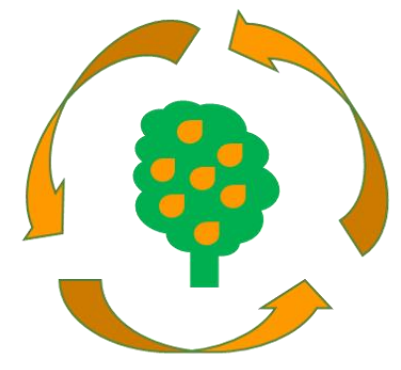


BIOPOLYMER COMPOSITES SOLUTIONS FOR SUSTAINABLE AND BIODEGRADABLE FOOD PACKAGING: PLAMINPACK PROJECT



PLAMINPACK

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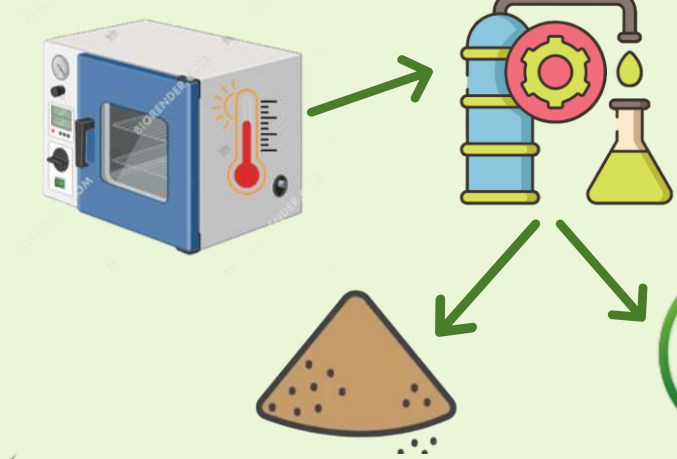


INTRODUCTION

- Large quantities of agricultural wastes are generated every year and represent an underutilized source of valuable bioactive compounds.
- These by products can be valorised in the framework of circular economy, using them, for instance, as **natural fillers in bio-polymers** for packaging applications.
- In this framework, PLAMINPACK project aims at promoting **new packaging solutions through the integration of Mediterranean agricultural residues** into biodegradable polymeric blends.



By-products derived from **tangerine, strawberry, and date** processing were **selected as representative Mediterranean fruit side streams**.



After drying, plant wastes are processed to obtain **antioxidant-rich extracts**; the remaining **solid residue is recovered and integrated into biodegradable packaging materials**.

The developed packaging solutions integrate the agro-food waste of the respective plants: **nets for tangerines and trays for strawberries and dates, sealed with biodegradable films**.



The effectiveness of the developed packaging solutions will be evaluated through **shelf-life studies on the selected fruits**.



Developed packaging materials will be assessed through **biodegradability and recyclability tests**.

MATERIALS AND METHODS



PLA



PBSA



PALM DATE RESIDUE



STRAWBERRY RESIDUE



TANGERINE RESIDUE



PALM DATE EXTRACT



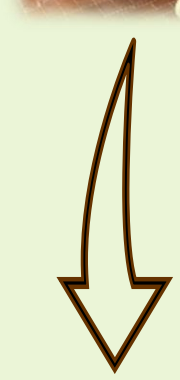
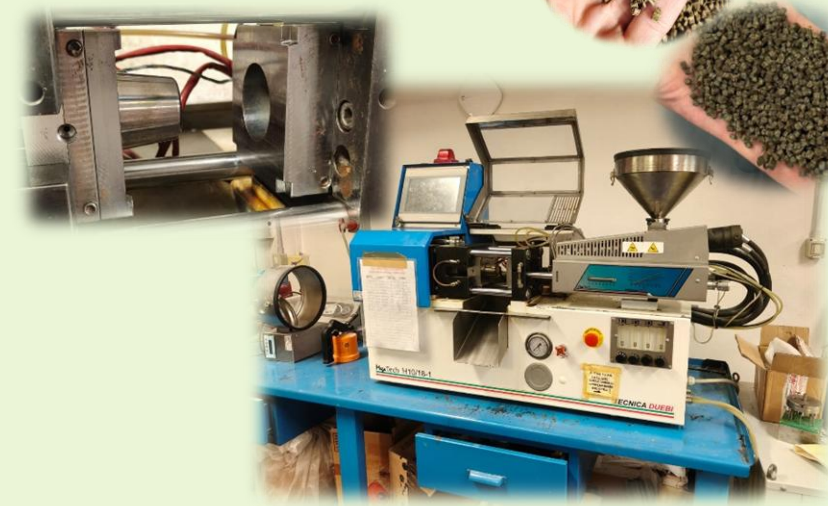
STRAWBERRY EXTRACT



