LAB TO PILOT UPSCALING OF NOVEL BIO-BASED AND BIO-DEGRADABLE BARRIER COATINGS FOR PACKAGING

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Our target food product groups for new packaging solutions

Typical requirements	
Thickness (µm)	70-100
Grammage (g/m^2)	70-100
WVTR ($g/m^2/day$) (38°C, 90% RH)	<5
OTR ($cc/m^2/day$) (23°C, 50% RH)	<2
Sealing temperature (°C) (1 s, 5 bar)	110-140

Materials used for film production and coating

- Unbleached kraft paper (90 g/m^2) as base substrate
- Bio-Poly(butylene succinate-co-adipate) Bio-PBSA as extrusion film and coating material to provide moisture barrier
- PLA-X as dispersion coating material for moisture barrier
- Fibrillated cellulose as coating material for oxygen barrier
  - Produced using mechanical treatment
- Carboxymethyl cellulose (CMC) as rheology modifier

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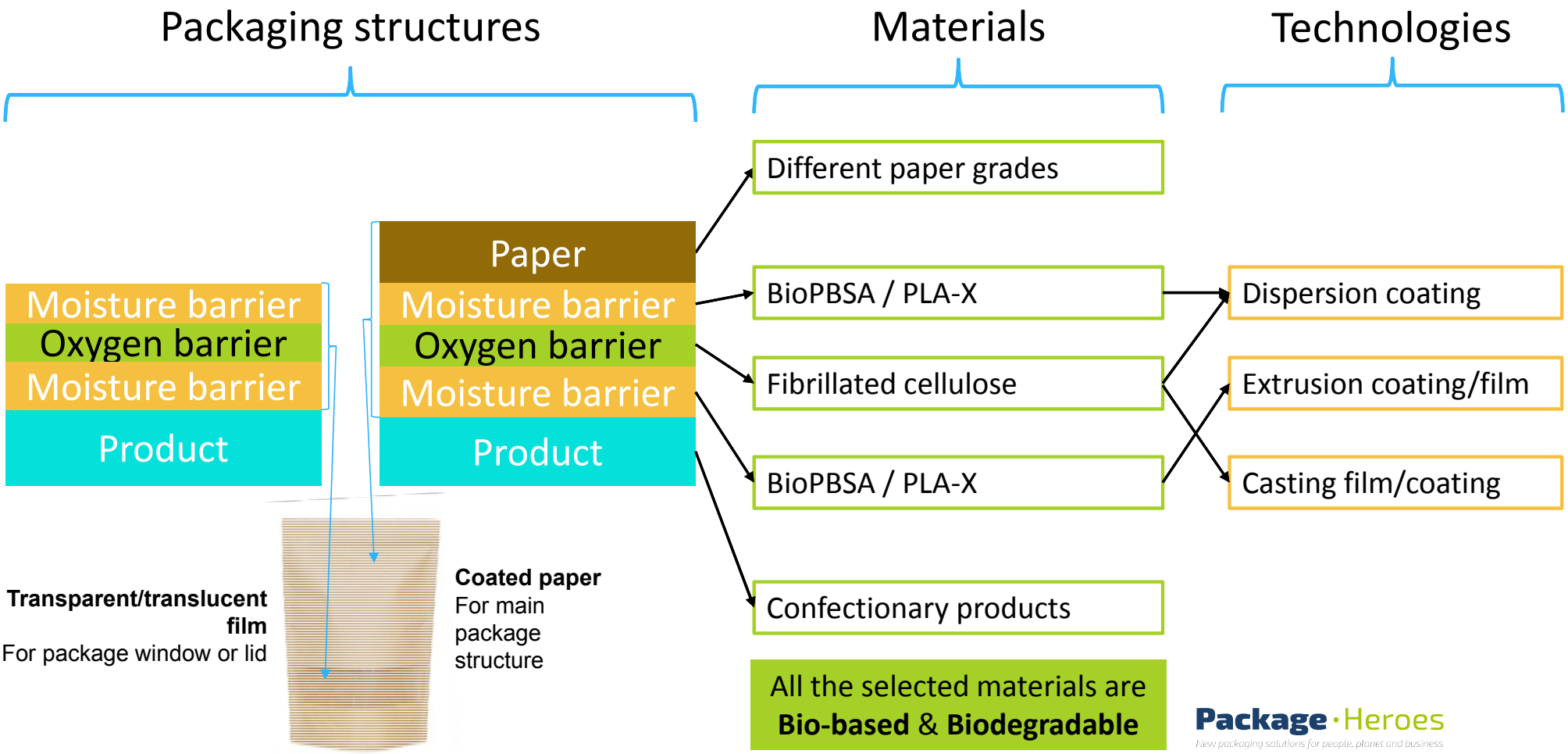
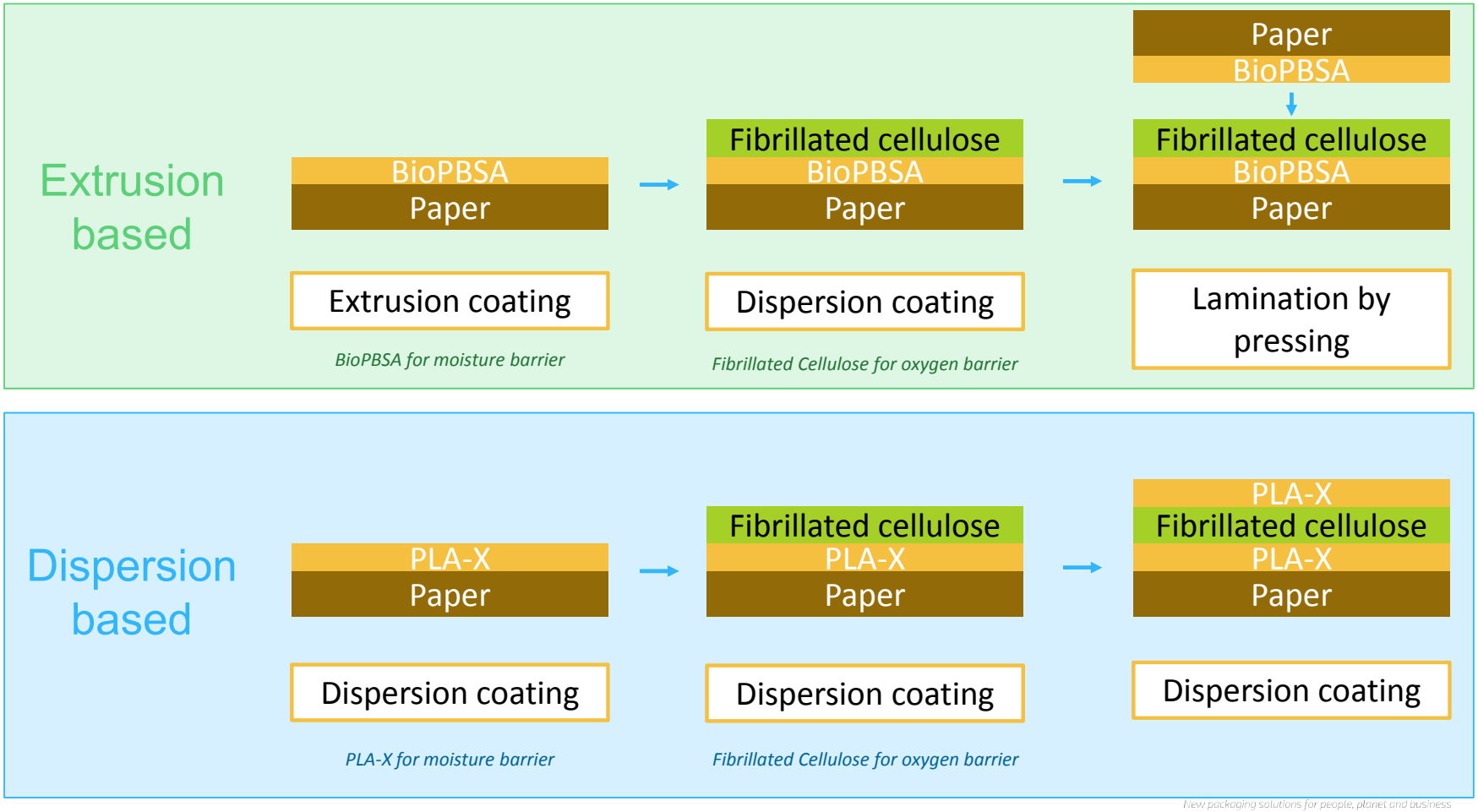
Development plan for the new packaging solutions



