

ActInPak

COST Action FP1405

Active and intelligent fibre-based packaging – innovation and market introduction

Tailoring chitosan film properties for food applications

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universidade
de aveiro



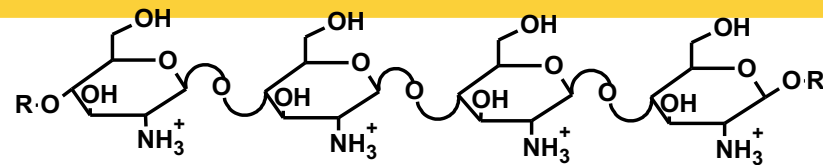
COST is supported by
the EU Framework Programme
Horizon 2020

Why chitosan?



Chitosan properties:

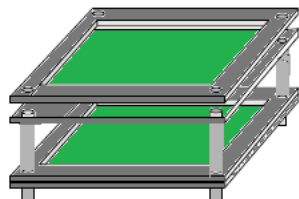
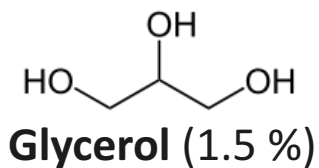
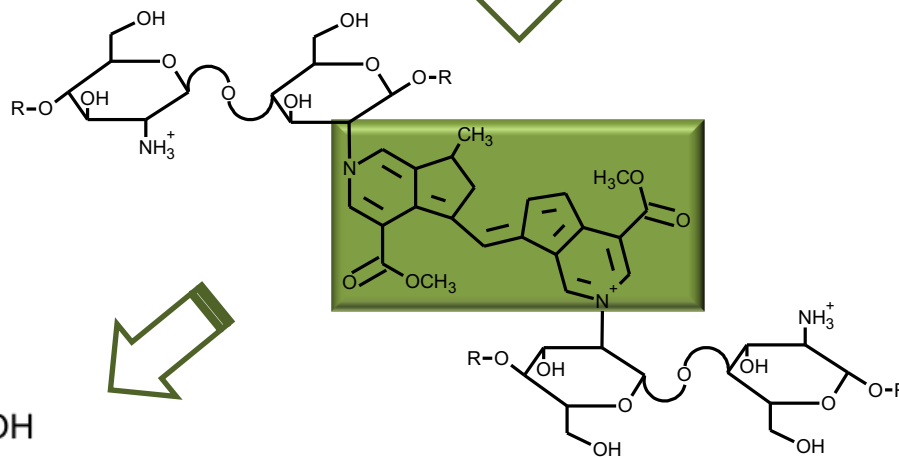
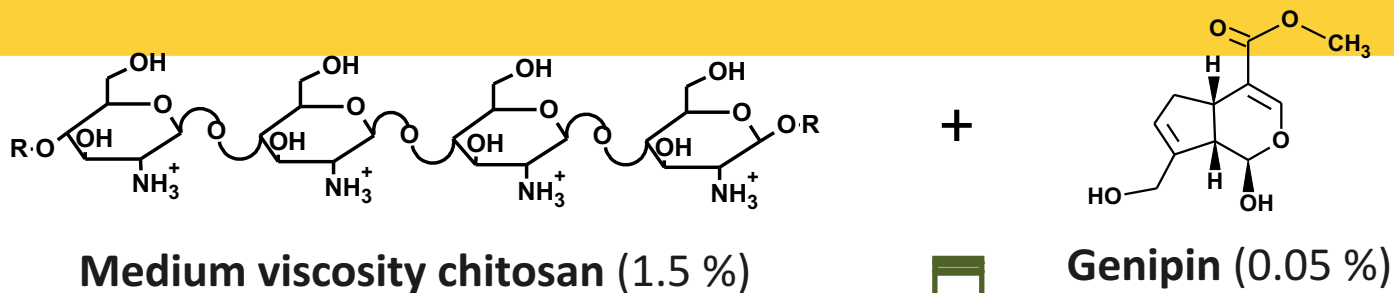
- ✓ **Biocompatibility**
- ✓ **Antimicrobial** activity
- ✓ **Antioxidant** capacity
- ✓ **Capacity to form films**



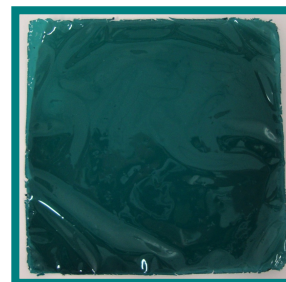
Disadvantage:

- ↳ Soluble in acidic aqueous media (pH of most foods)

Chitosan cross-linking

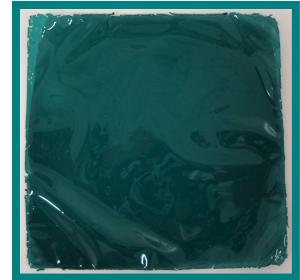
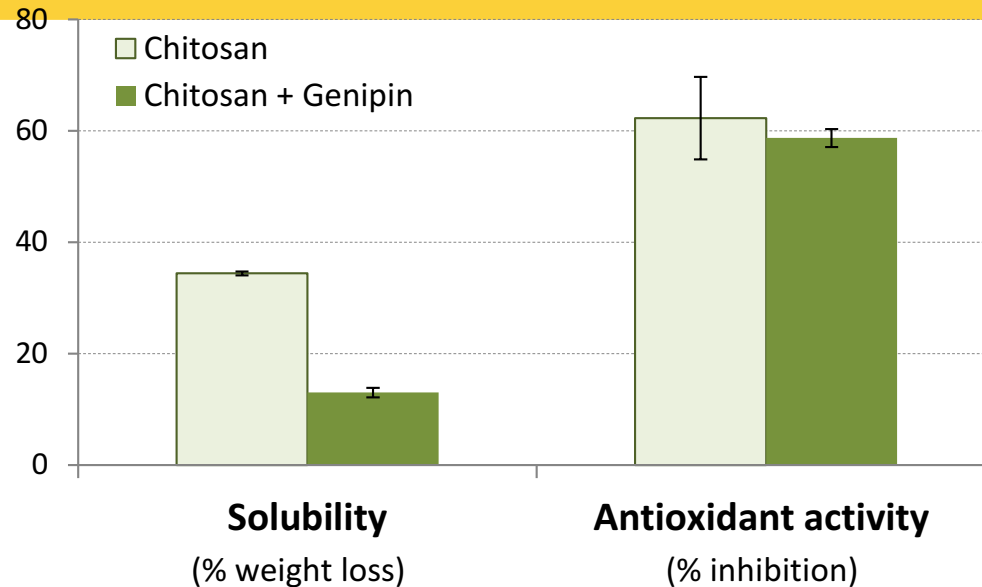


