

Active biobased packaging for protection of food products

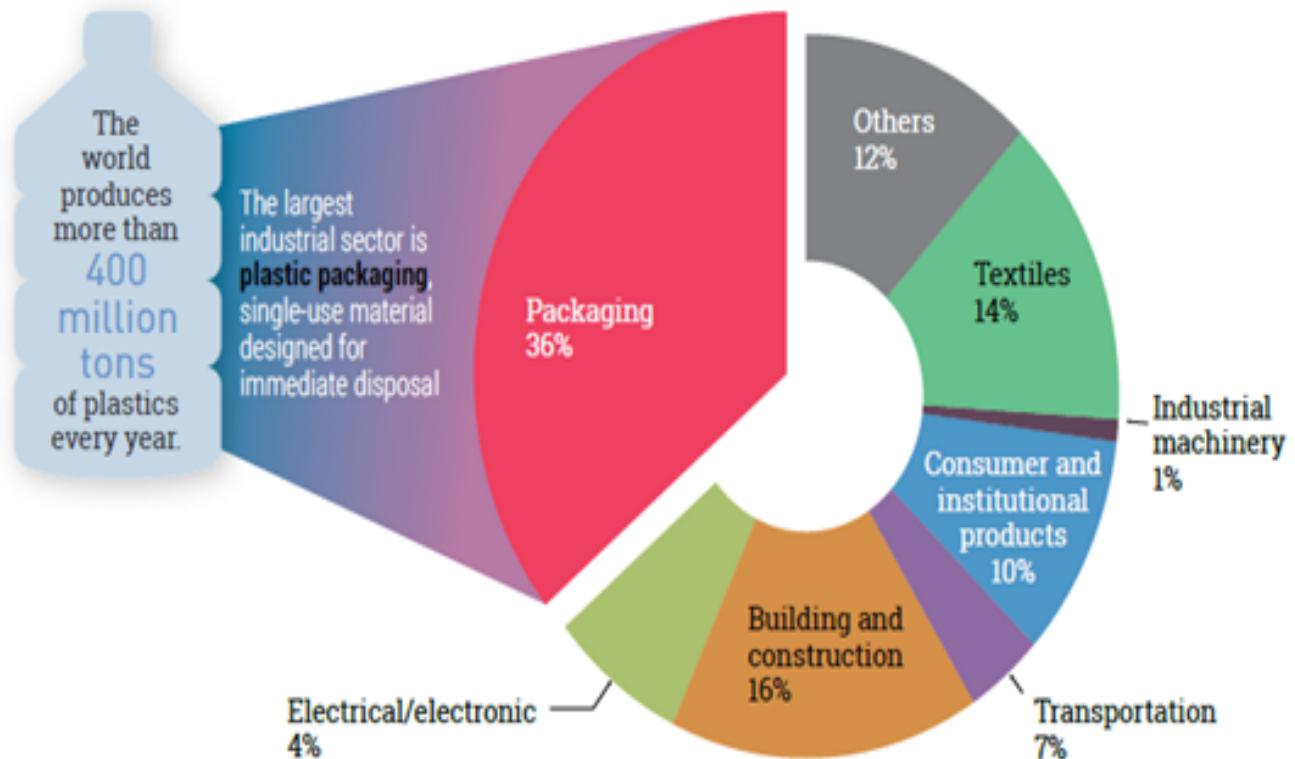


Aleksandra Nešić

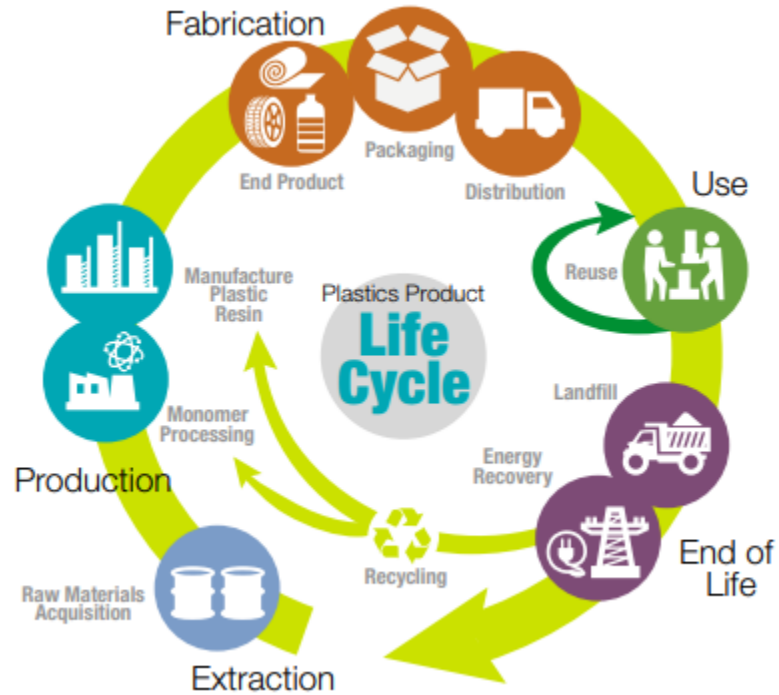
*University of Concepcion,
Technological Development Unit,
Concepcion, Chile*

WORLDWIDE PLASTIC PRODUCTION

- 400 mill. t/ year:
 - Asia 50%
 - Europe 19%
 - NAFTA 18 %
 - Middle East, Africa 7%
 - Latin America 3%
 - CIS 3%



PLASTIC WASTE MANAGEMENT

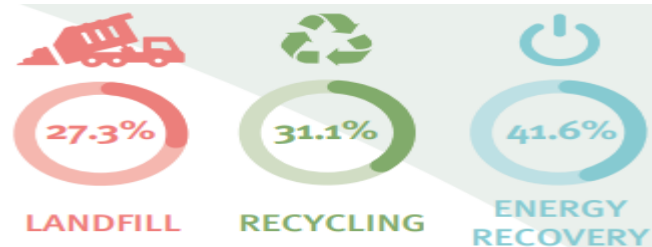


Plastic has slow rate of biodegradation.

It may remain intact in environment more than 100 years.