Focus of this study (WP2): selection and characterization of suitable biodegradable polymer blends and packaging prototypes incorporating agro-food residues.



All PLA/PBSA investigated formulations, including residue-filled biocomposites containing strawberry and date palm residues at 30 wt.% for tray production, were compounded using a COMAC EBC 25HT twin-screw extruder (Milan, Italy), with an L/D ratio of 44 (D = 25 mm).



	PLA	PBSA
Nets	90	10
Films	80	20
Trays	60	40

Due to the limited availability of strawberry extract, **PLA/PBSA 60/40 containing 0.5 wt.% strawberry and date extract was processed** using a mini-extruder. The resulting strand was cut into **pellets that were compression-molded into films using a hot-plate press**.

Specimens for mechanical testing were produced with an injection molding machine. Then, a **designed mold for trays was employed to injection mold the trays**.

CHARACTERIZATION



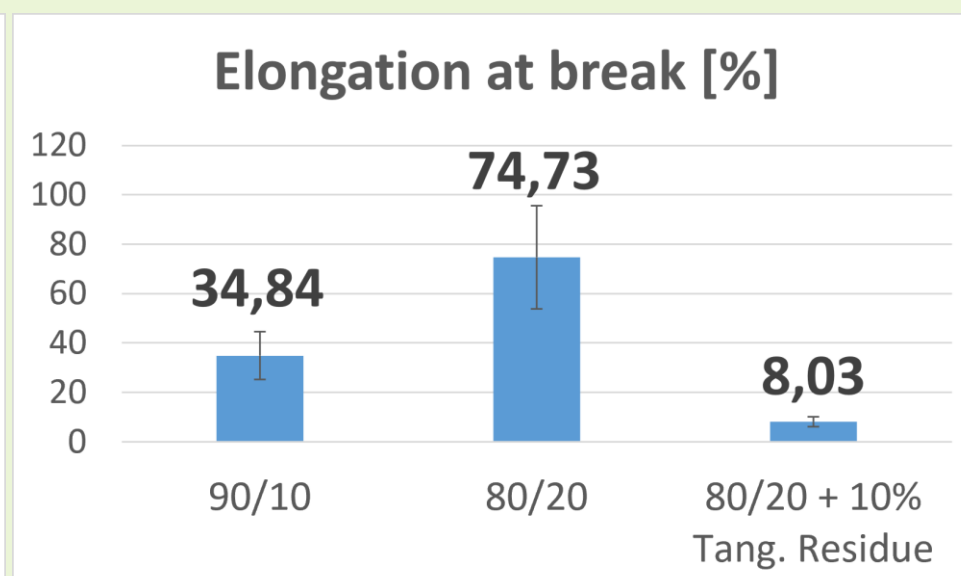
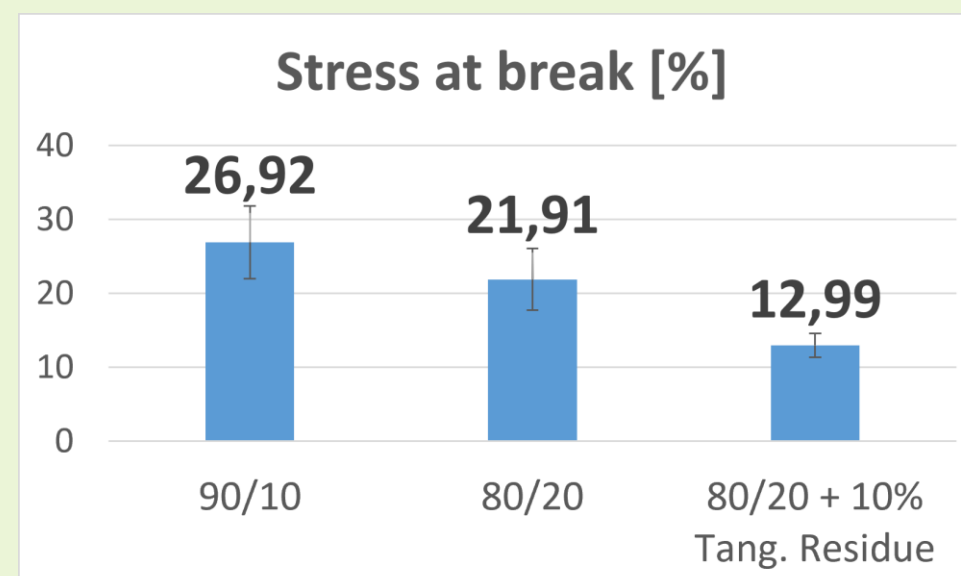
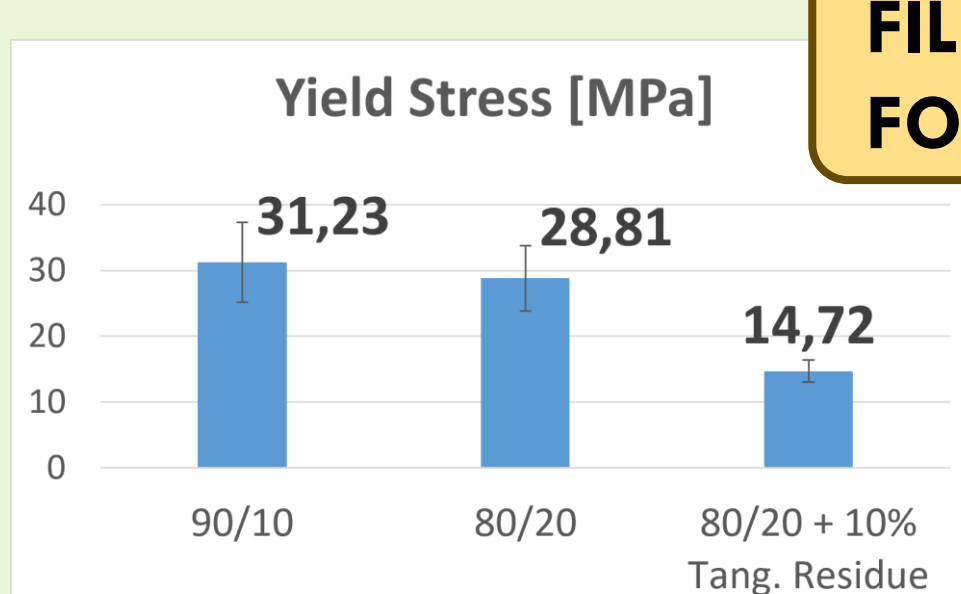
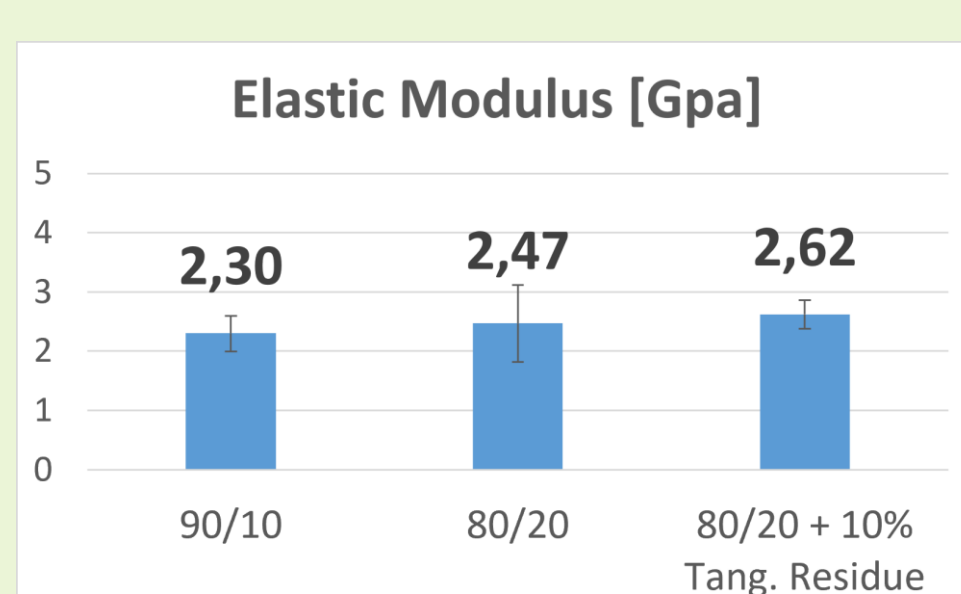
RheoSpin test on filaments to understand whether they are suitable for melt spinning process

