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COST Action FP1405

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

Chitosan-genipin paper coating – an alternative approach for active packaging materials

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cost
EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY

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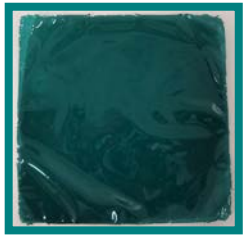
Horizon 2020

Scope

Chitosan-genipin films



Good mechanical properties

Antioxidant activity

Acidic stability

Paper coating for active packaging production???

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Experimental work

Chitosan-genipin solution	1% Chitosan + 0.05% (w:v) Genipin
	Temperature (40; 50; 60 °C) Time (0 - 120 min)
	Viscosity measurements
Paper coating	Non-calendared paper
	1% wt. Chitosan + 0.05% (w:v) Genipin (6CG)
	1:1 wt. Chitosan : Cellulose Nanocrystals* + 0.05% (w:v) Genipin (6CGCNC)
	6 coating layers Blade coated with IR @ 2500 W
	Color; Thickness; Weight gain; Barrier and mechanical properties; Acid stability

* $[CNC]_i \approx 12\%$

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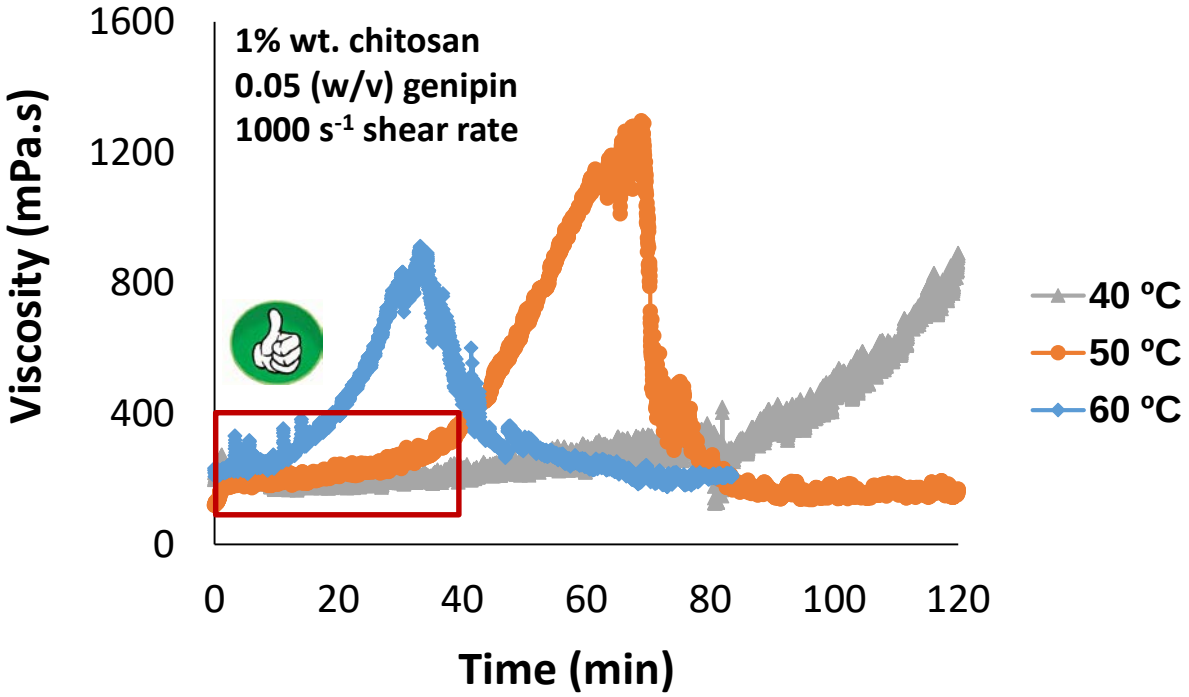
Chitosan-genipin crosslinking

❖ **Viscosity measurements**

MCR 302 rheometer

(Anton Paar)



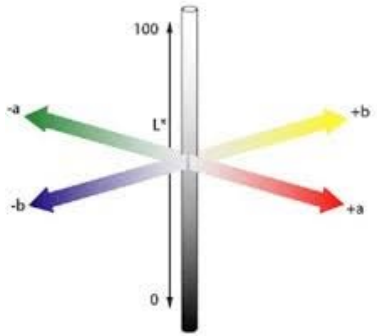
Selected crosslinking conditions: 30 min at 50 ºC