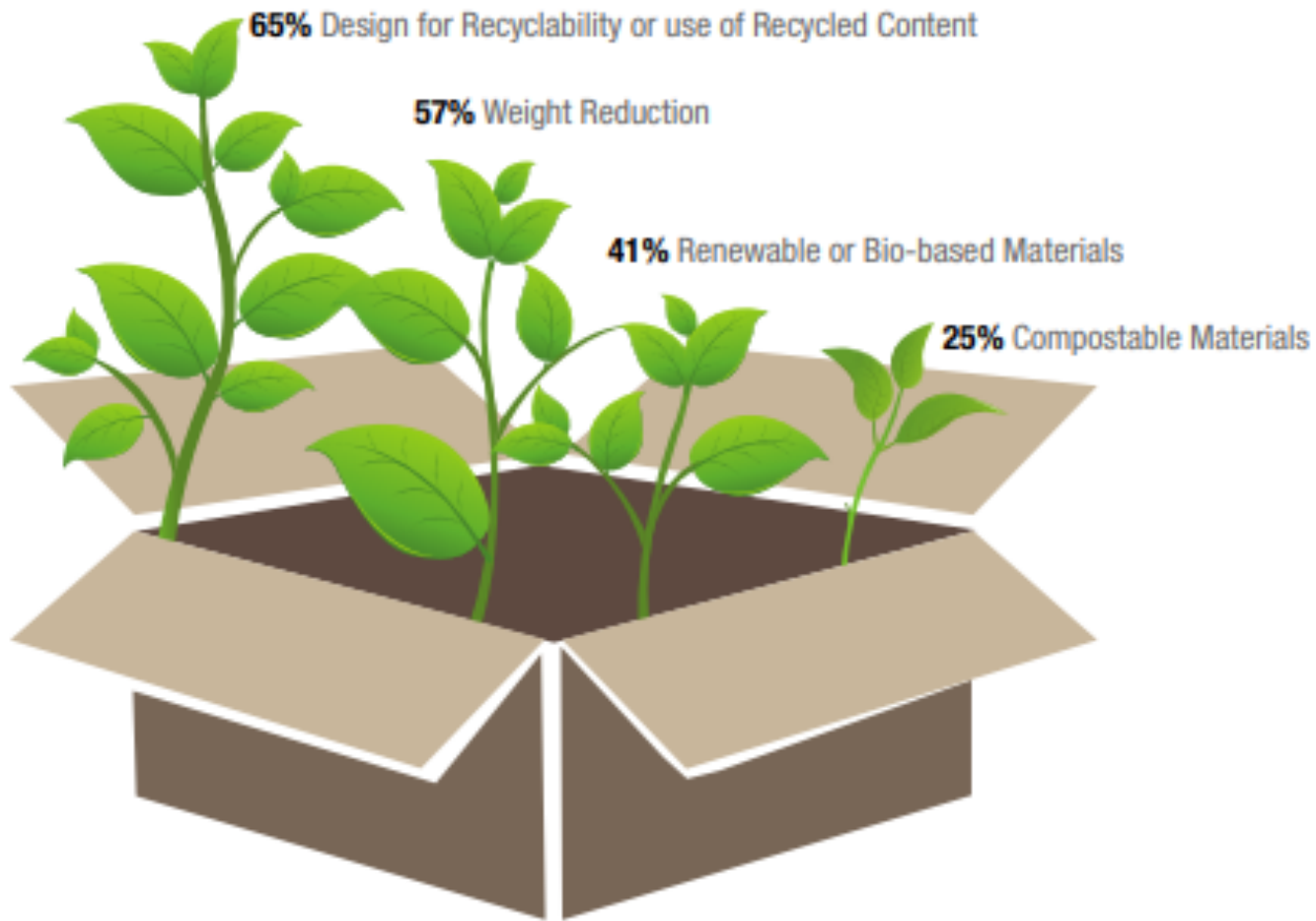


Plastic waste generation



Sustainable packaging

WHERE MOST SUSTAINABLE PACKAGING EFFORTS ARE DIRECTED



Active packaging

Allow interaction with food products and the environment and play a dynamic role in food protection.



Addition of sachets (pads)



Incorporating directly into the packaging films



Coating of packaging with a matrix that acts as a carrier for antimicrobial agent

- Delayed oxidation
- Control the respiration of fruits for example
 - Control the growth rate of bacteria
 - Moisture migration



Aim

From agro-waste
and natural resources...