Lab studies

Production of multilayer structures in lab

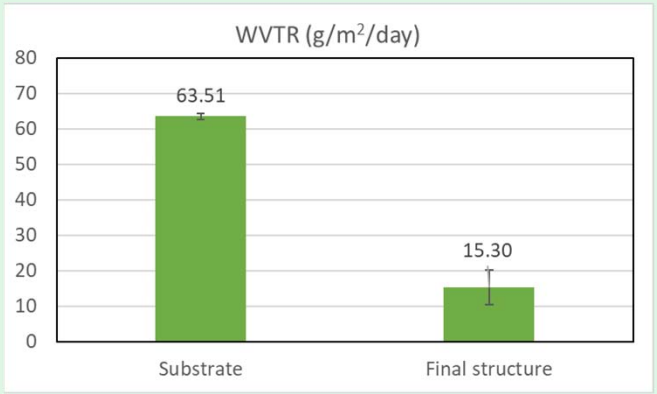


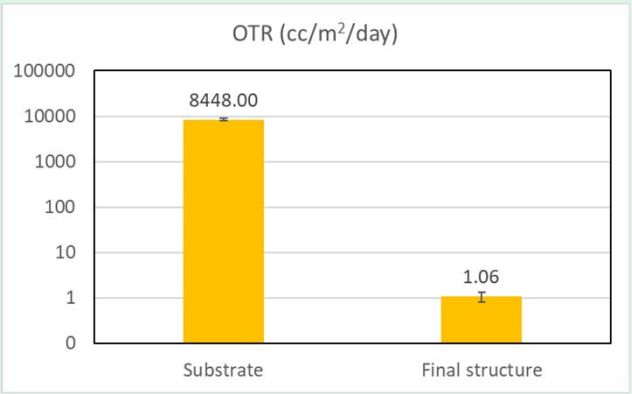
Barrier characterization results

(all tests done at 23°C and 50% RH)

Extrusion based

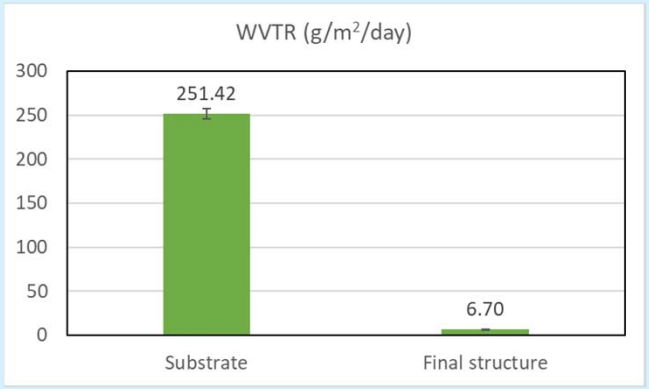
Paper
BioPBSA
Fibrillated cellulose
BioPBSA
Paper