Colorimetry

1% wt. chitosan + 0.05% (w/v) genipin | 1:1 chitosan:CNC + 0.05% (w/v) genipin

Coating	IR power (W)	*L**	*a**	*b**
0	----------	92.802	-0.012	-0.418
6CG	2500	87.592	-2.732	6.856
6CGCNC	2500	89.113	-1.660	6.358

SpectroEye



CIELab color model

Decreasing of *a parameter**

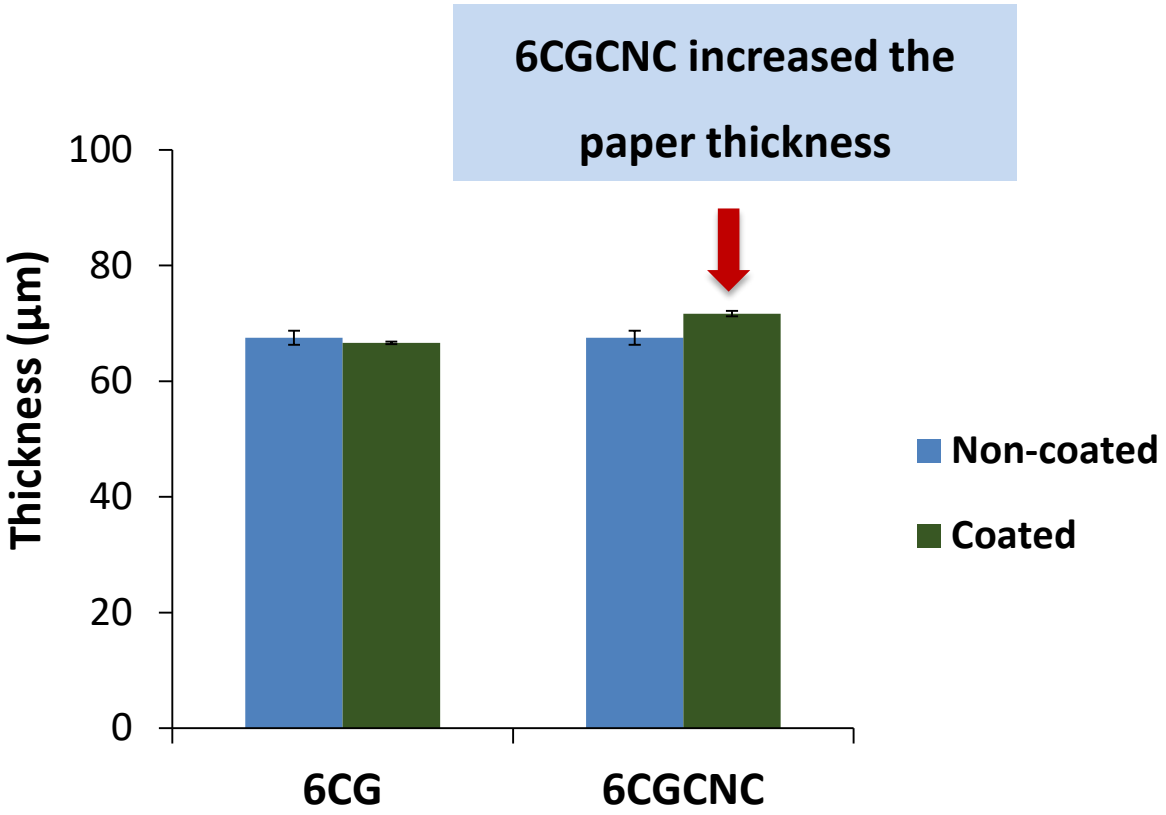
Greenish coloration

6CG: 6 layers of chitosan-genipin
6CGCNC: 6 layers of chitosan-genipin-cellulose nanocrystals