Solvent casting



Chitosan-genipin film

Chitosan-genipin films



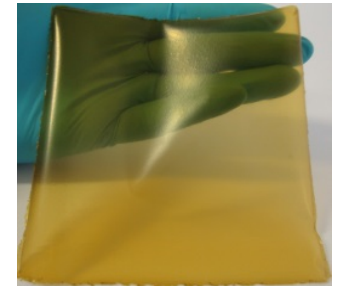
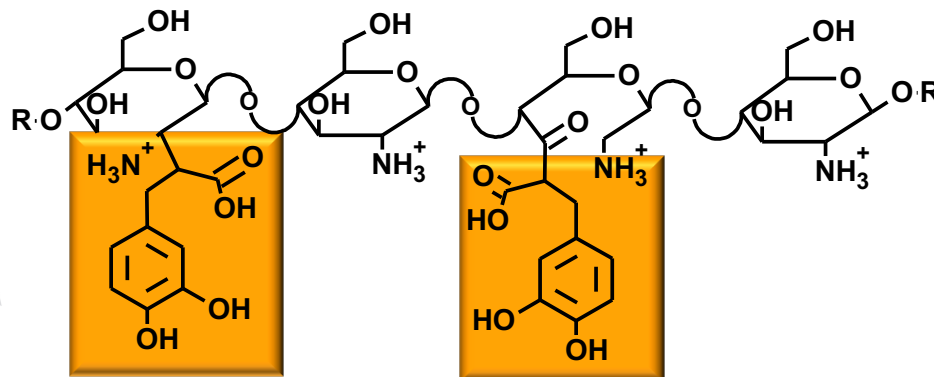
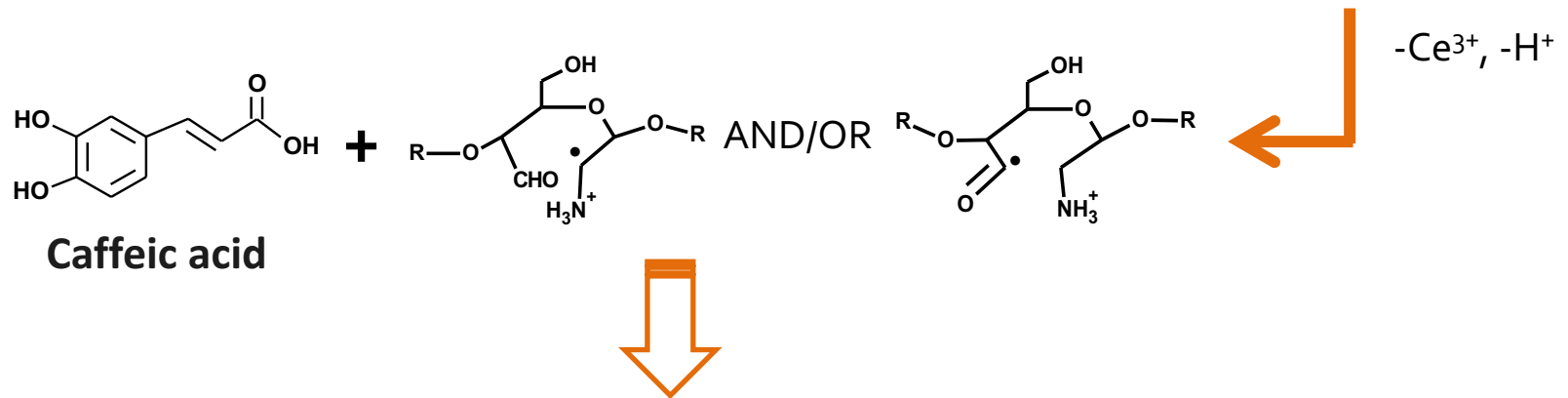
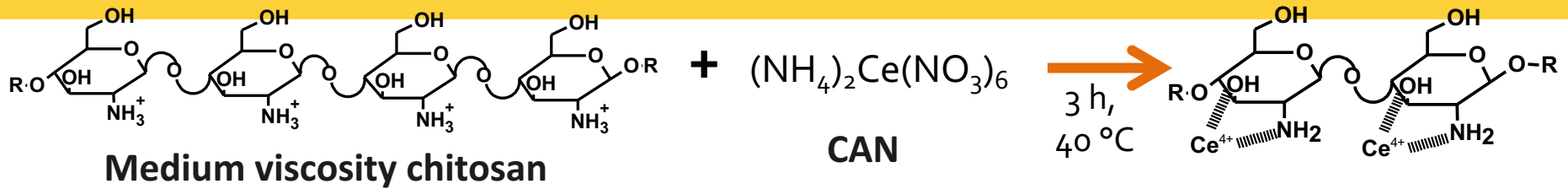
✓ **Low solubility** in acidic media