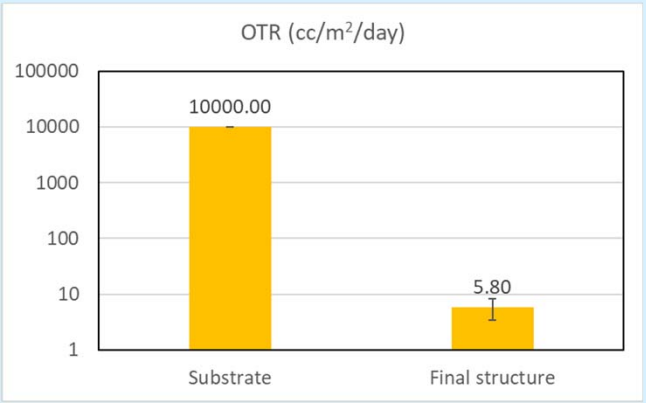




Dispersion based

PLA-X
Fibrillated cellulose
PLA-X
Paper

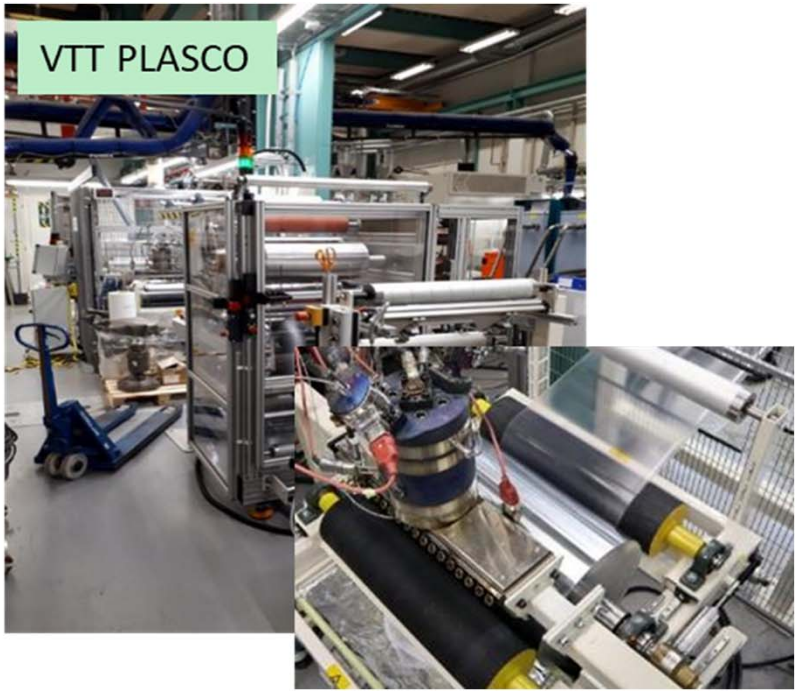




Piloting

Pilot lines used for production of bio-based packaging structures

SutCo: Modular pilot line for aqueous coatings



PlasCo: Pilot line for cast film and extrusion coating

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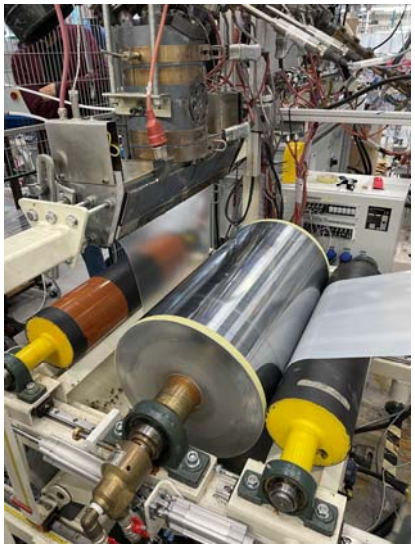
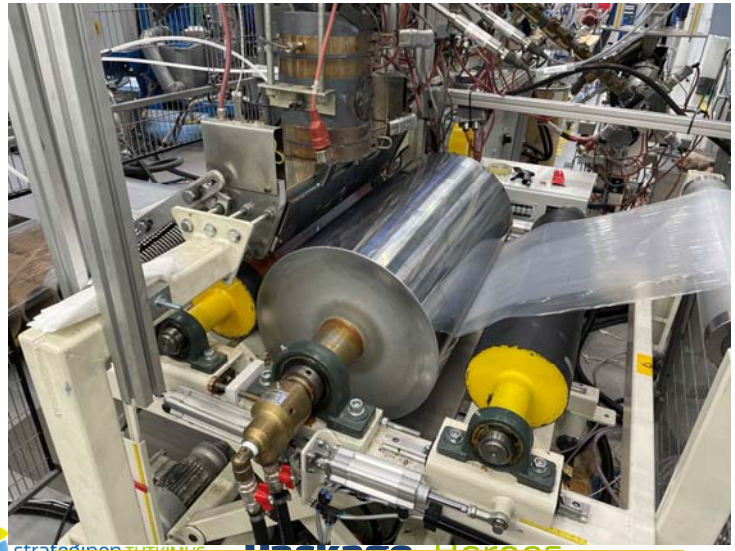
Pilot production of Extrusion based Structure (1)