Thickness

A coating using only water should be performed as control sample

1% wt. chitosan + 0.05% (w/v) genipin | 1:1 chitosan:CNC + 0.05% (w/v) genipin

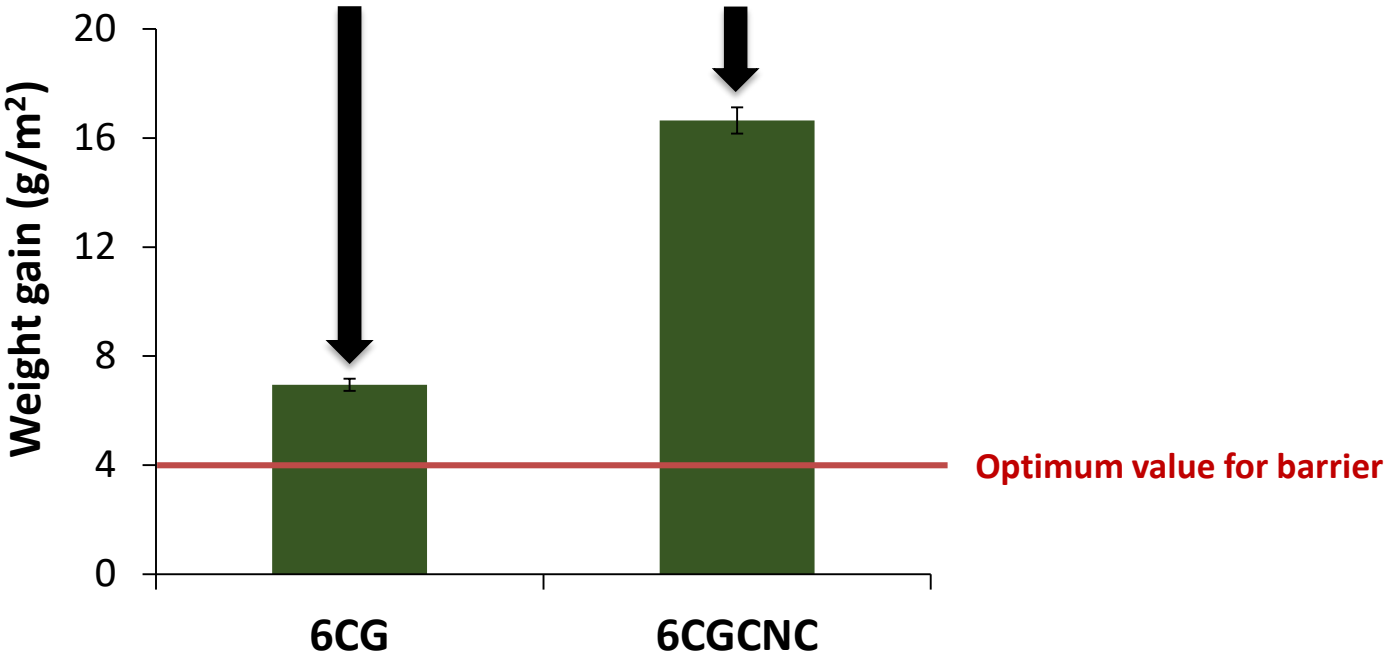


6CG: 6 layers chitosan-genipin
6CGCNC: 6 layers chitosan-genipin-cellulose nanocrystals

Weight gain

1% wt. chitosan + 0.05% (w/v) genipin | 1:1 chitosan:CNC + 0.05% (w/v) genipin

Both 6CG and 6CGCNC achieved a paper weight gain higher than 4 g/m²



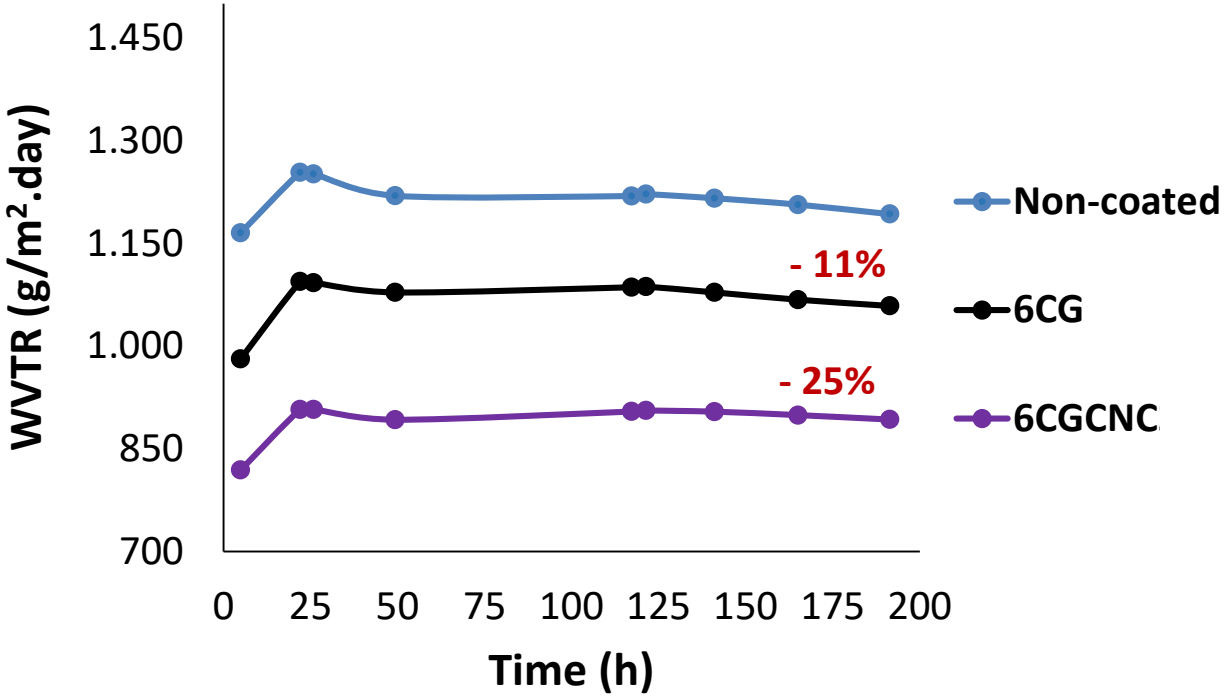
6CG: 6 layers chitosan-genipin
6CGCNC: 6 layers chitosan-genipin-cellulose nanocrystals