SEM analysis to investigate the morphology of the composites



Tensile test for filaments, films and injection molded formulation for trays

RESULTS



Blend	Melt Strength	BSR
PLA/PBSA 90/10	5,02 cN	10,47
PLA/PBSA 80/20	7,95 cN	13,29
PLA/PBSA 80/20 + 10% TANG. RESIDUE	5,70 cN	5,61

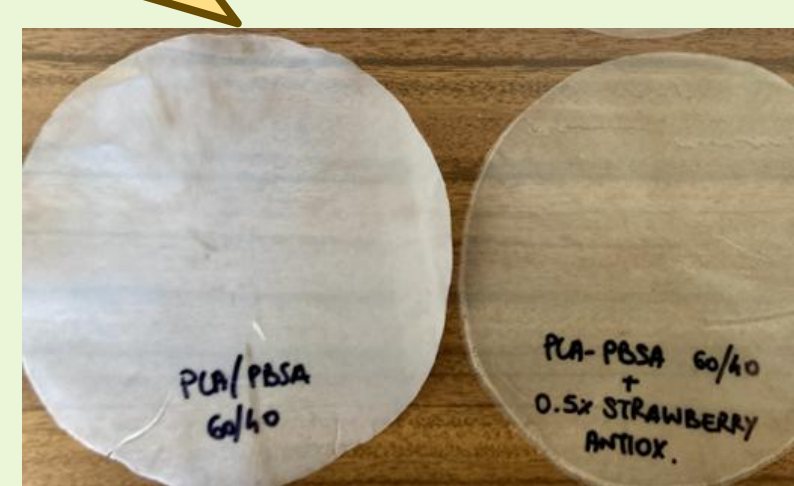
The addition of 10 wt.% tangerine residue made the formulation excessively brittle and unsuitable for subsequent melt spinning.

Based on the obtained results, the **PLA/PBSA 80/20** formulation was selected as the **most suitable formulation for net prototyping**.

