

Finished product and new formulations of varnishes, inks, adhesives and various types of coatings in response to the European directives on sustainable food packaging”

Assago (MI) Tuesday, October 22nd 2024

Sustainable coating systems for the development of innovative materials for food packaging

Prof.ssa Antonella Cavazza



**UNIVERSITÀ
DI PARMA**

Dip. SCVSA Università degli Studi di Parma

Consorzio INSTM

Centro Interdipartimentale per il Packaging, CIPACK



Technology transfer



A screenshot of the website for the Centro Interdipartimentale per il Packaging (CIPACK). The website has a yellow header with the CIPACK logo and the text 'Centro Interdipartimentale per il Packaging'. Below the header is a navigation menu with items: 'IL CENTRO', 'SERVIZI', 'STRUMENTI', 'RICERCA E TRASFERIMENTO TECNOLOGICO', 'NEWS ED EVENTI', and 'CONTATTI'. The main content area has a yellow background and features the title 'Centro Interdipartimentale per il Packaging CIPACK' and a paragraph of text: 'Promuoviamo e coordiniamo attività di ricerca di base e applicata legate al mondo del packaging e dell'imbottigliamento, in particolare per il settore agroalimentare e farmaceutico.' To the right of the text is a circular image showing a close-up of a mechanical assembly with rollers and yellow components.



RESOURCES: FUNDING



Programma Operativo Nazionale
AZIONE IV.5 – "Dottorati su tematiche Green del PON R&I 2014-2020«



Bando 2022 PRIN PNRR
Prot. P2022M3H2K



PNRR
Ecosistema Territoriale di Innovazione dell'Emilia-Romagna PNRR - Missione 4, Componente 2 Investimento 1.5



PNRR
Bando a cascata Made in Italy POLIMI



Progetti di **alta formazione** in ambito tecnologico economico e culturale per una regione della conoscenza europea e attrattiva

...and SYNERGIES



Outline



ECOLOGICAL
TRANSITION



DRAWBACKS OF
INNOVATIVE
MATERIALS



COATINGS DESIGN



POSSIBLE
APPROACHES AND
DEVELOPMENT



SAFETY
ASSESSMENT



Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint



Are bioplastics and plant-based materials safer than conventional plastics? *In vitro* toxicity and chemical composition



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Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem



Review

A spotlight on analytical prospects in food allergens: From emerging allergens and novel foods to bioplastics and plant-based sustainable food contact materials



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Ecological transition: innovative materials



Innovative materials
to replace plastics



Reduced
performance



“biobased” is not
related to “safe”

Biopolymers

- From agricultural sources
- Limited barrier properties (no modified atmosphere)
- Low stability during use and ageing

Paper/wood

- Scarce barrier properties
- Must be reinforced with coating and surface treatments.

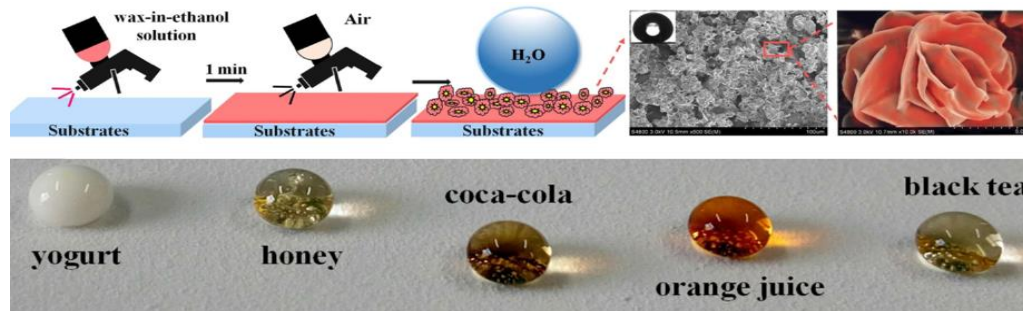
Recycled materials

- Lack of infrastructures
- Energy requirement
- Lower quality of the recovered material

- Limited performances
- Lower quality
- Requirement of thicker layers, higher mass, use of additives
- Limited availability!! High cost!!