Water Vapor Transmission Rate (WVTR)

1% wt. chitosan + 0.05% (w/v) genipin | **1:1 chitosan:CNC + 0.05% (w/v) genipin**

23 °C with 50% of RH

for 7 days

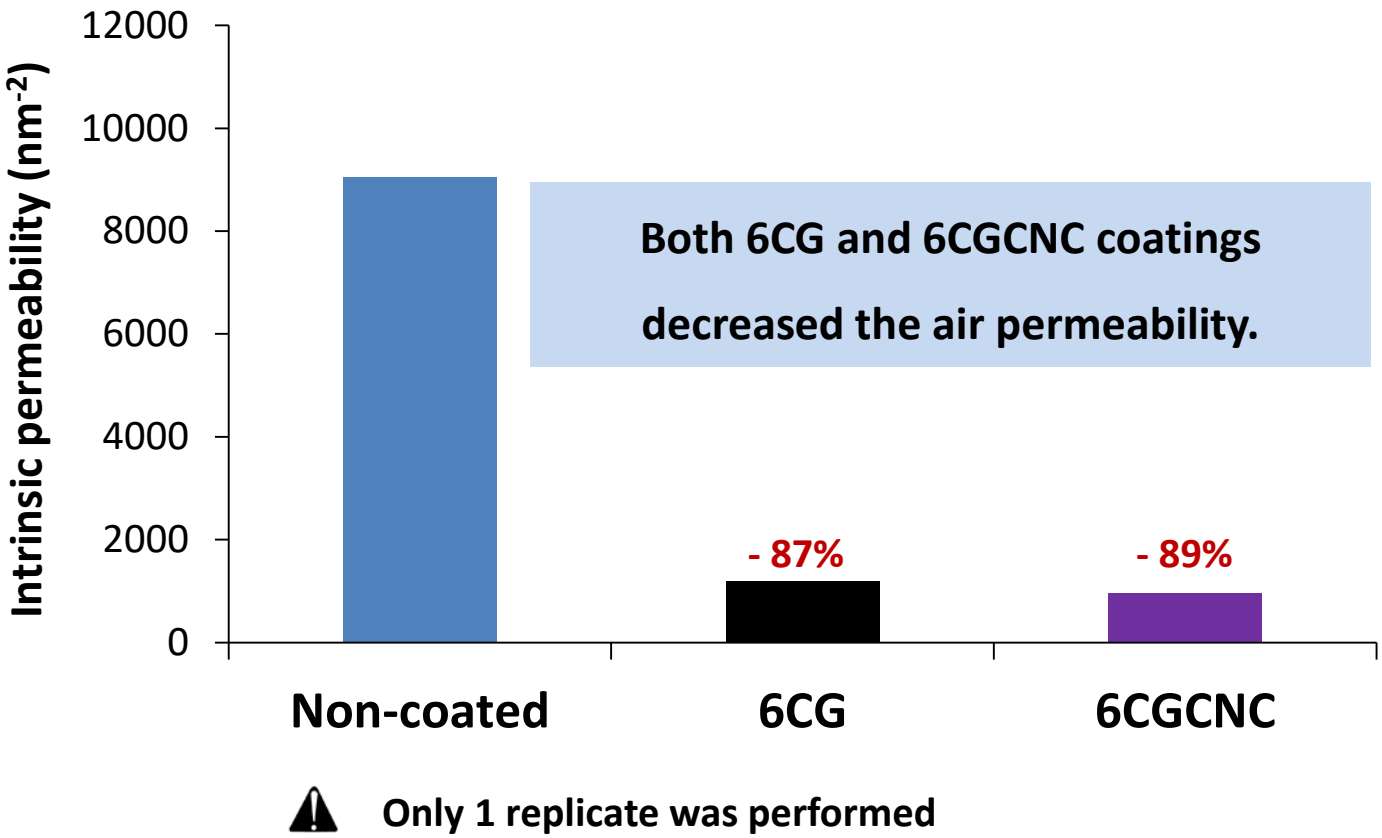


Both 6CG and 6CGCNC coatings decreased the WVTR, being 6CGCNC the most effective.

Air permeability – Mariotte vase