...Active biodegradable
food packages
for fruits and meat poultry

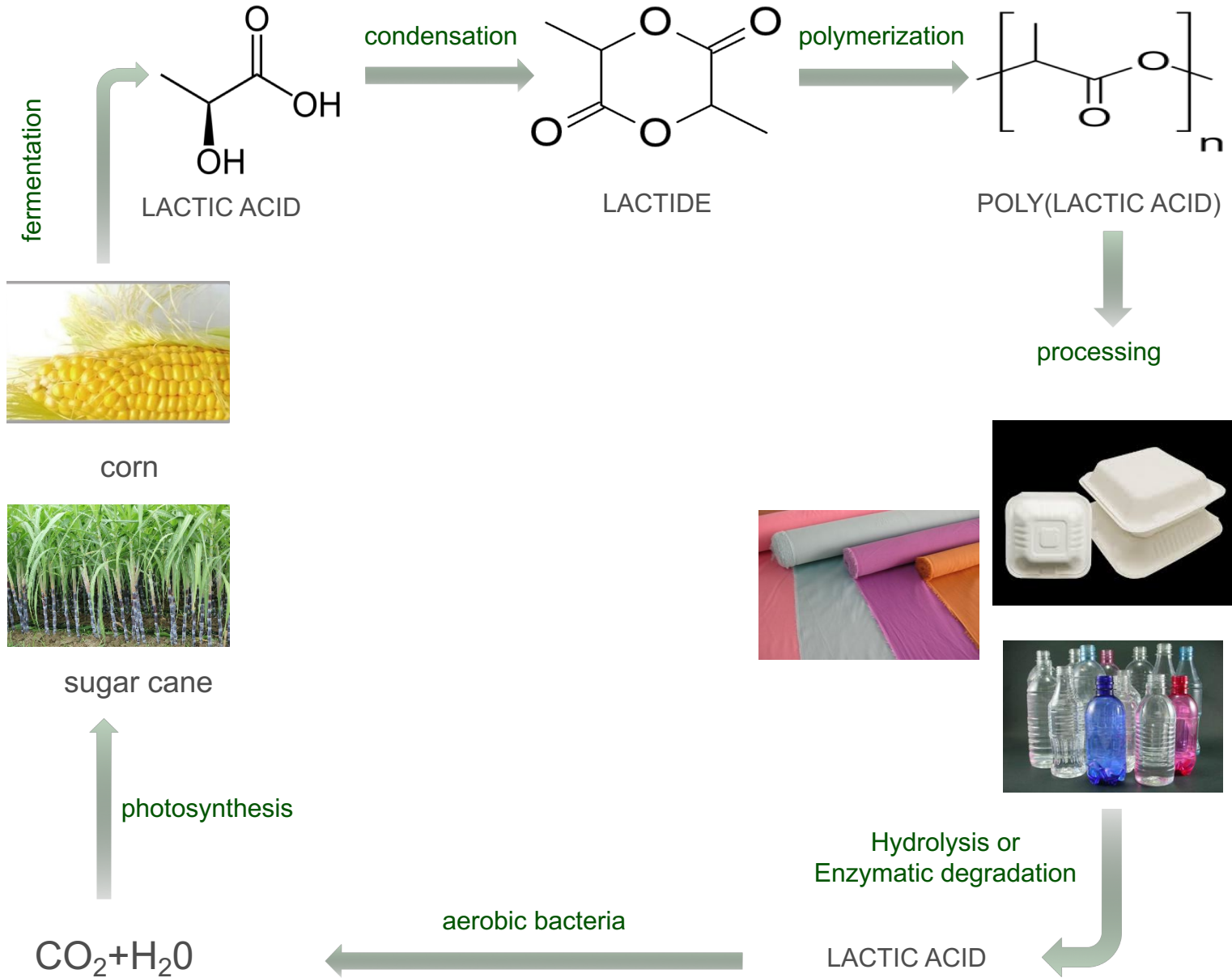


Applicative potential of raw materials

- **Green-sustainable approach**
- **Maintain the properties of origin package material**
- **Enhance the quality of targeted food products and shelf life**



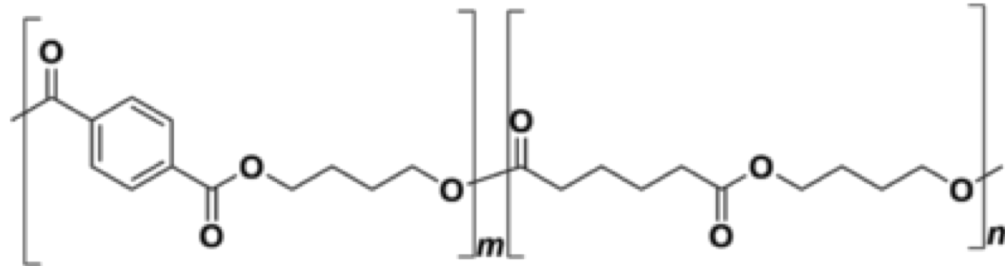
POLYMERS OF INTEREST-PLA



POLYMERS OF INTEREST-PBAT

Polybutylene adipate terephthalate:

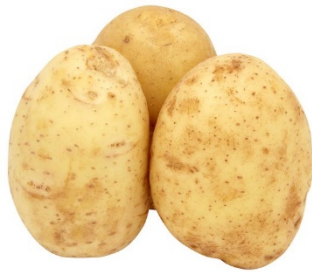
copolyester of adipic acid, 1,4-butanediol and terephthalic acid



Fully biodegradable under industrial composting conditions

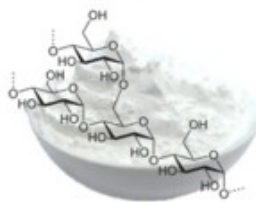


POLYMERS OF INTEREST-TPS



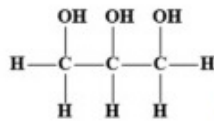
Starch

Thermoplastic starch

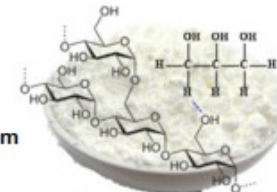
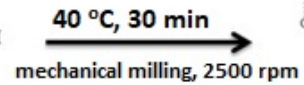


starch

+



glycerol



thermoplastic starch

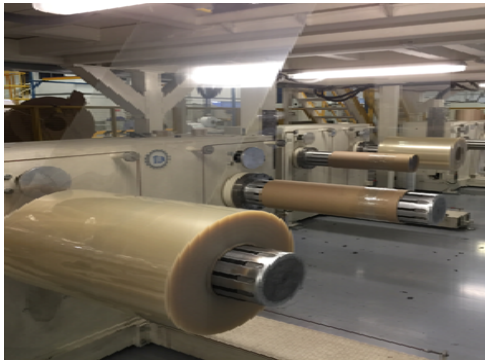


CASE I: PLA CLAMSHELLS-EXPORT OF BERRIES

PLA (85%)+ ADDITIVES (15 %)

↓ processing

1. Extrusion of laminates



2. Thermoforming



3. Clamshells



- ✓ Transparent
- ✓ Thermoresistant
- ✓ Compostable



IN VIVO TESTS

0. day



Control clamshells
(PET)

PLA clamshells

42. day



Control clamshells
(PET)

PLA clamshells

Storage at 0-4 °C, 85% RH

- ✓ After 42 days, blueberries were still in good conditions
- ✓ **No appearance of fungal infections**



CASE II: ACTIVE PLA/PBAT BAGS-CLIMACTERIC FRUITS

Sample	Formulation	Ingeo™ 4032D [%]	PBAT [%]	Compatibilizer [%]	Chain-extender [wt%]
T1	PLA/PBAT	88.0	10.0	2.0	0.5
T2	PLA/PBAT	78.0	20.0	2.0	0.5
T3	PLA/PBAT	68.0	30.0	2.0	0.5
T4	PLA/PBAT	58.0	40.0	2.0	0.5

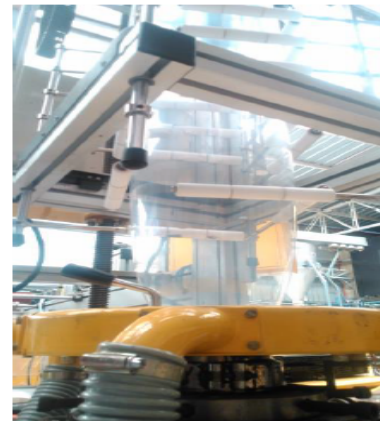
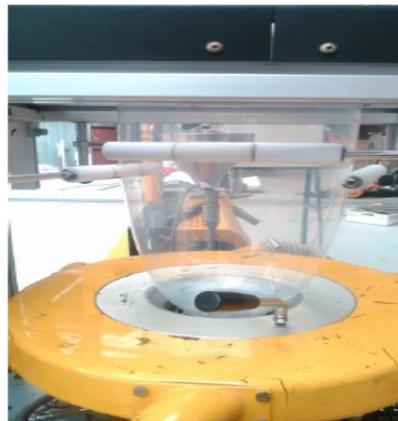
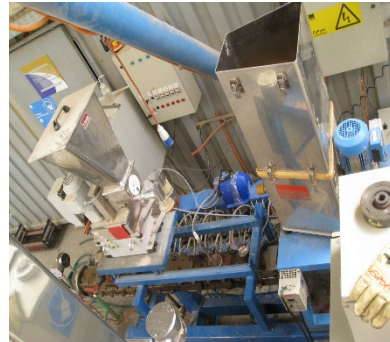