Common drawbacks of main solutions





(Liu et al., 2019)

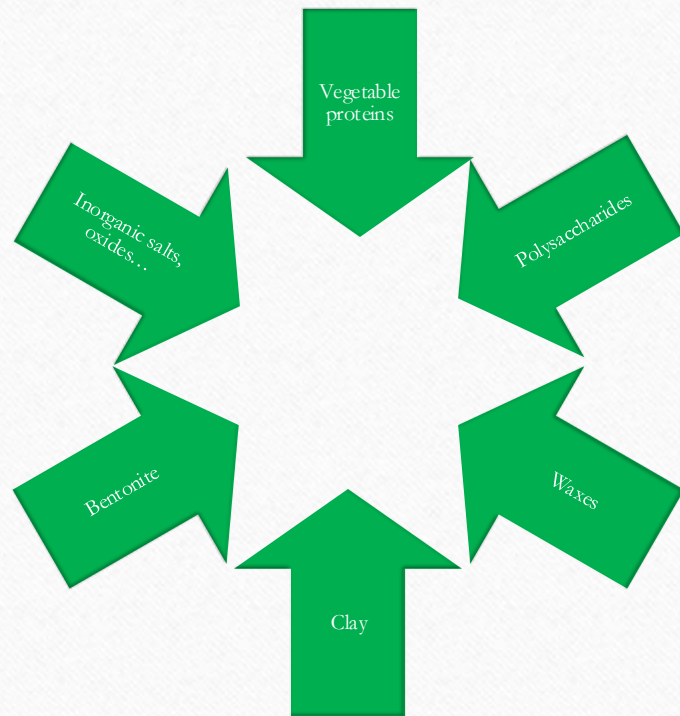
Possible solutions?

The use of active substances in packaging can be a strategy to improve properties and enhance shelf-life

- Resistance to water
- Barrier properties
- Functionalisation (antioxidant, antimicrobial features)

Coating and spray solutions

To be applied on paper, wood, biopolymers to achieve unwettable or functionalised surfaces



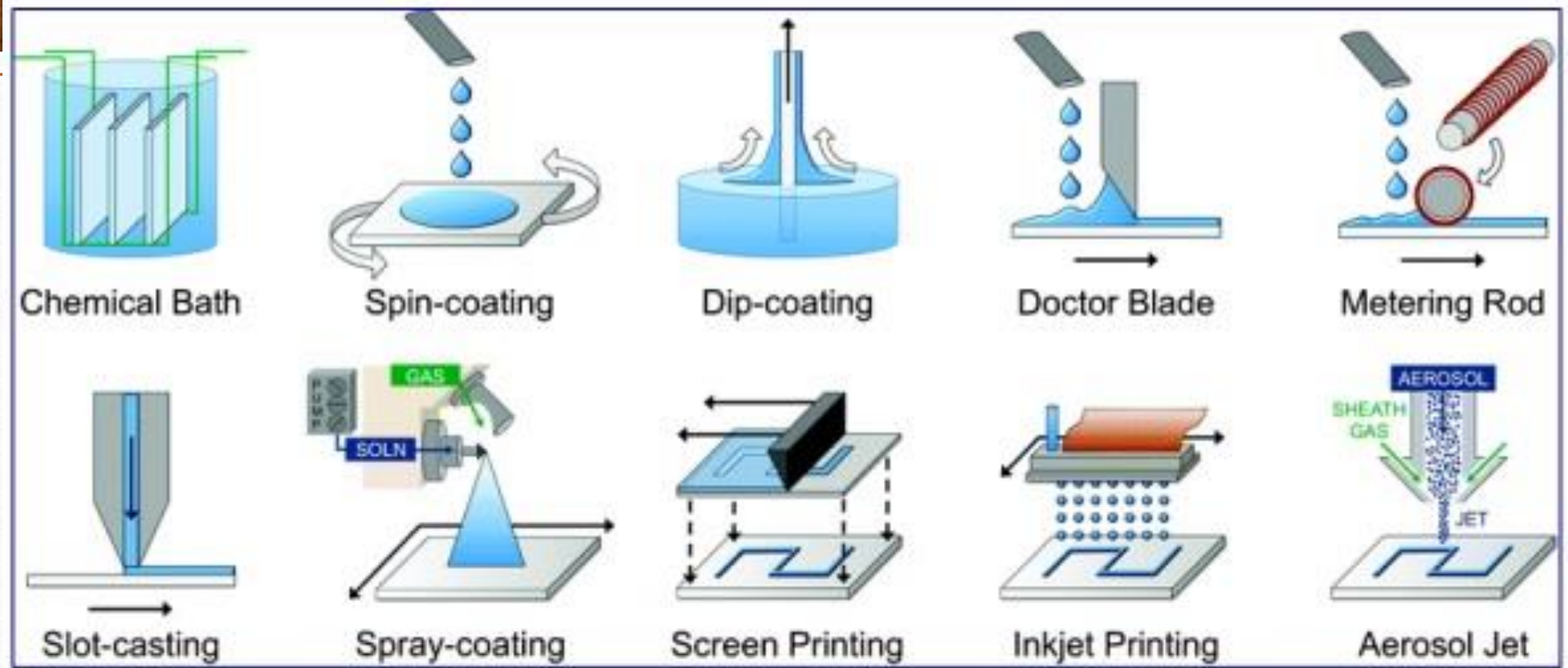
Use of organic or inorganic substances; agroindustrial byproducts