↳ No release of genipin and chitosan to the solution

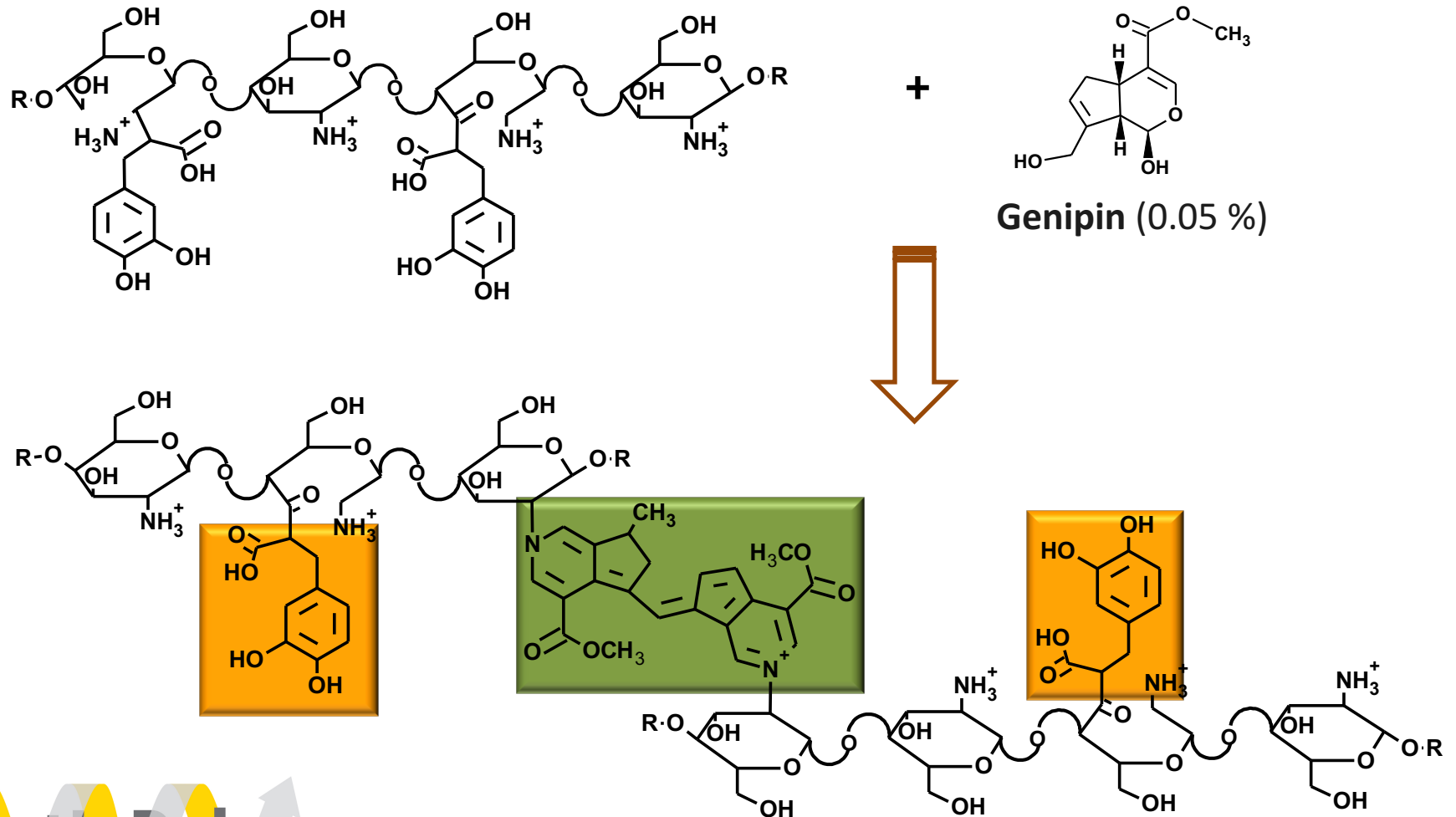
↳ Diffusion of glycerol

✓ Maintenance of **antioxidant activity**

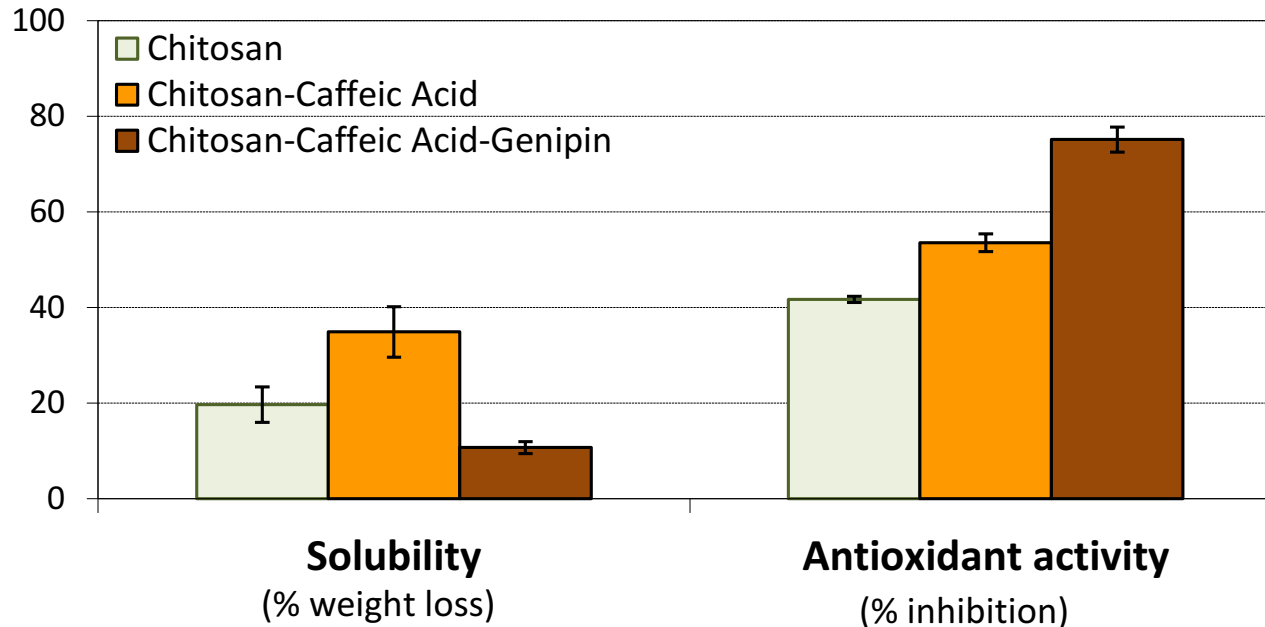
Chitosan grafting



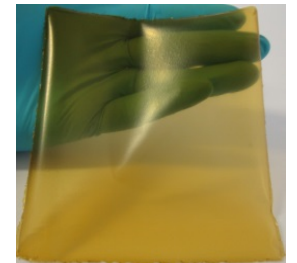
Chitosan grafting and cross-linking



Chitosan-caffeic acid-genipin films



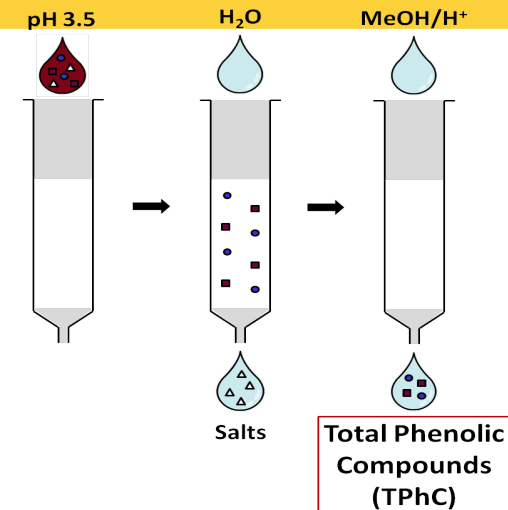
