Secondary packaging active to protect chocolate-madeleine (aroma barrier) and repulse insects

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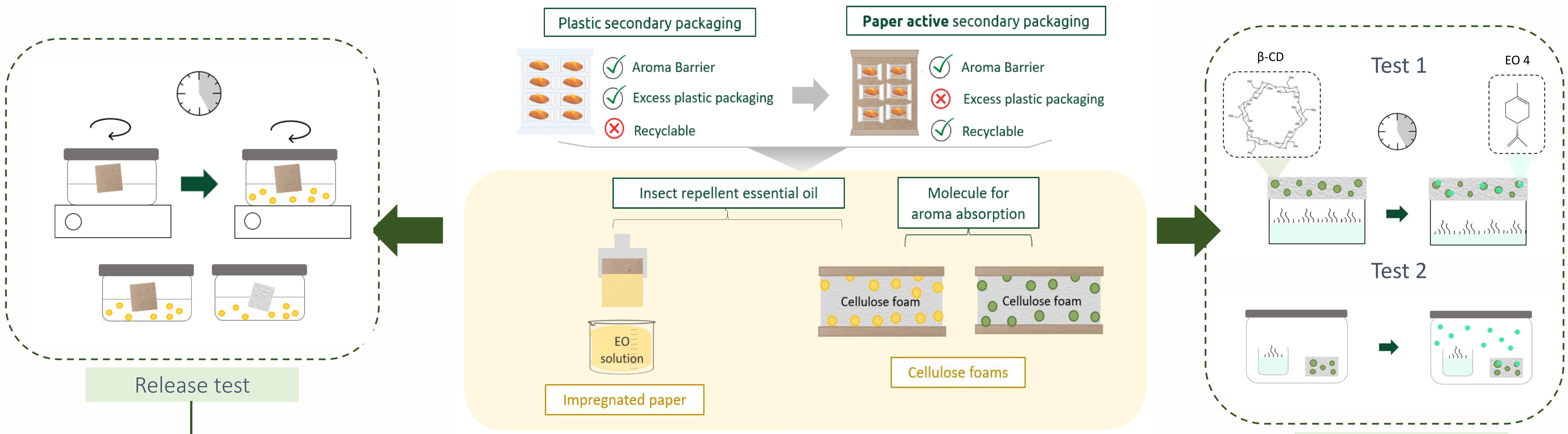
Cellulose Valley BY FONDATION GRENOBLE INP

Scope of the Project

Faced with the issue of excess plastic packaging, contamination of packaging by insects and the use of synthetic insecticides, the objective of this work was to develop a secondary active packaging based on cellulosic materials with the incorporation of essential oils (EO) (release system) and cyclodextrin (CD) (absorption system).

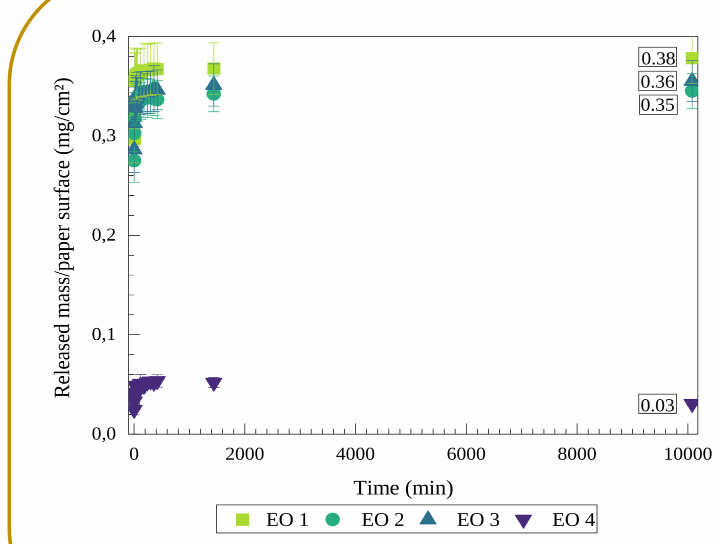


From these tests and the techniques used in the project (UV-Vis, DLS, SEM, FTIR and TGA), the behavior of each material in relation to the release or absorption of actives was studied.