Coatings

Deposition

Layer-by-layer



Characterization of coatings:

- Morphology (optical microscopy, electron microscopy)
- Wettability (water uptake; contact angle measurements)
- Surface profilometry (optical profilometry)

Spray 4 Pack



SPRAY 4 PACK



Enhancement of shelf-life

Antioxidant and antimicrobial properties

Biodegradable (high solubility in water)

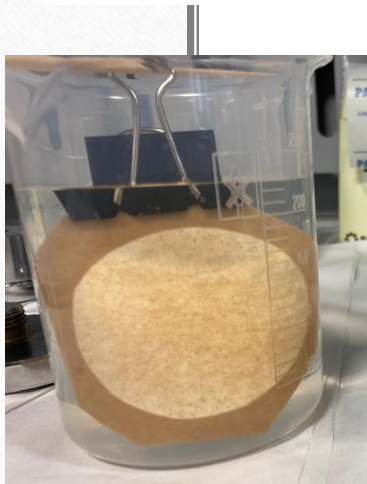
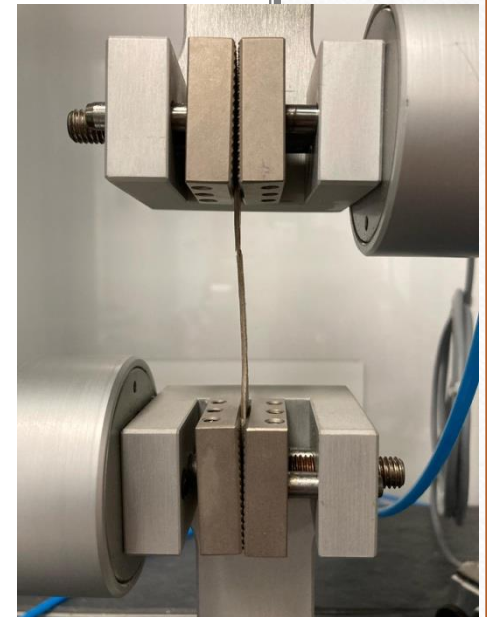
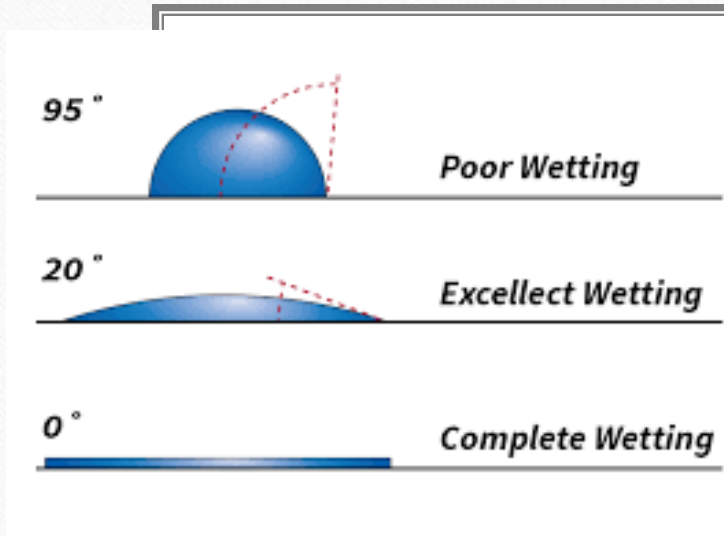