- ✓ **Low solubility** in acidic media (< 10%)
- ✓ **Higher antioxidant activity** (2 times)



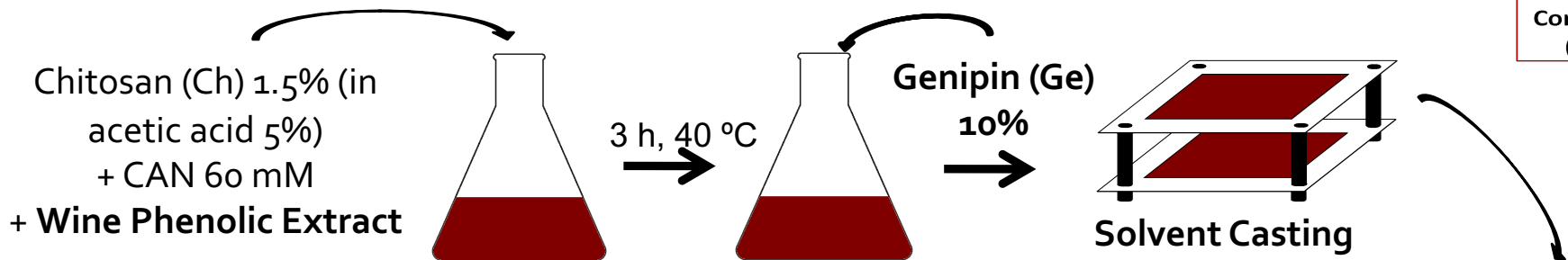
Chitosan-phenolic compounds-genipin films



→ Phenolic compounds from grape pomace extraction



→ Chitosan-based film preparation



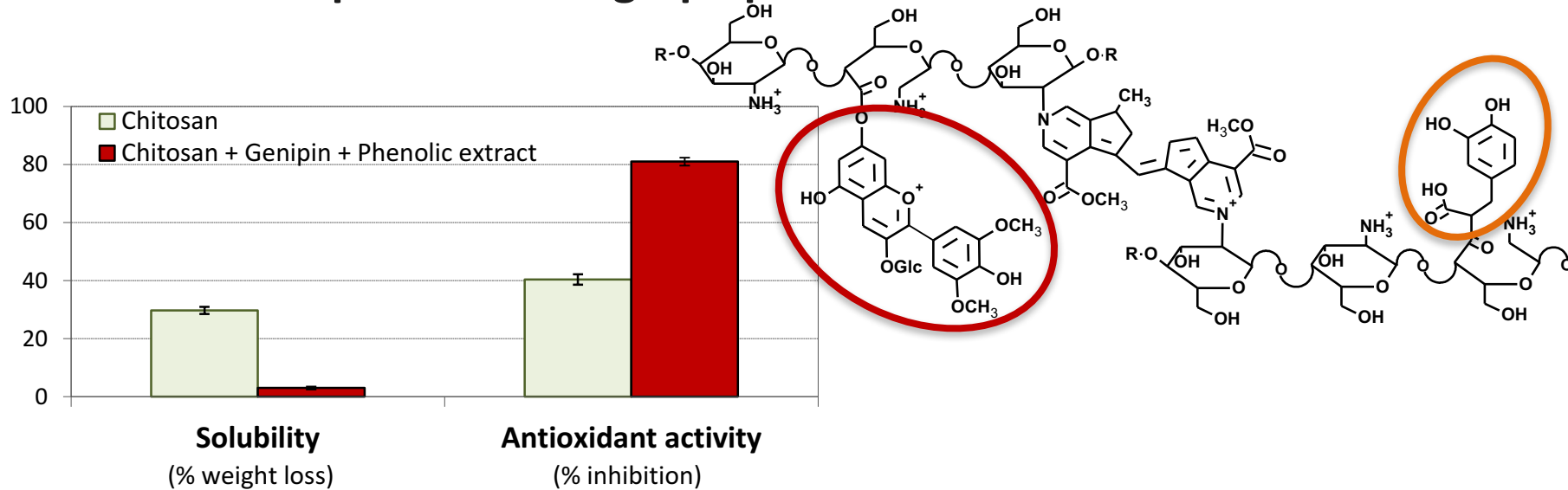
Chitosan-phenolic
compounds-genipin films