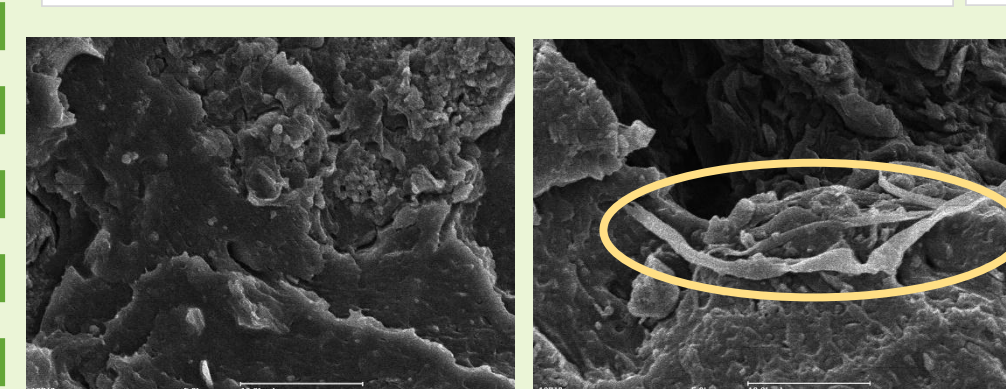
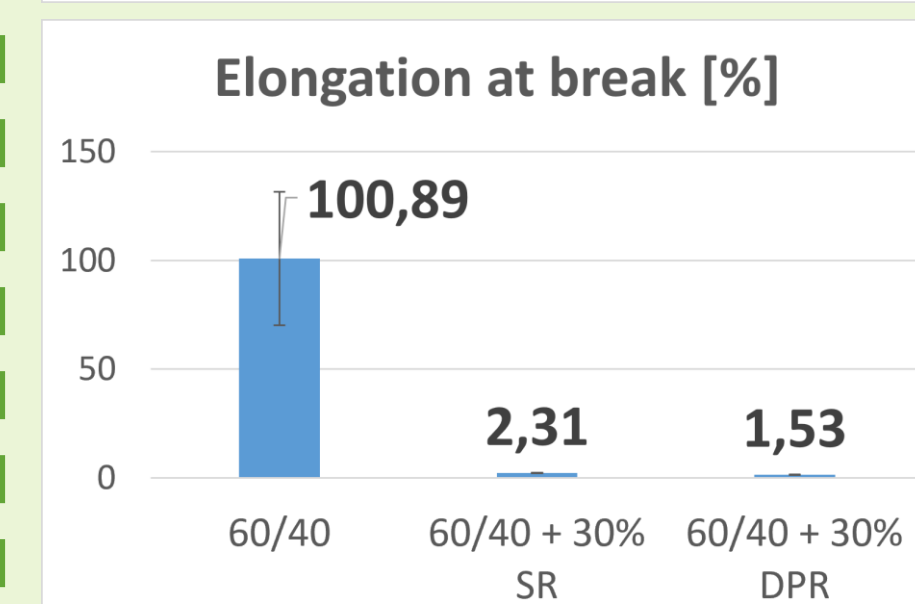
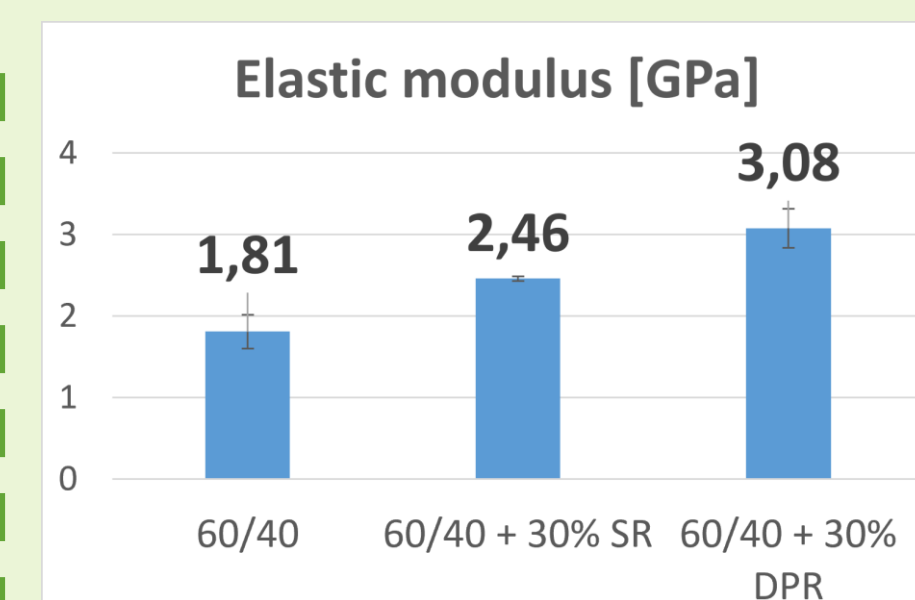