Surface coating to enhance performances: PAPER

Active packaging based on natural products, with antioxidant and antibacterial activity.

Impermeabilisation to water and oils - Stable in microwave oven





Water uptake

Surface evaluation

Contact angle

Mechanical tests

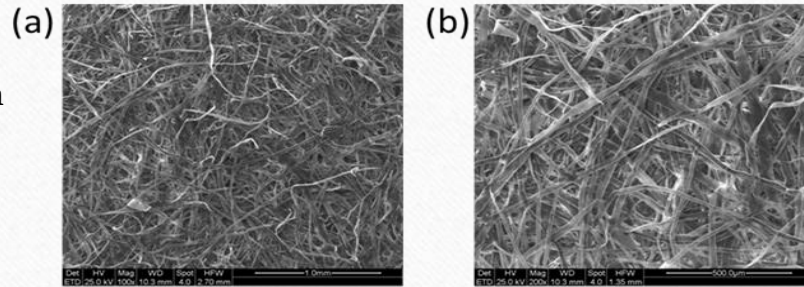
In collaboration with Prof. Milanese, DISTI, UNIPR

Characterization of neat samples

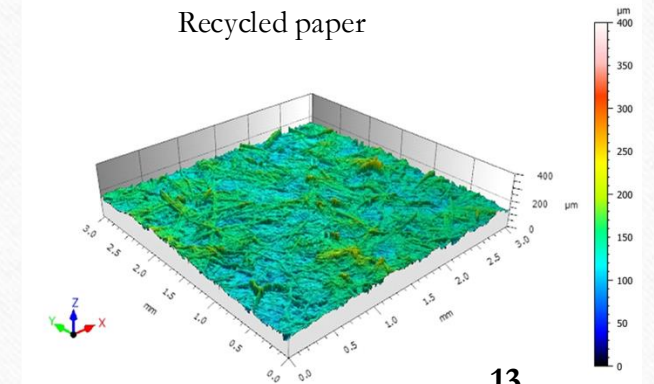
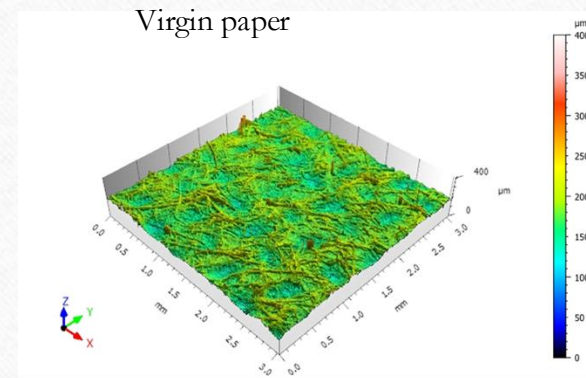
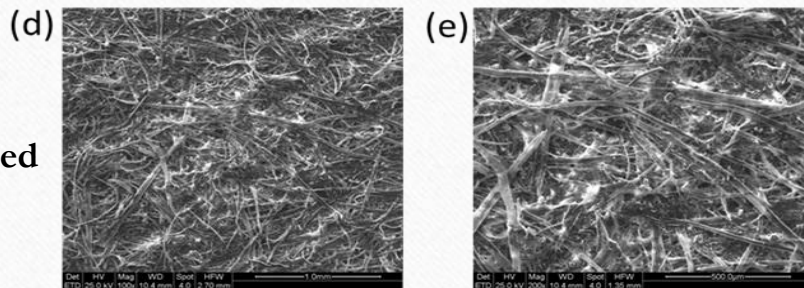
	Sq [μm] \pm SD	Sa [μm] \pm SD
Virgin Paper	17 ± 1	13 ± 1
Recycled Paper	19 ± 3	15 ± 2