Results and Discussion

Release System

Impregnated paper



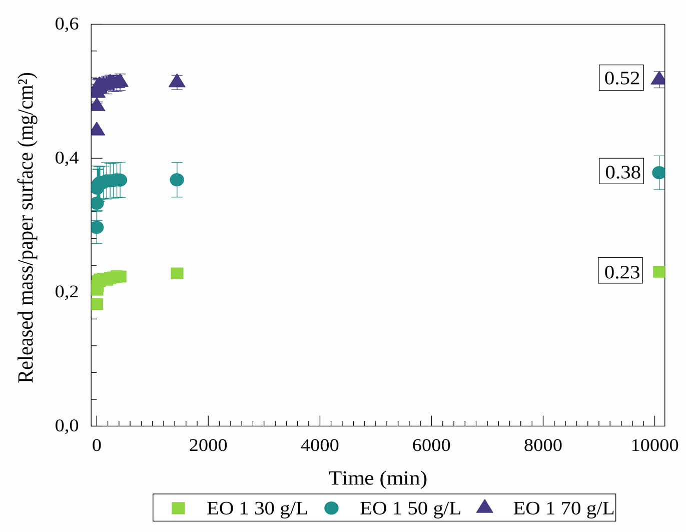


Figure 2. Release test of paper impregnated with EO 1 at different concentrations

- The release of EO occurred quickly, probably due to the easy mobility of EO in the structure.
- All EOs released a final mass close to 0.3 mg/cm², except EO 4 (0.03 mg/cm²), this is due to its high volatility.
- The amount of EO present in the paper, after the impregnation process, was proportional to the concentration of the solution used.

Cellulose foams

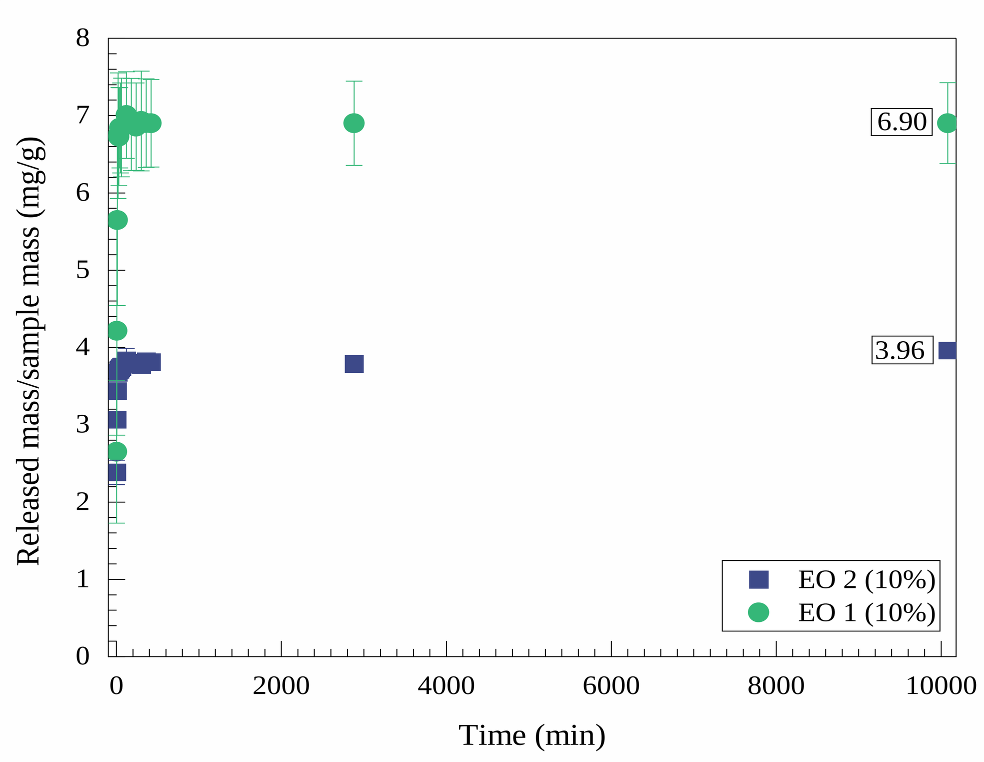


Figure 5. Release test of cellulose foams

- Fast release kinetics and similar behavior for both EOs.