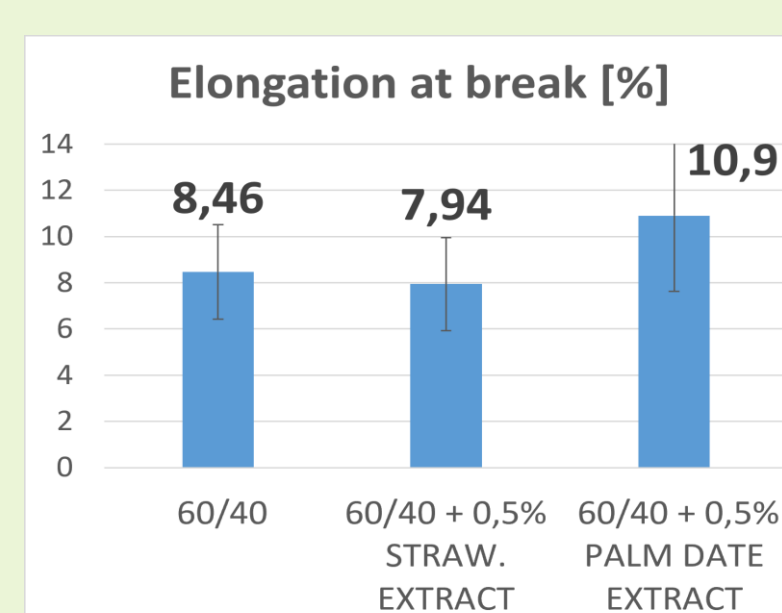
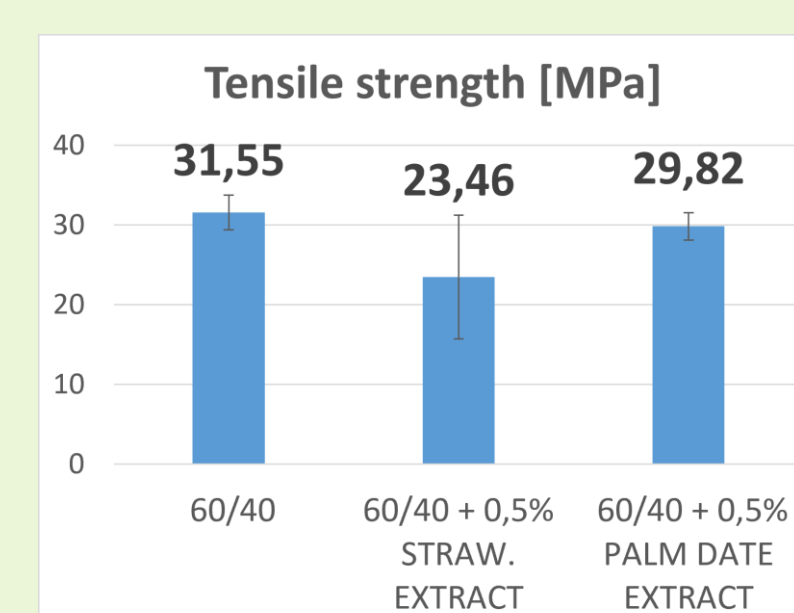
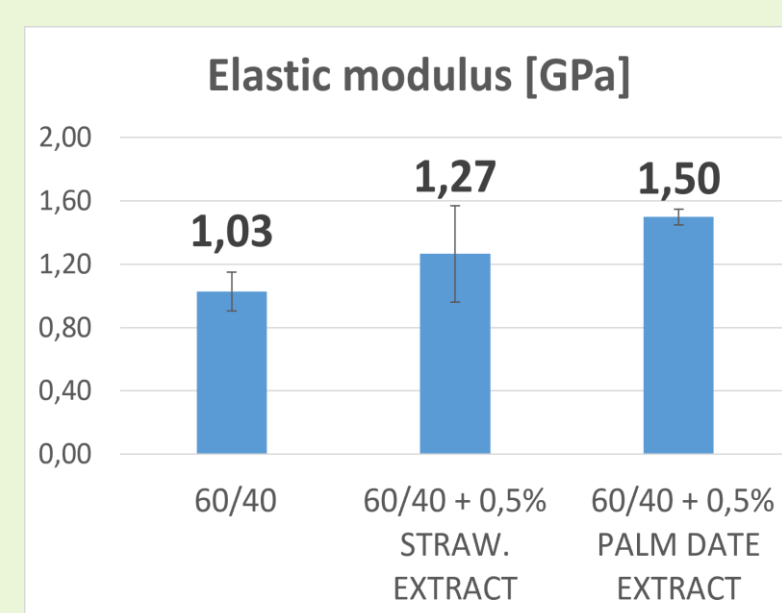
FILAMENTS FOR NETS



