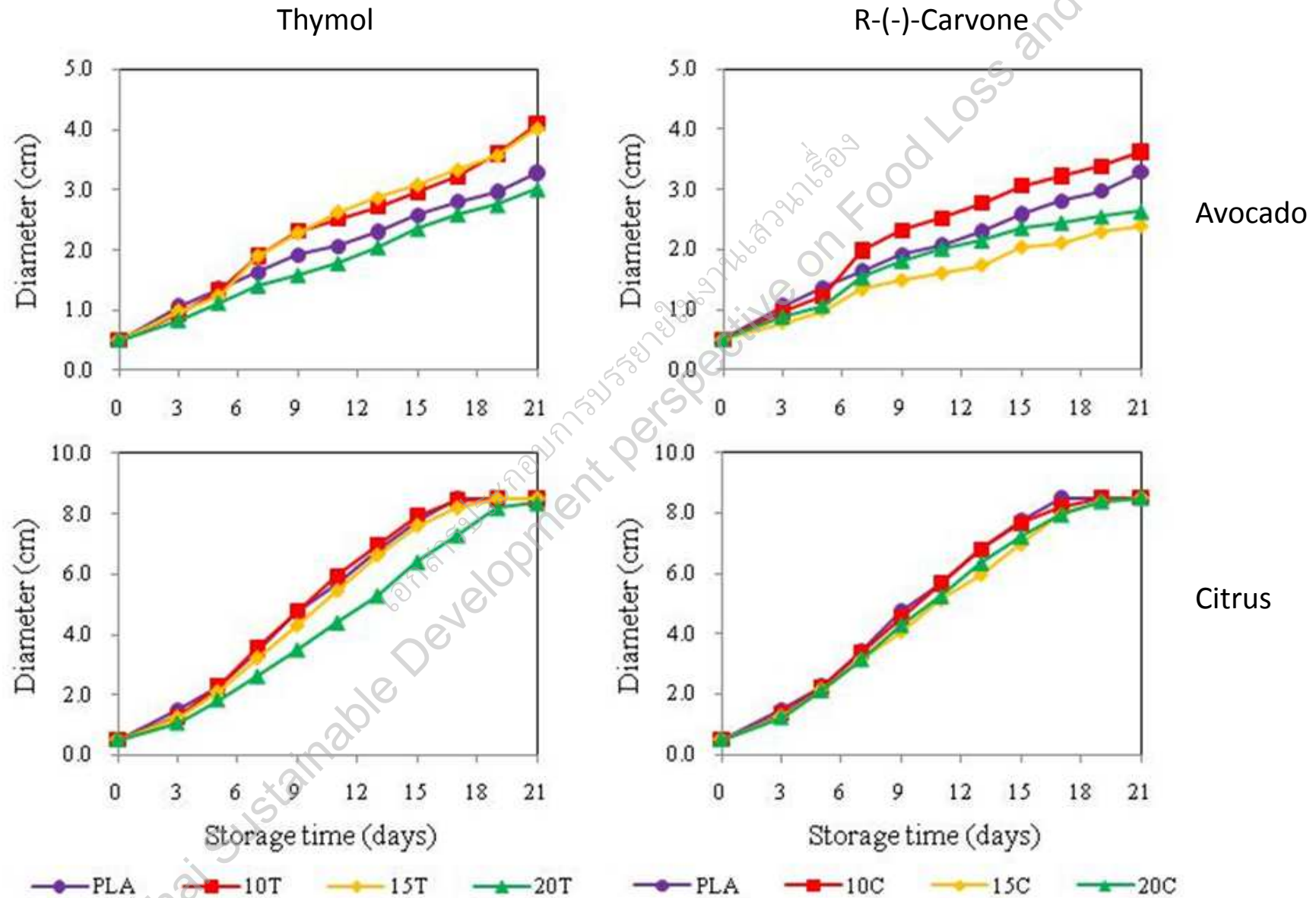
Antifungal effect of poly(lactic acid) films containing thymol and R-(-)-carvone against anthracnose pathogens isolated from avocado and citrus

Boonruang et al. Antifungal effect of poly(lactic acid) films containing thymol and R-(-)-carvone against anthracnose pathogens isolated from avocado and citrus. Food Control 2017; 78: 85–93.

Anthracnose caused by *Colletotrichum gloeosporioides* pathogen is the major postharvest disease in many tropical and subtropical fruits



Antifungal activity of the antifungal PLA films containing thymol and R-(-)-carvone against anthracnose at 12°C



"Thai Sustainable Development perspective on Food Loss and Waste"



Fungal growth in antifungal films entrapped with thymol

DAY 7

DAY 10

Neat PLA



LT-PBSA/PLA



HT-PBSA/PLA



“Thai Sustainable Development”

Intelligent Packaging



Chonhenchob et al. (2005)



<http://www.ripesense.co.nz/>

DO NOT USE



Vitsab L5-8 Smart TTI Seafood Label

In the green box: the TTI labels at various stages of thermal exposure. When the dot is green, this represents how the L5-8 Smart TTI Seafood Label should look under perfect shipping conditions.