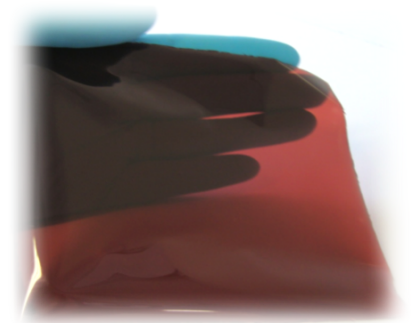
Chitosan-phenolic compounds-genipin films



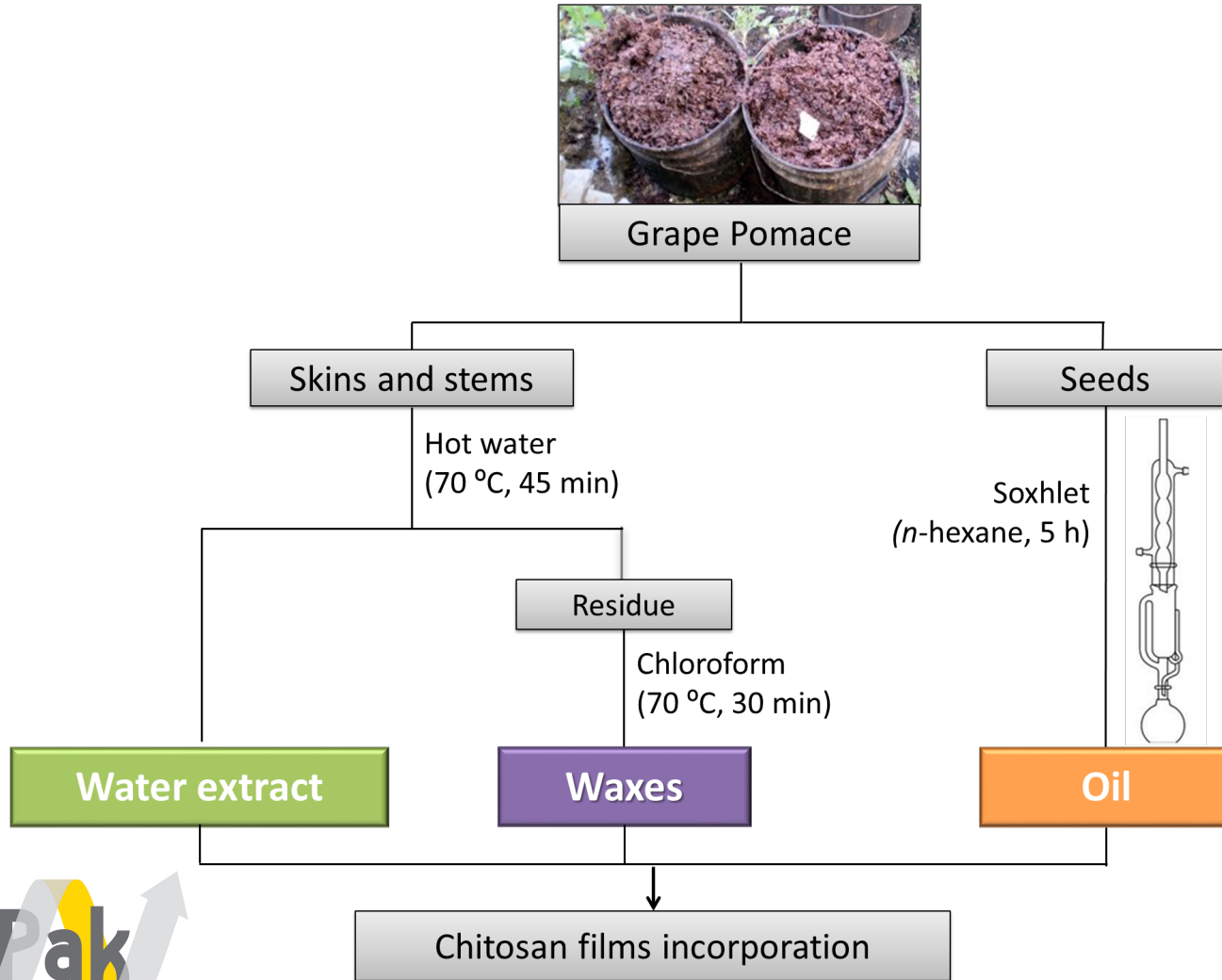
→ Phenolic compounds from grape pomace



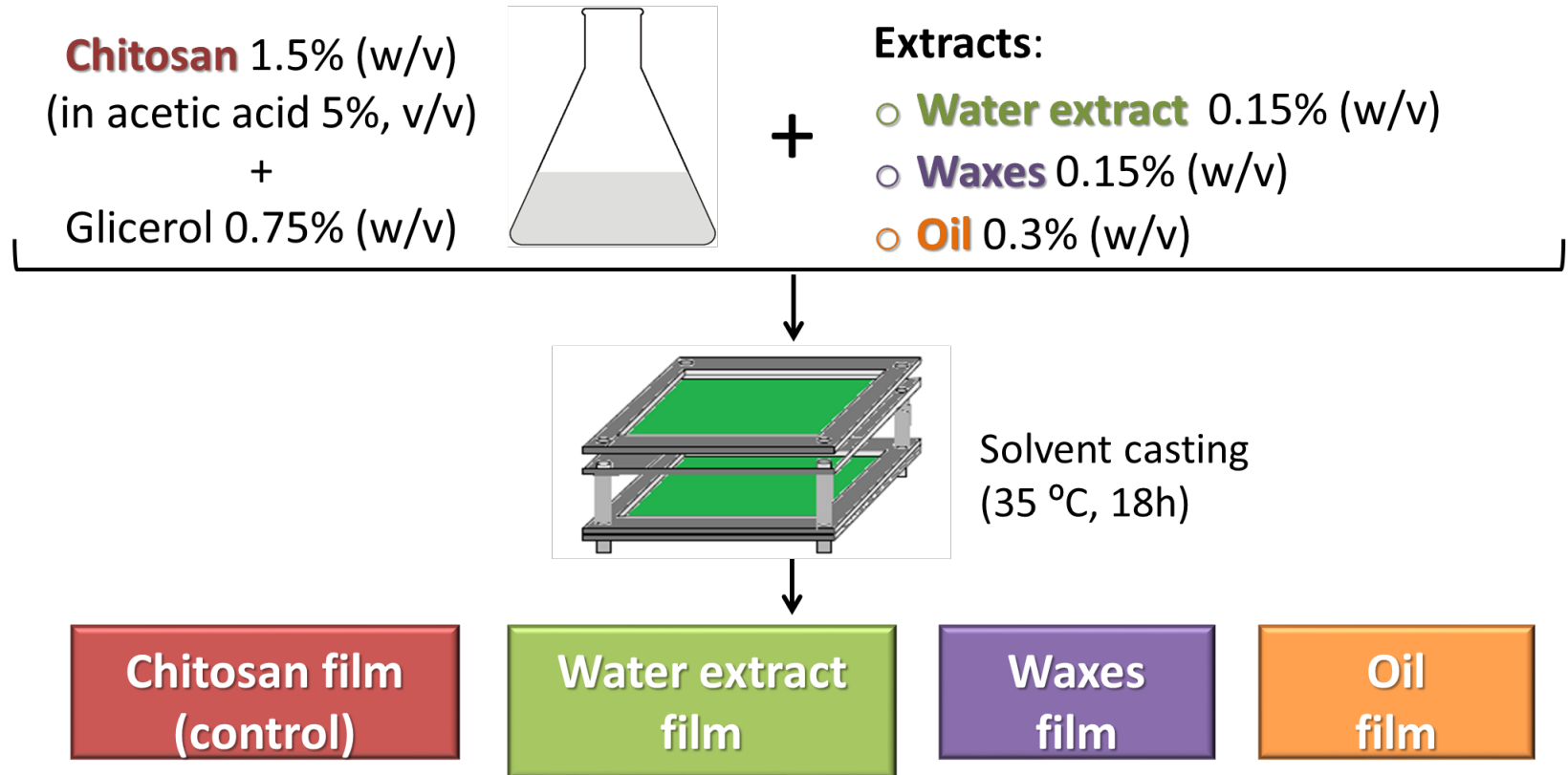
- ✓ **Low solubility** in acidic media (< 3%)
- ✓ Higher **antioxidant activity** (2 times)



Grape pomace



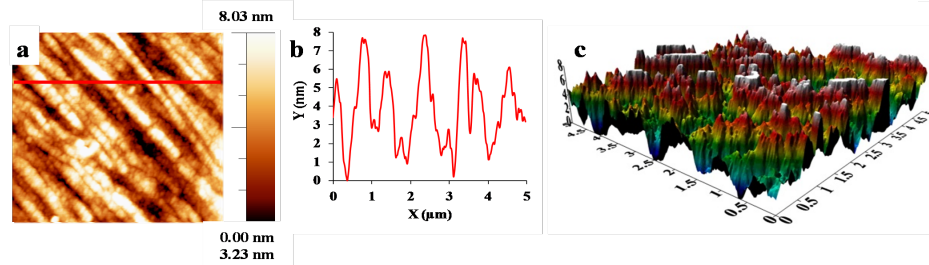