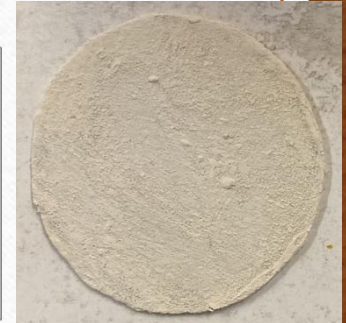
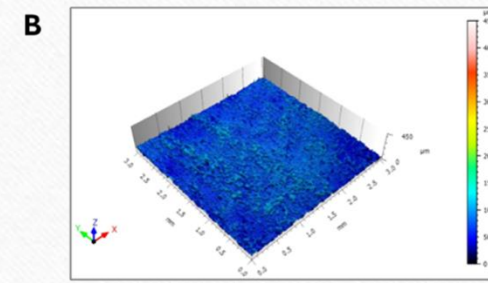
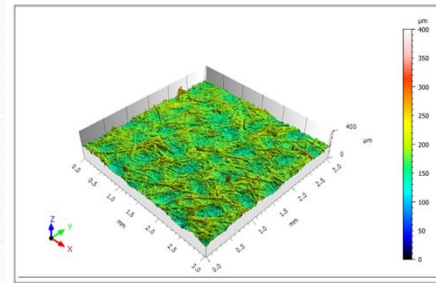
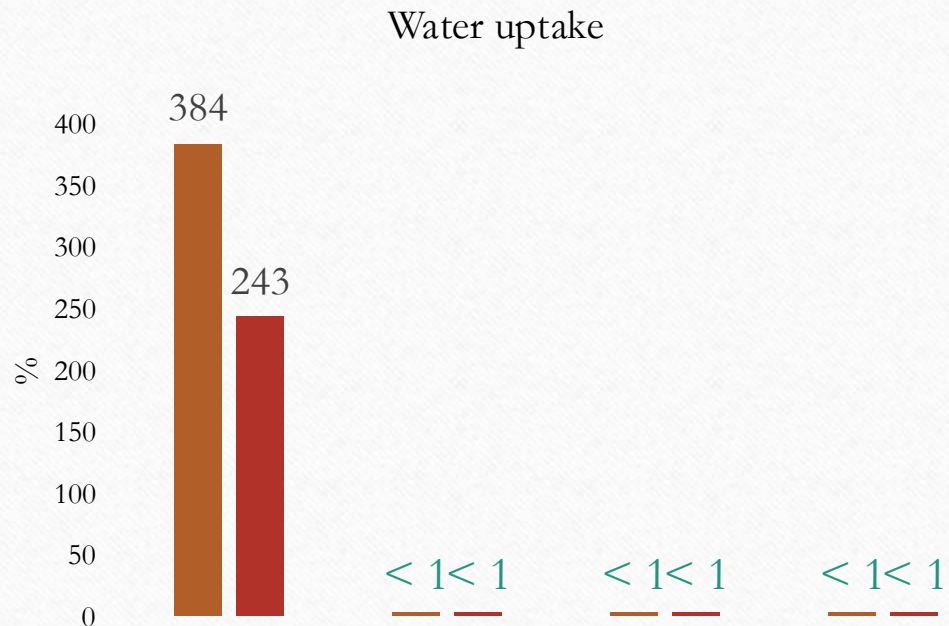
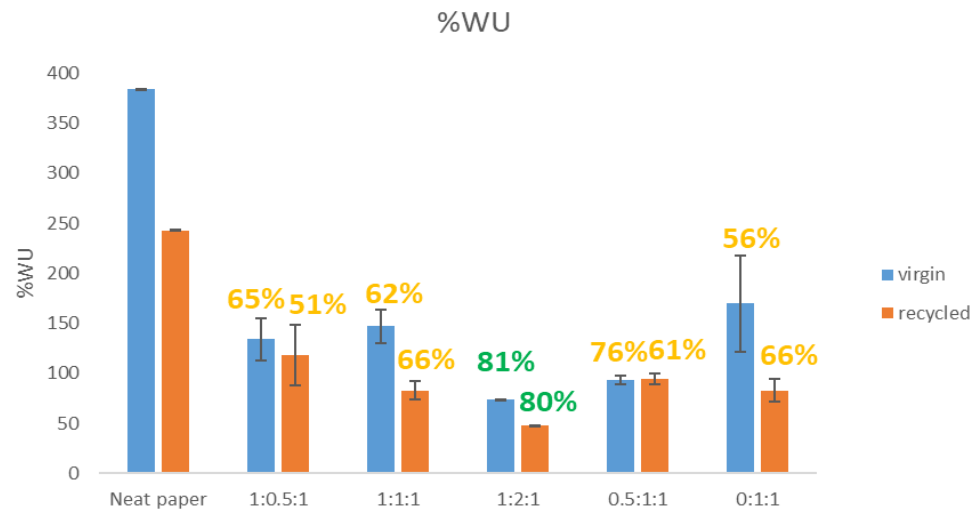