PlasCo pilot →	BioPBSA coating	40-50 µm (40 gsm)
SutCo pilot →	Fibril. Cellulose coating	5-10 µm (8 gsm)
PlasCo pilot →	BioPBSA film	40-50 µm (40 gsm)



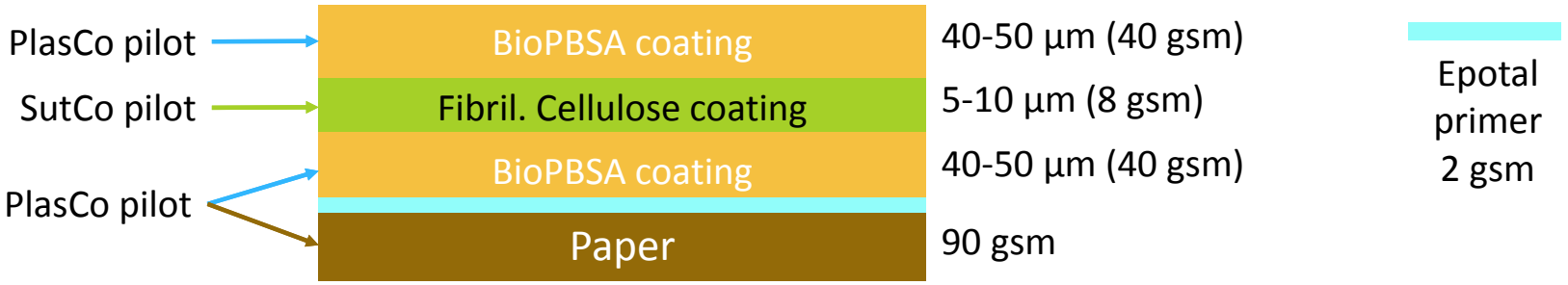
BioPBSA film production

Application of Fibril. Cellulose coating



BioPBSA extrusion coating

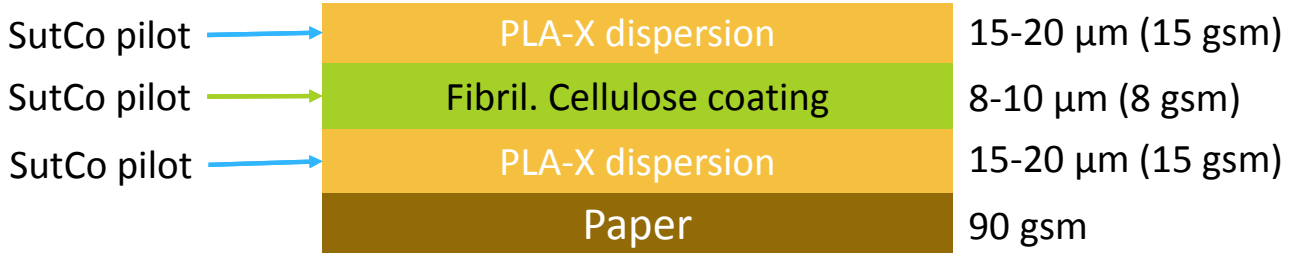
Pilot production of Extrusion based Structure (2)