Chitosan films with grape pomace extracts



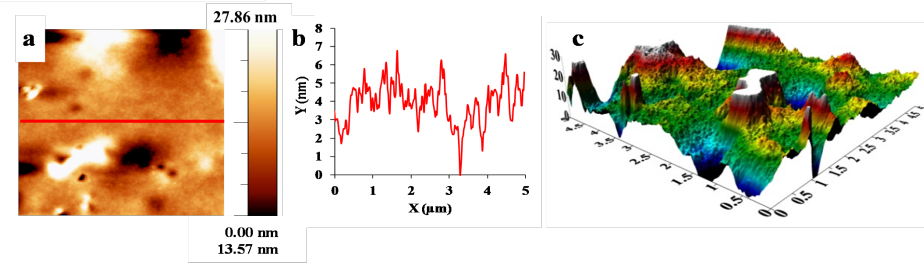
Chitosan-based films morphology



❖ Chitosan films

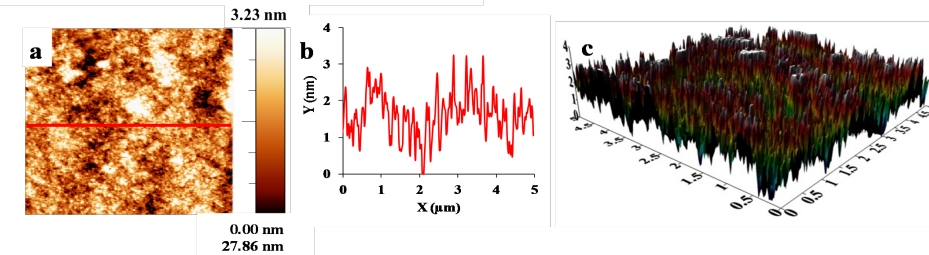


❖ Waxes films

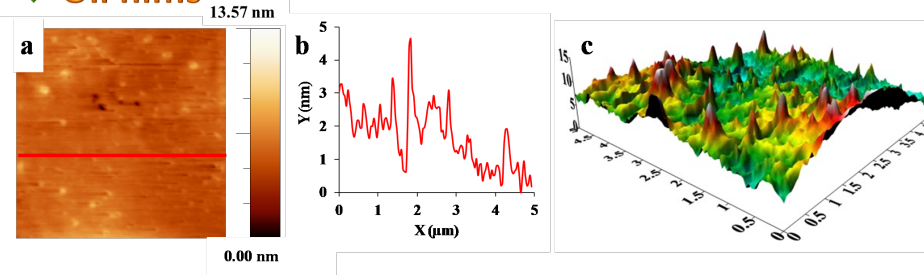


✓ Good structural integrity with a hill-valley-structure

❖ Water extract films (HWE)