Virgin paper

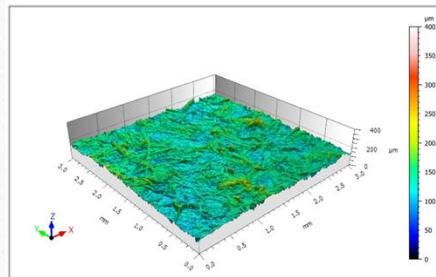


Recycled paper

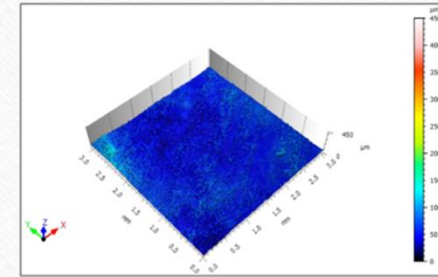




C



D



Virgin paper



Recycled paper

Coating based on vegetable protein + inorganic compound

Surface coating to enhance performances: WOOD

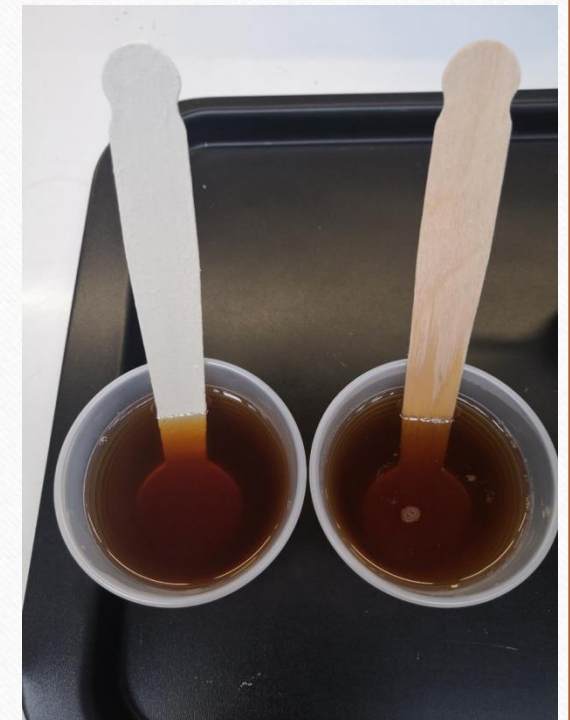
Better appearance, smell, and palatability; Reduced migration



No mould development



Enhanced resistance to hot beverages contact
Higher mechanical resistance



In collaboration with SeatPlastic srl (RE)

Surface coating to enhance performances: BIOPOLYMERS

COATING

NO COATING



COATING

NO COATING

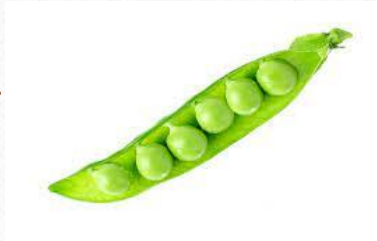


Enhanced resistance to mechanical stretching and stability with liquid contact

Inspiration ..from Nature

Potential use of underutilized or waste materials as a source of antimicrobial-antioxidant compounds for innovative packaging formulations.