Figure 1. Co-extrusion of biodegradable bags

Mechanical and optical properties

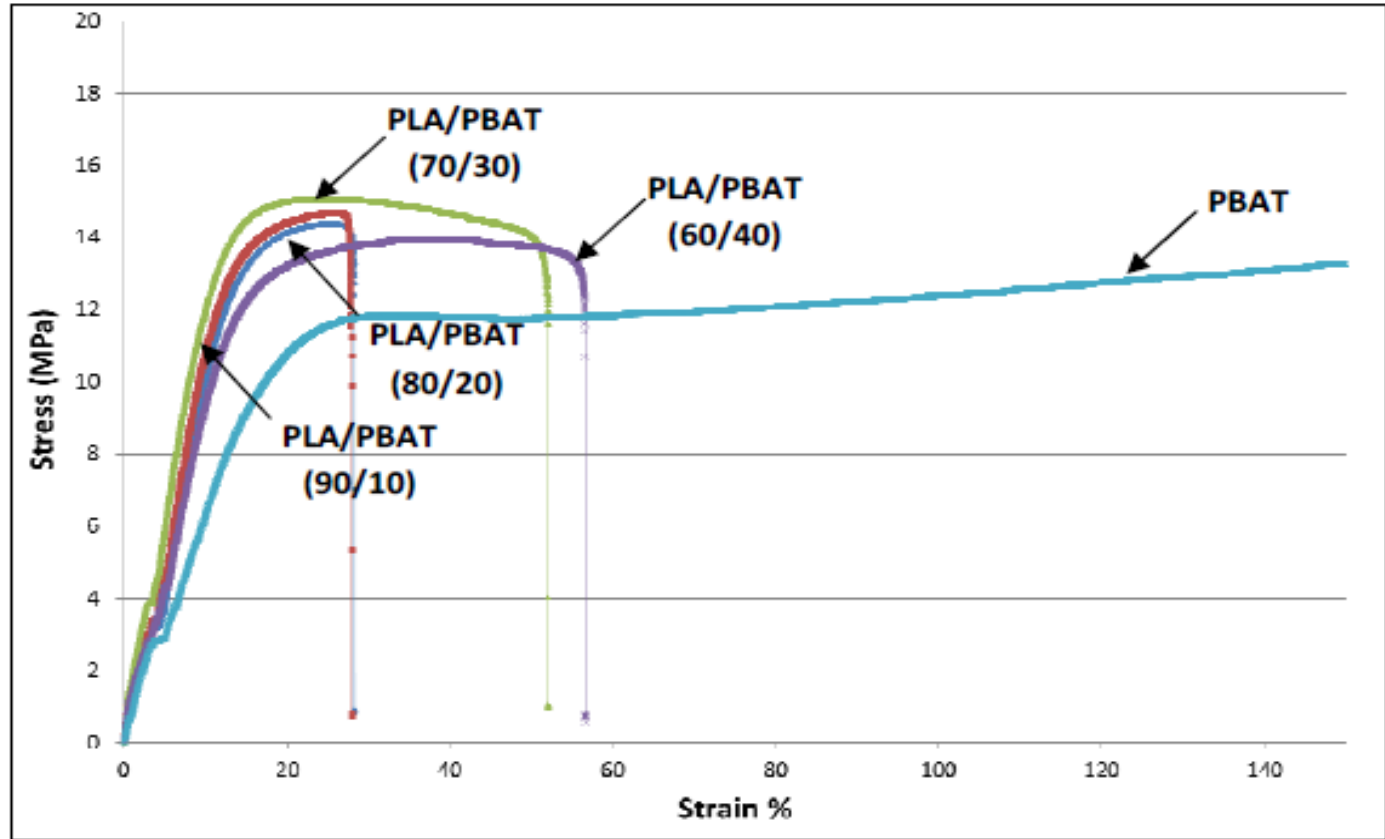


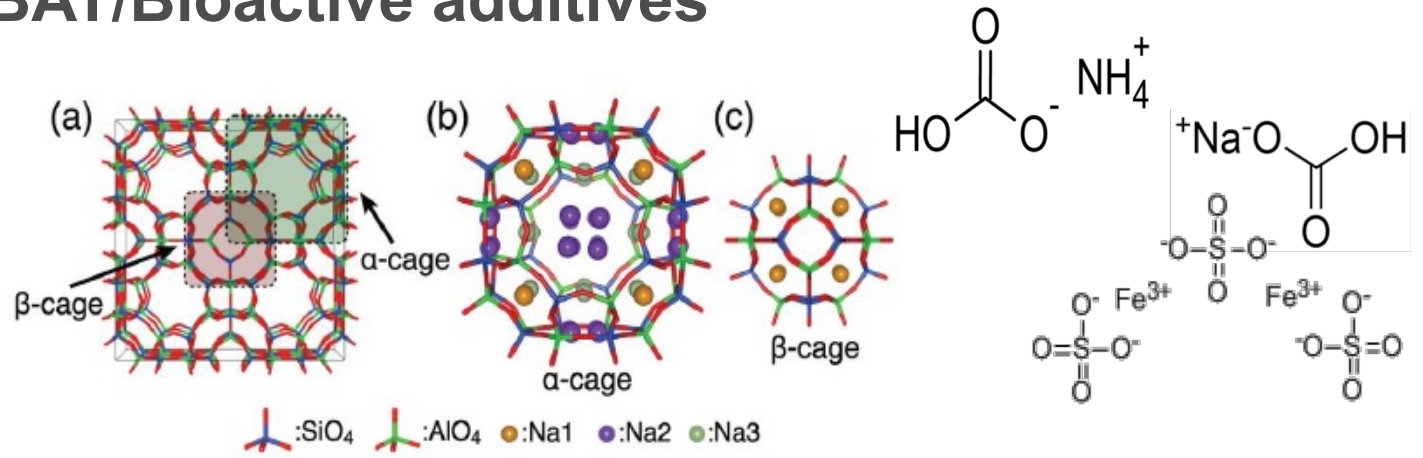
Figure 2. Stress-strain diagram

✓ PLA/PBAT 70/30

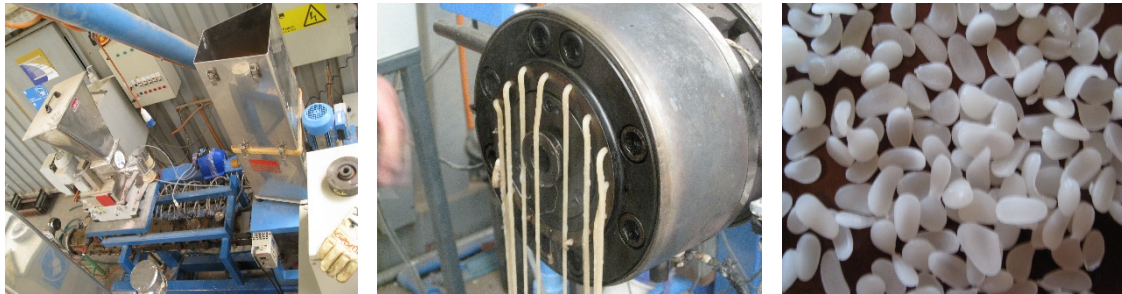
the best mechanical and optical properties