❖ Oil films

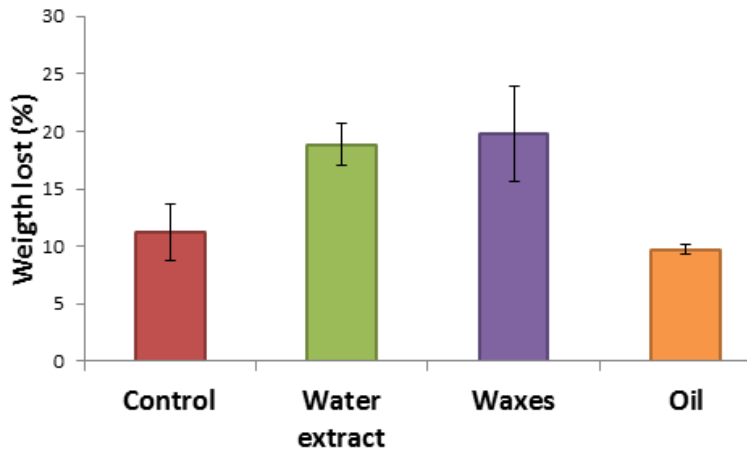


✓ The incorporation of compounds lead to a more homogeneous and smoother surface.

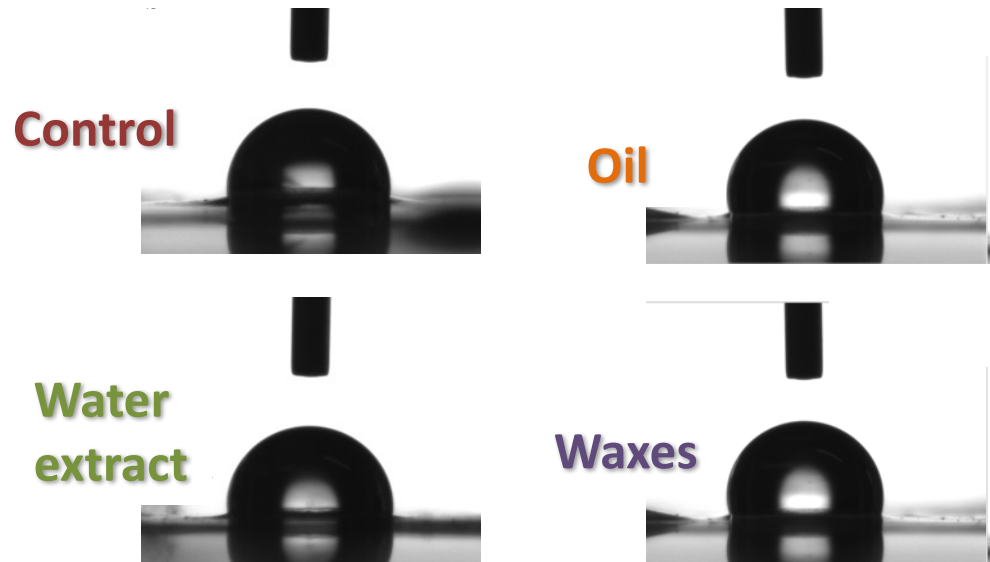
Chitosan films with grape pomace extracts



↳ Solubility in acidic water



↳ Films Hydrophobicity



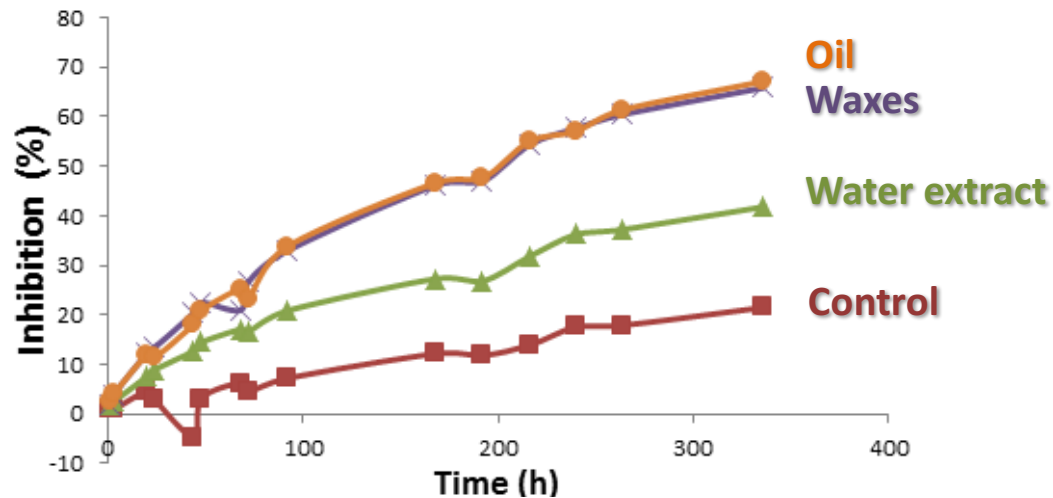
✓ The **chitosan film with oil** had lower solubility.

✓ The incorporation of **oil** or **waxes** increases hydrophobicity.