FILMS

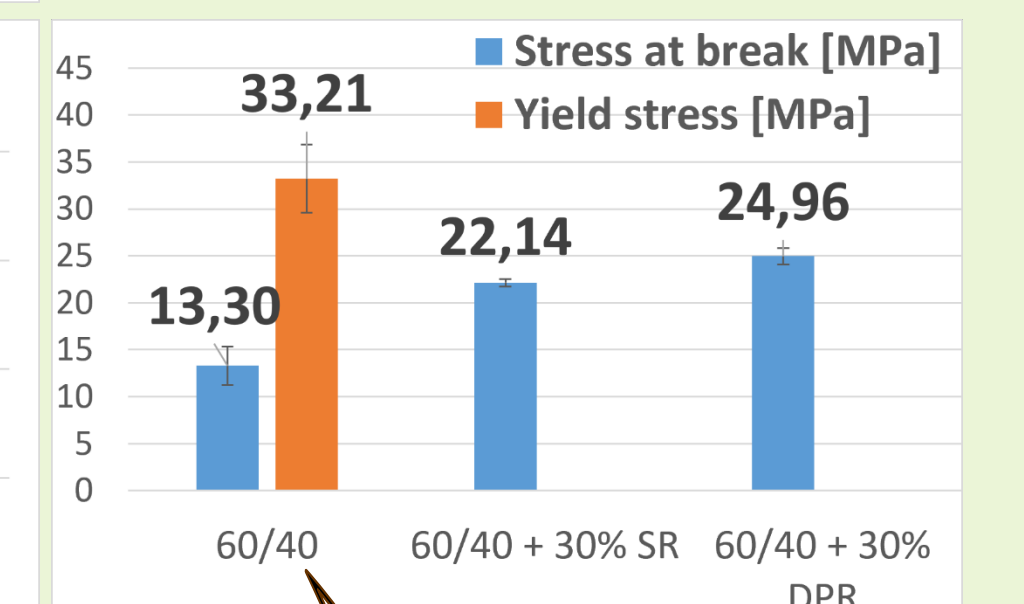


Strawberry and date extracts were incorporated into the films as natural antioxidant additives to delay the oxidative degradation of the PLA/PBSA matrix.



SEM analysis revealed a non-uniform dispersion of the fibers within the PLA/PBSA 60/40 matrix.

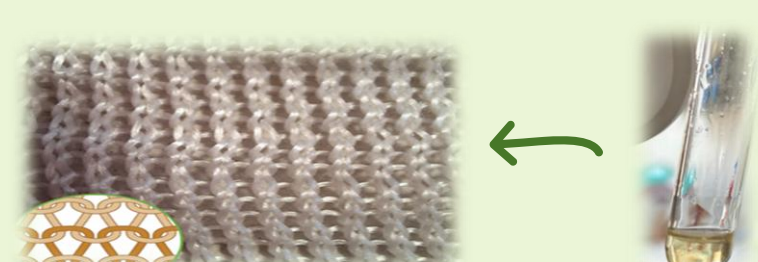
TRAYS



Addition of residues resulted in stress at break values above 20 MPa and facilitated tray demolding, promoting more efficient solidification and improving the overall processability of the formulations.



A coating formulation containing tangerine extract has been developed. The coating was applied to the net prototypes using spray-coating technique.

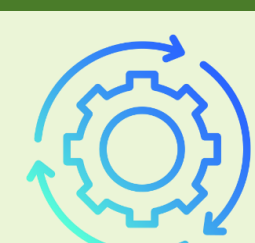


Scale-up of films containing strawberry and date extracts is currently ongoing using flat-die extrusion.



CONCLUSIONS

- Agricultural residues were successfully incorporated into biodegradable polymer matrices.
- Materials for nets, films and trays have been selected.**
- Production of prototypes is almost complete; they will be sent to other partners for further characterization.
- The developed formulations showed promising properties for sustainable packaging applications.



WHAT'S NEXT?

- Mechanical and thermal characterization of film properties after flat-die extrusion**
- Thermal characterization of trays with strawberry and date residues**
- SEM micrographs of films**

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- Link to PLAMINPACK website:



SCAN ME