This objective perfectly fits in the Circular Economy and sustainability context, against food waste.



Biodegradable



Resistant



Perfect design



Protective



Waterproof



Edible



Active

Agroindustrial byproducts

Food Packaging and Shelf Life 33 (2022) 100900



ELSEVIER

Contents lists available at ScienceDirect

Food Packaging and Shelf Life

journal homepage: www.elsevier.com/locate/fpsl



Valorization of agro-industrial byproducts: Extraction and analytical characterization of valuable compounds for potential edible active packaging formulation

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<https://doi.org/10.1007/s11947-023-03158-2>

REVIEW



By-Products as Sustainable Source of Bioactive Compounds for Potential Application in the Field of Food and New Materials for Packaging Development

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Circular economy

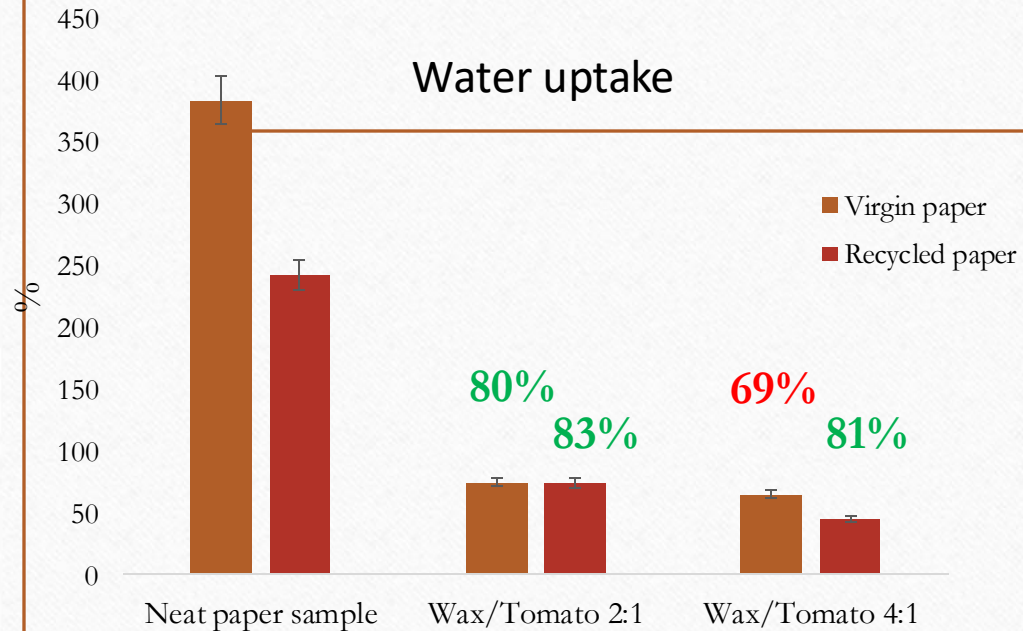


..still rich of bioactive compounds

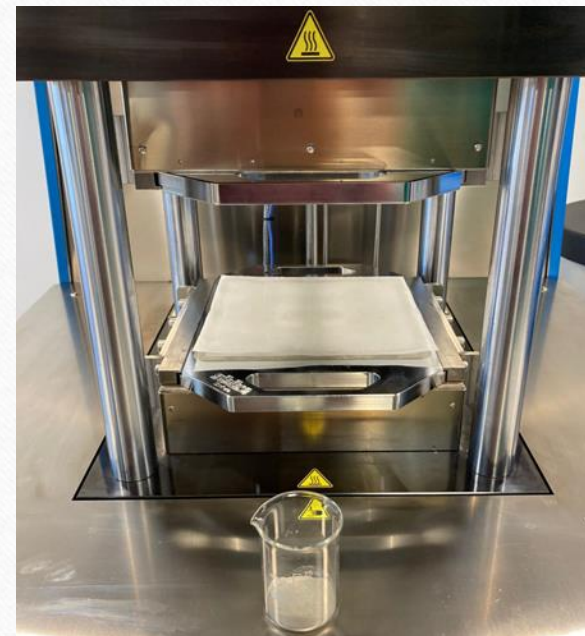
New source in the context of circular economy