Application of fibril. Cellulose coating on Bio-PBSA coated paper

Application of BioPBSA extrusion coating on top of fibrillated cellulose coating

Pilot production of Dispersion based Structure



PLAX dispersion coating

Application of fibril. Cellulose coating

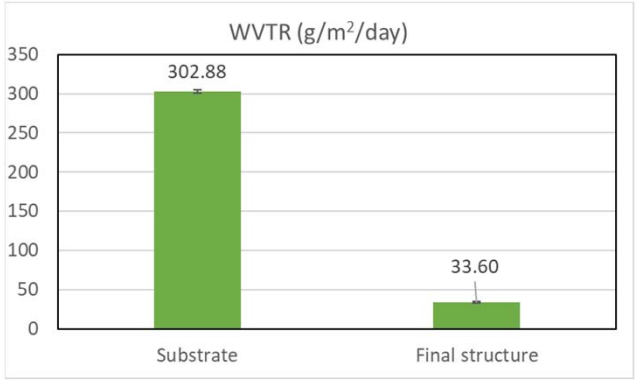
PLAX dispersion coating on top

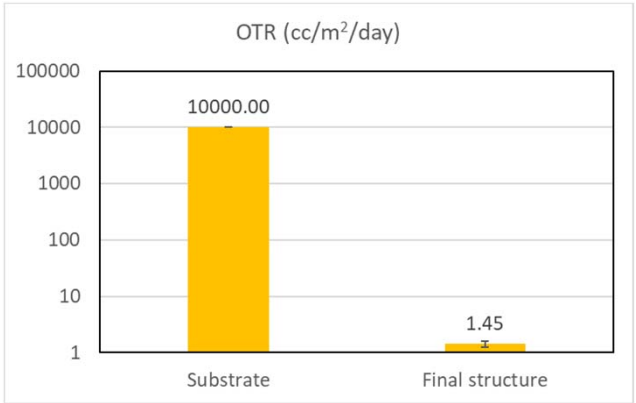
Barrier characterization results

(all tests done at 23°C and 50% RH)

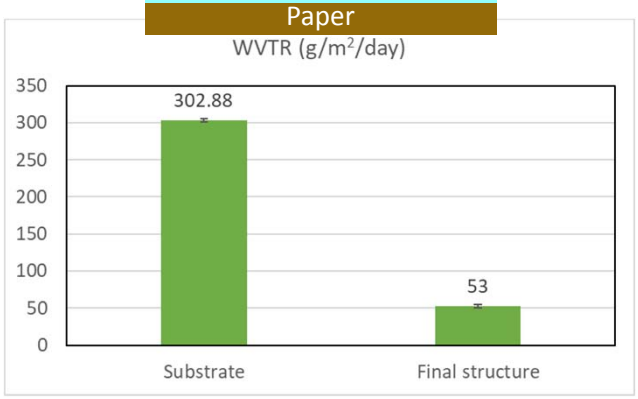
Extrusion structures

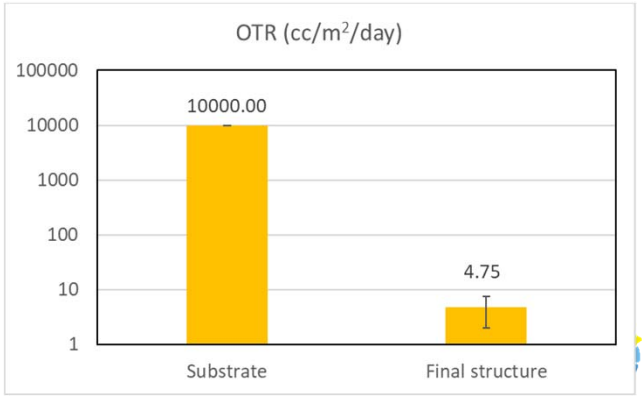
BioPBSA coating
Fibril. Cellulose coating
BioPBSA film





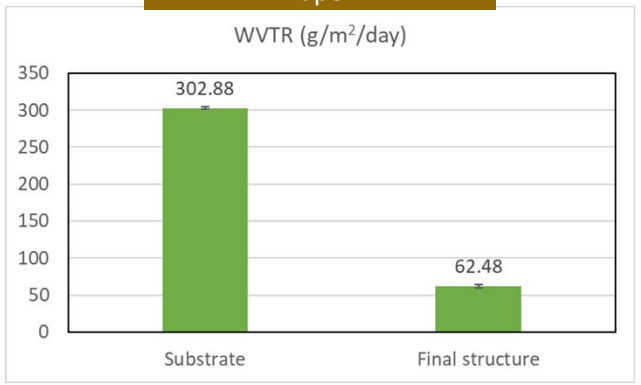
BioPBSA coating
Fibril. Cellulose coating
BioPBSA coating
Paper