Table 1. Densities of cellulose foams with EO

Sample	Density (kg/m³)
Reference	40 ± 3
EO 1 10%	60 ± 4
EO 2 10%	35 ± 2

- It is believed that the foam with EO 1 was able to retain a greater amount of EO due to poor bubble formation during processing, which also influenced the difference in foam density.

Absorption System

- Overlapping peaks and increasing intensity as the amount of CD increases: change in foam structure.

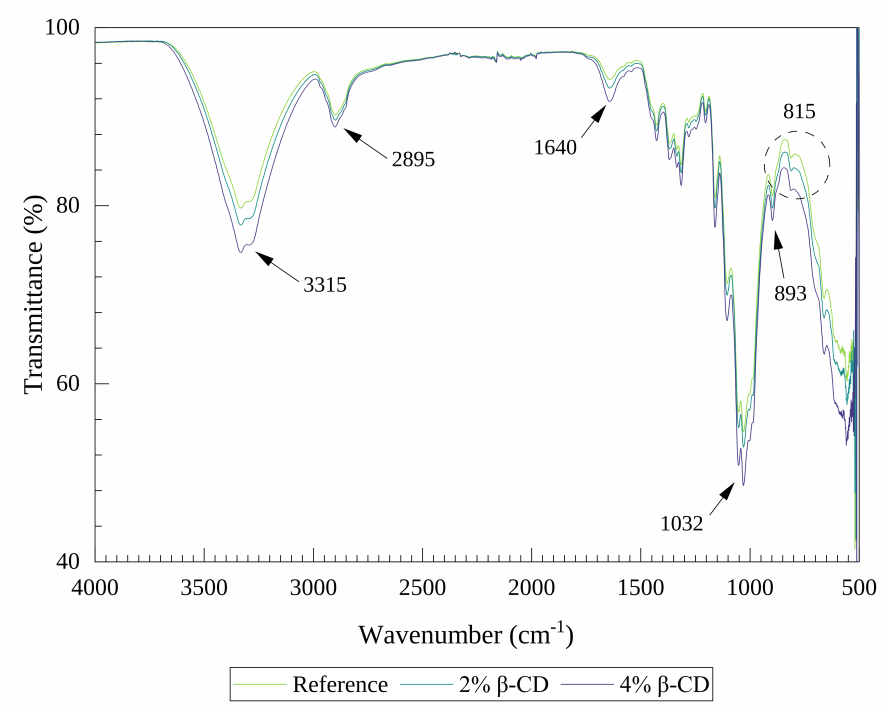


Figure 6. FTIR of cellulose foam with β-CD in the proportions of 2% and 4%.

- For the absorption peak at 815 cm-1, characteristic of the α-type glycosidic bonds of CD, only an increase in peak intensity was observed: the presence of CD in the foam was not as significant.

Table 2. Absorption test results

	Test 1 (g/m².day)	Test 2 (%)
Reference	58 ± 2	0.1 ± 0.03
4% β-CD	52 ± 1	- 4.1 ± 0.5

- In Test 1, the 4% CD sample absorbed a small amount of EO 4 molecules relative to the reference.
- In Test 2, the 4% CD sample experienced a 4% mass loss: moisture loss from the foam and due to water loss in processing.

Conclusions and Perspectives

- **EO delivery systems**: numerous variables influence the release kinetics and the amount of EO released, mainly due to the interaction of each material with the EO and processing.
- **Absorption systems:** CD was probably lost during foam processing, but there was still a small amount of EO 4 absorbed by the sample at 4%.
- Potential and versatility of using cellulosic materials as active food packaging for potential insect repellency and aroma absorption.
- Validate the repellent potential of each material against insects through a biological test using the analyzed EO. The must be done for the absorption system with β-CD.
- Testing ways to better control EO release in paper, while for foam, testing ways to prevent EO and CD loss during processing.

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