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▶ **To cite this version:**

Morgan Guilbaud, Sandra Domenek. EVALUATION OF FOOD QUALITY AND SAFETY FOR PACKAGED HAM USING BIODEGRADABLE PACKAGING. CEIAL VIII Ecuadorian Congress on Food Engineering, Nov 2022, Guyaquil, Ecuador. 2022. hal-03887512

HAL Id: hal-03887512
https://hal.science/hal-03887512

Submitted on 6 Dec 2022

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EVALUATION OF FOOD QUALITY AND SAFETY FOR PACKAGED HAM USING BIODEGRADABLE PACKAGING

Morgan Guilbaud, Sandra Domenek

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Introduction

Inconvenience of PLA for Food Packaging

PLA is a bio-based and compostable commercial polymer already used widely in catering and processed-food packaging. Despite all the advantages of PLA, it misses satisfying properties for food packaging applications.[1,2]



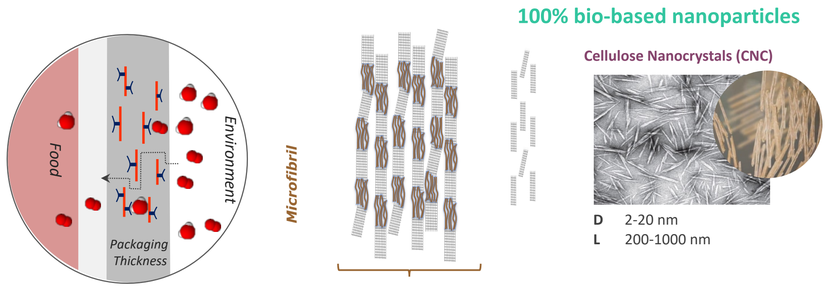
Bio-plastic
PLA

Defects

- Inherent brittleness
- Low thermal stability
- **Low gas barrier properties**

Objectives of the project "GASP"

- Develop innovative bio-based and bio-degradable packaging materials with high gas barrier properties
- Use nanocelluloses for property improvement



Specific Objectives:

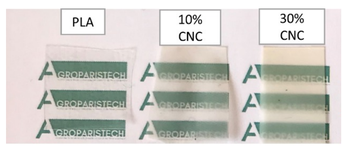
- **Evaluate hygienic properties** of the new PLA/CNC materials by adhesion and cross contamination tests with bacteria representative of common food pathogens and food spoilage
- Analyse the chemical and microbiological safety aspects of PLA packaging materials in **a real life conditioning experiment** of ham inside PLA trays compared to commonly used poly(ethylene terephthalate) (PET) trays under modified atmosphere

Materials and Methods

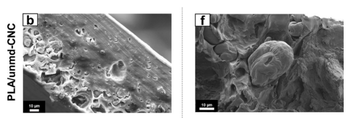
• PLA/CNC materials



- Thermoformed trays of PLA 4060 D (NatureWorks)
- Lids:
  - PLA 4060 D (blank)
  - PLA/CNC 33 wt% obtained by twin-screw extrusion and thermoforming



PLA and PLA/CNC films



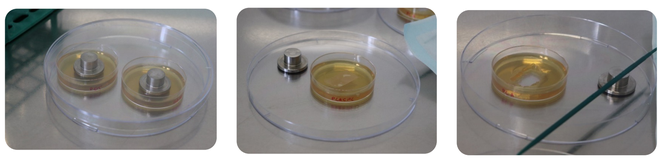
SEM images of PLA/CNC films

Benchmark:
- PET trays (PE seal layer)
- Lid: PET/PE/EVOH/PE

• Hygienic evaluation

Bacterial Adhesion (in-house protocol):
- Inoculation with bacterial suspension
- Adhesion: 2 hours at 8 °C (PLA, PET, LDPE), detachment with ultrasound bath for 2 min
- Counting of viable colonies after incubation on BHI agar for 24 h at 37 °C
- Analysis of total flora with epifluorescent coloration via optical microscopy

Cross Contamination test on food (ham), solid food model (TSA agar) and liquid food model (physiological water)
- Contamination of the material using the adhesion test
- Contact of the contaminated material with food model (see photos)
- Contact time: 24 h; contact pressure: 25 g
- Analysis of viable flora
  - Homogenization of solid food by a Stomacher (230 rev min^{-1}, 60 sec)
  - Serial dilution and incubation for 24 h at 37 °C for counting



Placement of polymers on food simulant (BHI agar) + 25 g weight | After 24 h of cross contamination | Polymer and food simulant taken for serial dilutions

Strain	Gram +/-	Microbial Risk
Hafnia alvei	-	Spoilage Bacteria
Listeria monocytogenes	+	Foodborne Pathogen

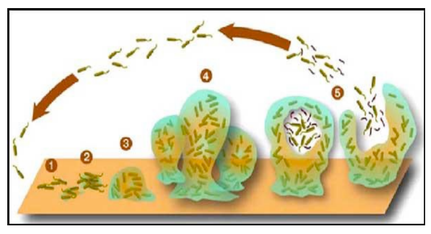
• Conditioning under modified atmosphere



- Lidding machine Cryovac Mulitvac™ T 250
- Modified atmosphere: N_2/CO_2 70/30
- Ham purchased from local supermarket
- Storage at 4 °C for 20 days
- Analysis of aspect, pH, total flora