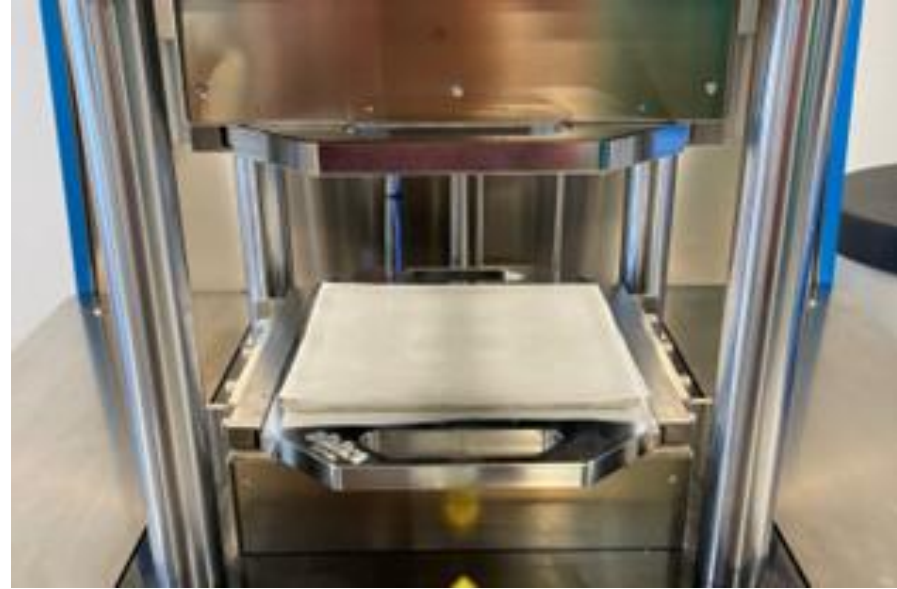
Paper Coating

Application of tomato byproducts for the production of prototypes of new cellulose-based packaging.



	Contact angle (°) ± SD	
	Virgin paper	Recycled paper
Neat		
Wax/Tomato 2:1	89 ± 3	91 ± 1
Wax/Tomato 4:1	81 ± 1	88 ± 2





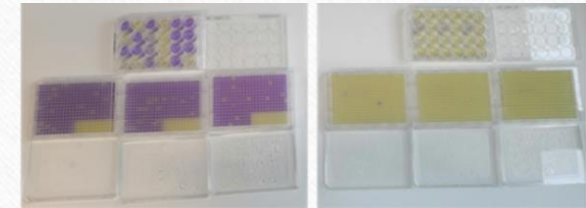
Active edible film application on paper
→ antioxidant properties

Migration from packaging

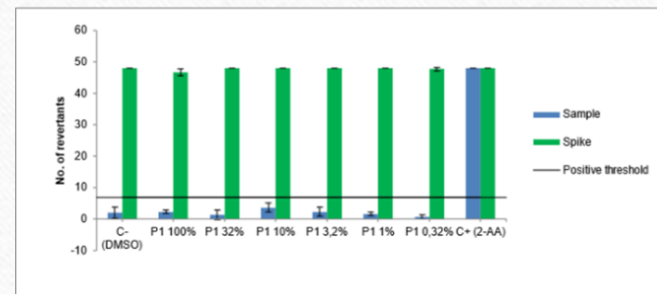
- Packaging materials contain additives and many other substances deriving from industrial processes.
- Possible migration of contaminants is an important issue to be addressed when considering food, pharmaceuticals and cosmetics safety.



FCM safety assessment



Biological assay to assess the mutagenic potential of chemical compounds occurring in the final formulations intended for food contact (AMES test)





Thank you!



PRESENTAZIONE DEL **MASTER IN PACKAGING**

Centro Congressi S. Elisabetta
(e online su piattaforma Teams)
Lunedì 28 ottobre 2024, ore 14:30

Master in Packaging *dal 2011*



Percorso di Formazione multidisciplinare
di primo livello, dedicato a:

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- Dipendenti di aziende