In the orange box: the fresh seafood products could have been compromised by time/temperature exposure. White dot indicates that the TTI has not been activated and the safety of the product can not be guaranteed.

<http://vitsab.com/index.php/en/tti-label/>

Fresher – preserving without preservatives



ONE DRINK PROVIDES
38%
OF DAILY CALCIUM REQUIREMENT

Fresh nutritious food is vital for health, but in many parts of the world people have limited access to refrigeration.

"Power outages are common in numerous parts of Venezuela. This means many households can't rely on refrigeration to store fresh dairy produce that are essential to a healthy diet, such as milk and yogurt."

HAS LIGHT BLOCKING CAPABILITIES TO PREVENT SPOILAGE AND DEGRADATION



Amcor scientist Chris LaBombarbe led a two year research and development program to design a PET bottle that keeps yogurt fresh without refrigeration and without the use of preservatives.

This breakthrough technology enabled Empresas Polar to utilise its extensive, nationwide ambient



MAINTAINS NUTRITIONAL VALUE WITHOUT REFRIGERATION FOR
6 months

".....We designed an advanced barrier technology using a PET monolayer barrier, to enable aseptic filling of up to 140°F and provide unique light-blocking capabilities that would preserve and protect the nutrients in the yogurt product."

PET bottle that keeps yogurt fresh without refrigeration and without the use of preservatives.

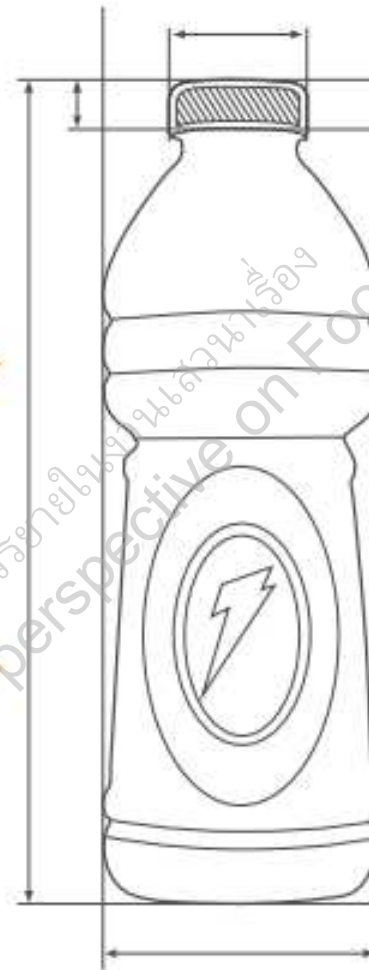
This breakthrough technology enabled Empresas Polar to utilise its extensive, nationwide ambient distribution chain to reach families in Venezuela, including those in low-income regions not served by refrigerated distribution channels.

Lighter – re-imagining what’s possible

REDUCTION IN ENERGY CONSUMPTION
23%

REDUCTION IN GREENHOUSE GAS EMISSIONS
26%

SAVINGS IN RAW MATERIALS
25%



REDUCTION IN WATER USE
24%

In 2009, PepsiCo invited Amcor to redesign the packaging for its sports hydration drink, Gatorade.

“We approached Amcor with the challenge to design and develop the lightest bottle in the world.”
Jorge Maquita,
PepsiCo Latin America

Beyond the sports arena, the Gatorade packaging has brought wins for the environment. In meeting the challenge to make the design lighter, the bottle uses less raw material. In another innovation, Amcor’s research and development team created a new way to seal the containers that reduces energy consumption.

PepsiCo together with Amcor joined in the development of a new ultra-light weight container to replace the current Gatorade global container and change the industry standard.”

“The WorldStar 2015 Packaging Awards”

Summary

- Packaging can help **extend shelf life** of fresh produce and food products.
- Antimicrobial packaging can help **control or inhibit the growth** of spoilage and pathogenic **microorganisms**.
- Antioxidant packaging can help **delay or prevent oxidation** of food products.
- Intelligent packaging can **provide information** related to quality and history of food products, becoming a significant tool in **tracking and tracing in the food supply chain**.
- Scientific and technological advancements in packaging and materials will help extending the shelf life and enhancing the safety of various foods.
- **Packaging innovation responds to the needs of both consumer and business!**

THANK YOU
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“Thai Sustainable Development project: Effective on Food Loss and Waste”

เอกสารประชาสัมพันธ์
โครงการวิจัยในงานเสวนาเรื่อง
“Thai Sustainable Development project: Effective on Food Loss and Waste”