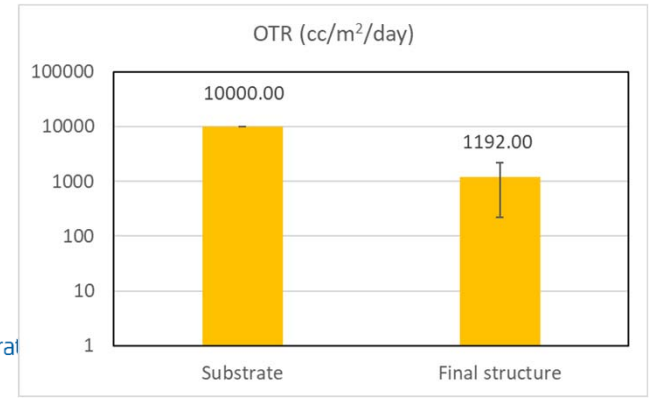




Dispersion structure

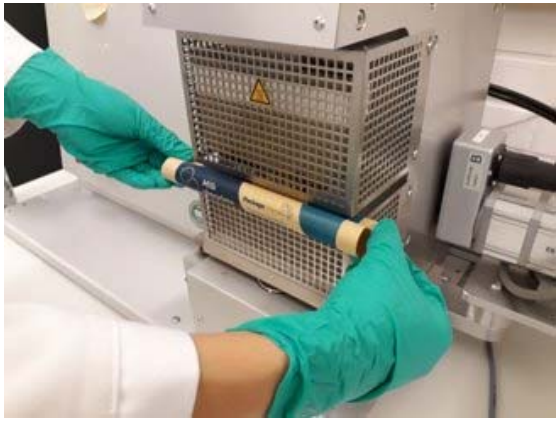
PLA-X coating
Fibril. Cellulose coating
PLA-X coating
Paper





Packing and sealing of demo packages (Extrusion Structure 2)

Sealing conditions: Temperature: 90°C, Pressure: 3.5 bar, Time: 2 s



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Challenges in coating pilot trials

When applying fibrillated cellulose directly onto the paper substrate

- Lots of water goes into the paper substrate
- Drying stresses of coating structure overpower the machine tension and cause wrinkling of the web

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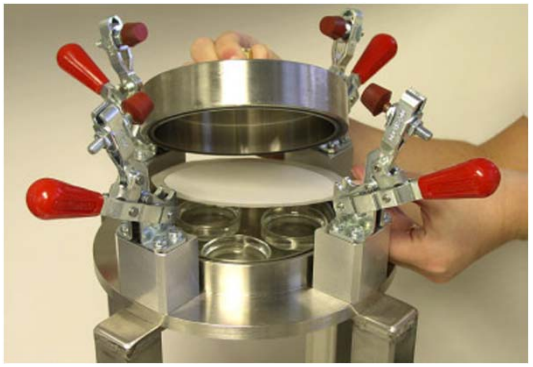
Thermal expansion of PBSA film during drying of fibrillated cellulose coating

Does fibrillated cellulose coating provide aroma barrier?

- We are not sure!
- Testing is challenging due to the amount and diversity of the aromas in actual products
  - The major component alone does not represent the whole aroma
  - The challenge is to choose a representative compound or blend at proper concentration



Gravimetric,
KCL Desiccator and
KCL Permeation cell
methods for Aroma barrier
determination

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Summary and conclusions

- We were able to demonstrate the upscaling of new **bio-based and biodegradable** packaging material solutions from lab to pilot
  - The pilot produced multilayer structures were converted to demo packages for chocolates and cookies
  - Shelf-life test results from the demo packages (extrusion coated structures) were very encouraging
  - We need to re-visit piloting of the dispersion structure due to poor oxygen barrier

- The upscaling of production from lab to pilot is not so straightforward with the new materials
  - Material performance may be affected by the dynamic processing conditions of pilot

- It is indeed possible to work with the new materials on a larger scale
  - Material and process optimization is required

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Register now!

Check out this conference if you are interested in bio-technology for lignocellulose processing and valorization. Conference programme is now available!

Thank You

Questions? Or other remarks

Package Heroes

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