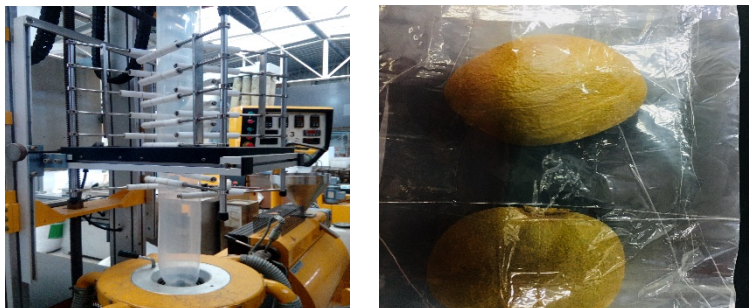
PBAT/Bioactive additives



Production of masterbatch PBAT/bioactive additives



Co-extrusion



- ✓ High transparency
- ✓ Maintained mechanical stability
- ✓ High thermal stability (up to 390 °C)
- ✓ High antifungal activity toward *Alternaria alternata*
- ✓ High absorption of ethylene



IN VIVO TESTS-KIWI

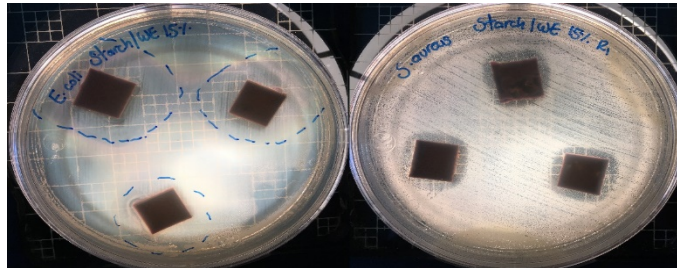


Physical parameters of kiwi after 30 days of storage at 85 % RH

SAMPLE	FIRMNESS (4.2 initial)		TSS, % (12.4 initial)		Dehydration, %	
	0 °C	20 °C	0 °C	20 °C	0 °C	20 °C
PLA/PBAT ACTIVE BAG	4.2	2.4	12.9	13	1.1	3.0
COMMERCIAL BAG	3.7	2.4	13.9	12.8	0.4	2.6

CASE III-ANTIOXIDANT TPS PADS FOR MEAT

Bioactive component: Grape cane extract
rich in resveratrol and viniferin



- ✓ Thermal stability up to 280 °C
- ✓ Mechanical resistance 1.5-2 MPa
- ✓ Antioxidant activity 80-90%
- ✓ Moderate antifungal activity toward *B. cinerea*
- ✓ High antibacterial activity toward *E. coli* and *S. aureus*

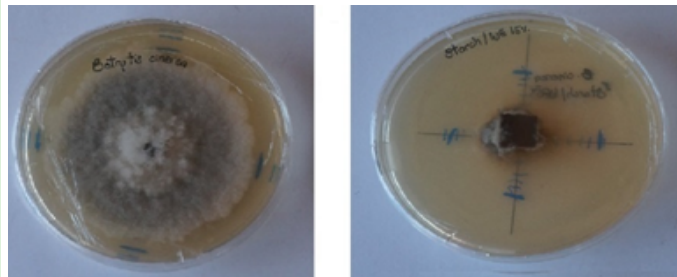


✓ **Potential as active pad or inner layer of bilayer package for meat**

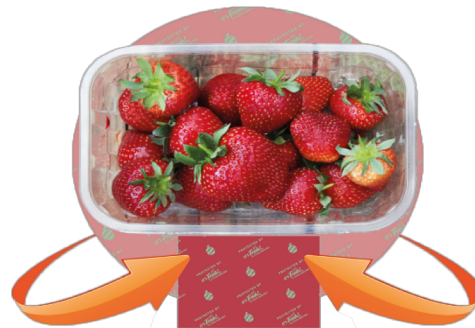


CASE IV-ANTIFUNGAL TPS PAD FOR FRUITS

Bioactive component: Cinnamon oil-based emulsion



- ✓ Thermal stability up to 280 °C
- ✓ Mechanical resistance 2 MPa
- ✓ Moderate antifungal activity toward *B. cinerea*



- ✓ *Potential as active pad or inner layer of clamshells for fruits*





Thank you for your attention!