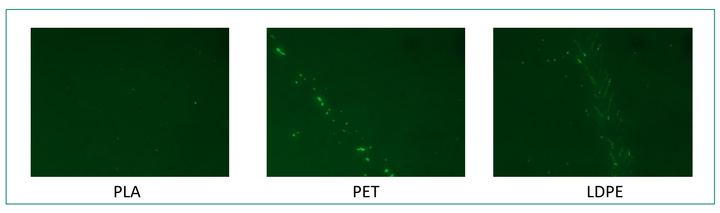
Results

• Microbial adhesion on polymers

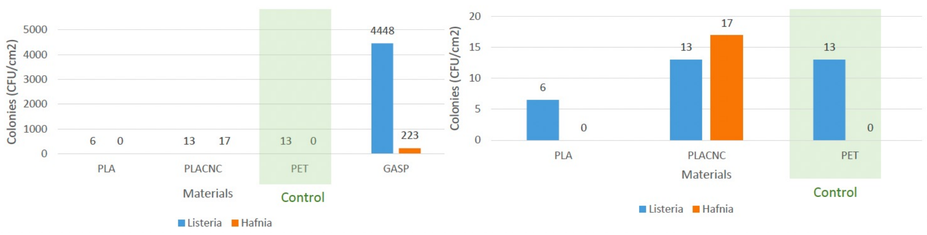


Bacterial adhesion and biofilm formation stages

The mechanism of adhering of bacteria to the surface is usually triggered by adhesion forces[3]
- Surface Charge, Surface Hydrophobicity
- Topological and mechanical surface characteristics
- Surface roughness, Surface hardness
- Environmental factors
  - Blooming of Additives
  - Presence of other substances (proteins, lipids ..)
  - pH and ionic force of the contact medium



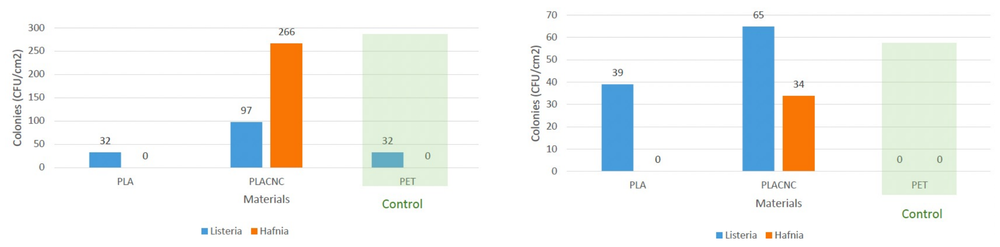
Bacterial adhesion on different materials



Count of bacterial adhesion on different materials

- **High adhesion level for PLA/CNC (GASP) → delamination and roughness of cellulose particles**
- **Less contamination of PLA compared to PET**

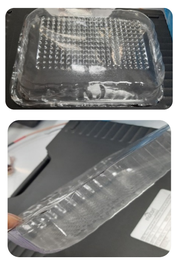
• Cross-contamination of the food model by packaging



Bacteria remaining on the material after transfer | Bacteria transferred to the BHI agar

- **Less contamination of PLA compared to PET but higher transfer to the food model**

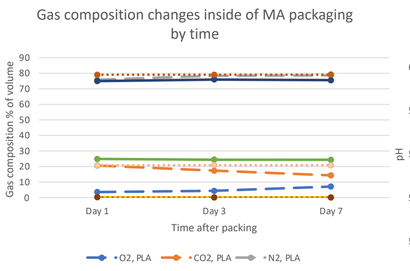
• Shelf-life of ham in PLA versus PET trays

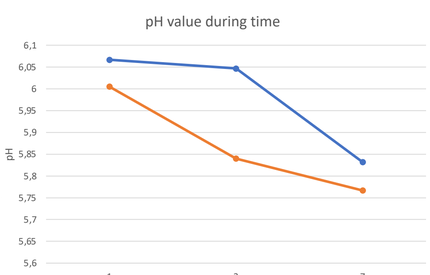


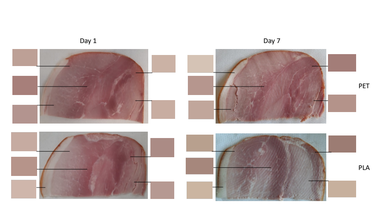
Heat sealing of PLA trays

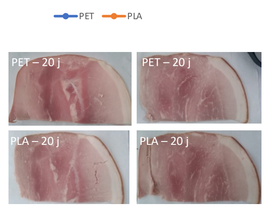


Packaging under modified atmosphere









→ **Lower barrier properties of PLA cause lower shelf life**
→ **PLA/CNC materials showed difficulties in heat sealing properties -> optimization needed**

Conclusions

- **The biodegradable character of PLA does not induce a higher microbiological risk with respect to adhesion.**
- **The cross-contamination of the model food was higher for PLA than for PET.**
- **PLA trays could be heat-sealed and used in modified atmosphere packaging.**
- **The lower gas barrier properties of PLA with respect to PET diminished the shelf-life of ham.**

→ **This shows that the materials need to be optimized for equal performance.**

ACKNOWLEDGEMENTS

The authors acknowledge financial support from the French National Research Agency (ANR) for the national research project ANR-16-CE08-0040 – GASP.

REFERENCES

1. Ducruet, V., Domenek, S. (2015) In Biodegradable and Bio-based Polymers: Environmental and Biomedical Applications; S. Kalia, L. Averous, Eds.; Scrivener Publishing LLC: Beverly, MA 2015, Chap. 6.
2. Salazar, R., Domenek, S.; Plessis, C., Ducruet, V. (2017) *Polym. Degrad. Stab.* 136: 80-88
3. Sandle, T., Bacterial Adhesion: An Introduction| IVT.

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