Chitosan films with grape pomace extracts



↳ Antioxidant activity

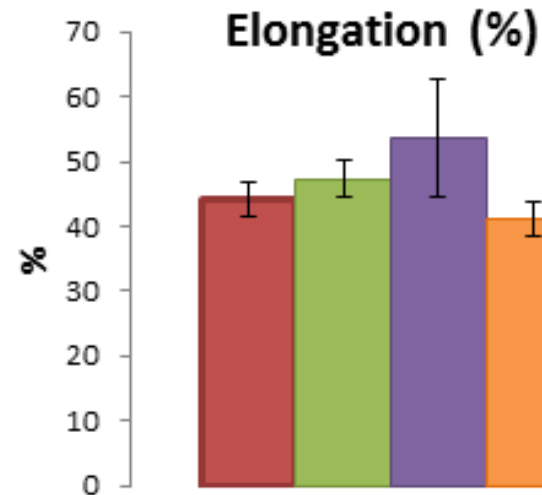
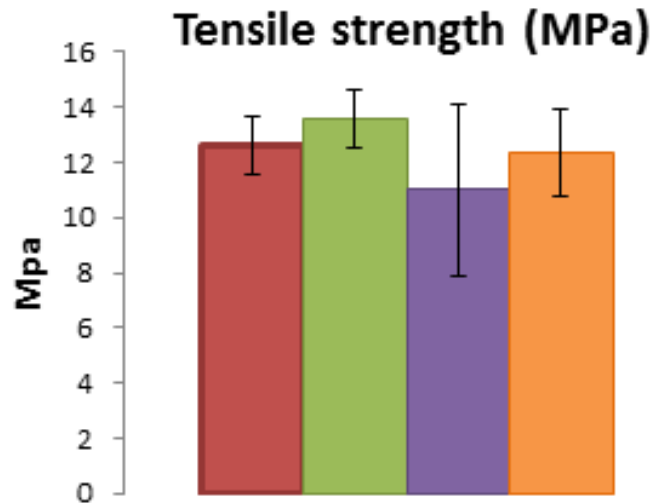


- ✓ Chitosan film with **waxes** and **oil** showed a DPPH antioxidant capacity 4 times higher than the **control film**.

Chitosan films with grape pomace extracts

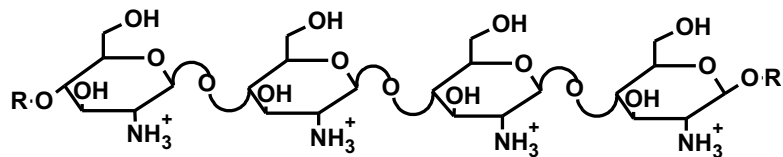


↳ Mechanical properties



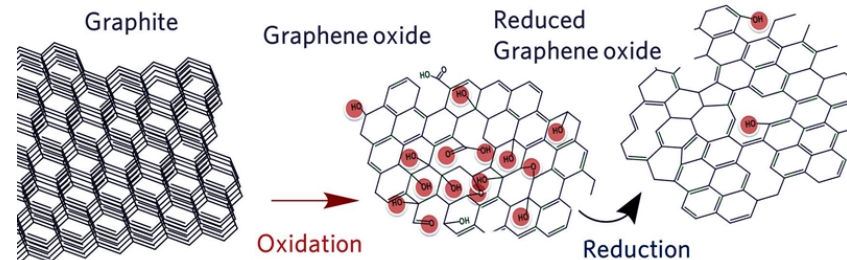
✓ The incorporation of the extracts **did not affect significantly** the mechanical properties of films.

Chitosan films with graphene

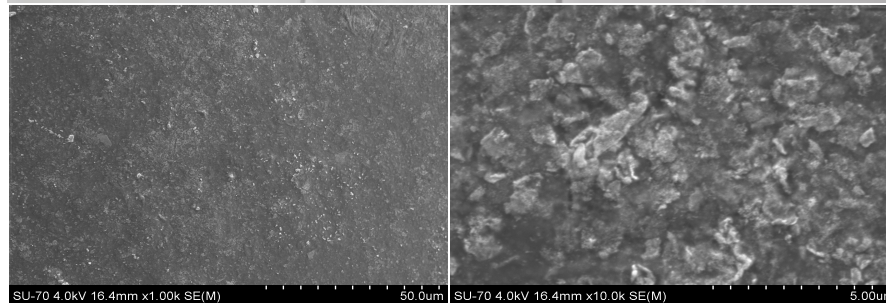


Medium viscosity chitosan

+



Reduced graphene oxide (RGO)



Chitosan films with graphene



Films properties comparing with chitosan film

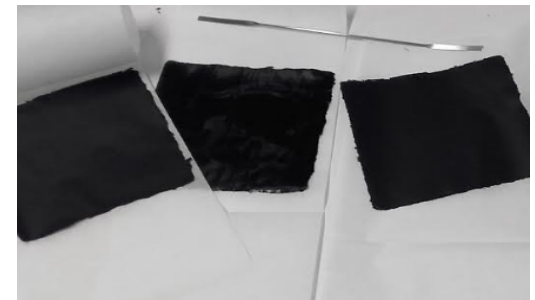
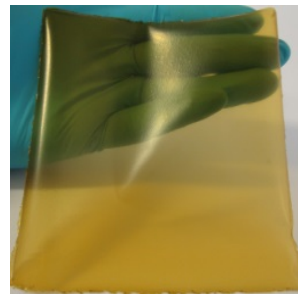
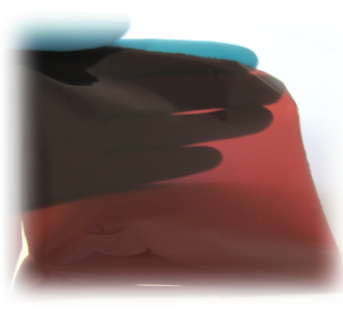
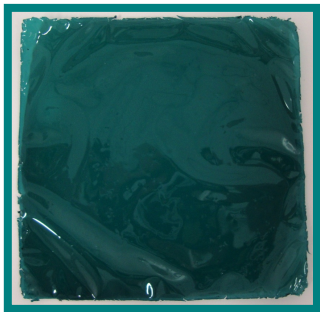
- ↳ **Reduction of the solubility** in water (10%)
- ↳ **Higher antioxidant activity** (until 70%)
- ↳ **Higher flexibility** with lower mechanical resistance
- ↳ **Conductivity** → **Widen applications** (PEF, pulse electric fields)



Conclusions



- ✓ The chemical modification of chitosan allows the development of films with tuned properties.
- ✓ These films are promising active materials to be used for food preservation and shelf-life extension.



Acknowledgments

❖ Team

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Centre for Research on Polysaccharides Structure and Applications at the University of Aveiro

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Thank you for your attention