1% wt. chitosan + 0.05% (w/v) genipin | 1:1 chitosan:CNC + 0.05% (w/v) genipin

Mariotte vase



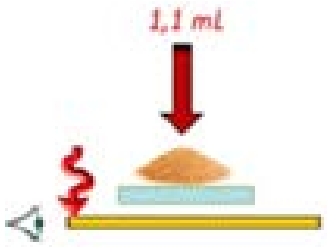
⚠ Only 1 replicate was performed

6CG: 6 layers chitosan-genipin
6CGCNC: 6 layers chitosan-genipin-cellulose nanocrystals

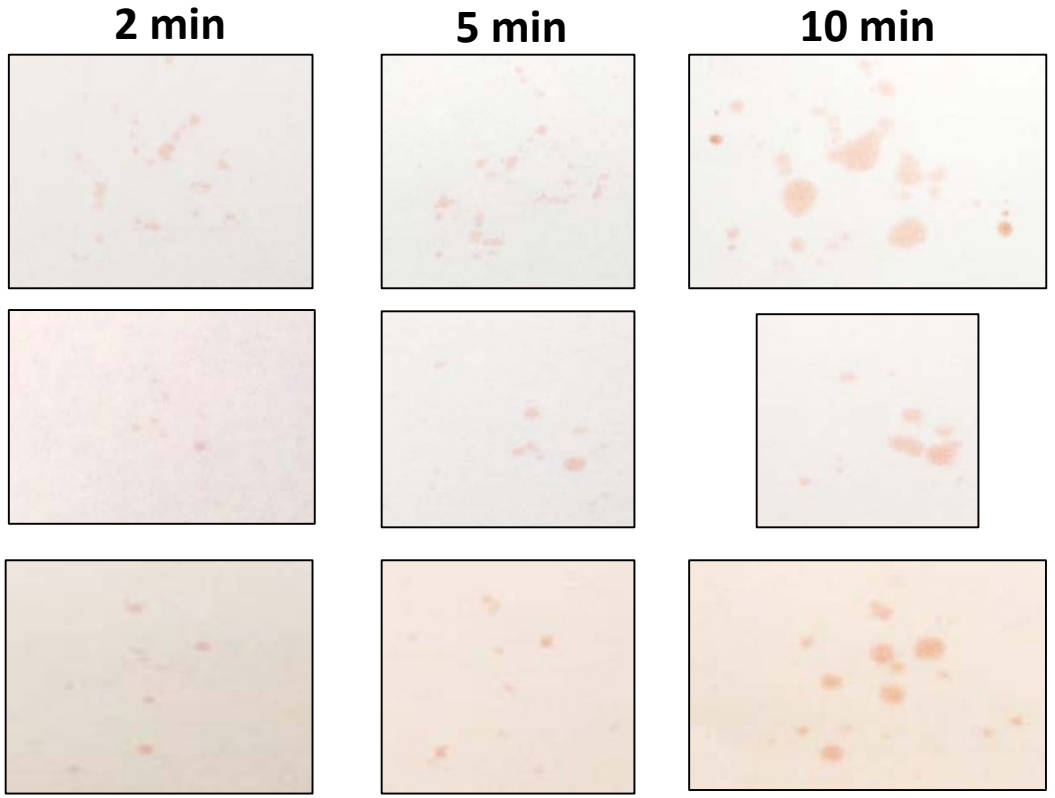
Grease permeability

1% wt. chitosan + 0.05% (w/v) genipin | 1:1 chitosan:CNC + 0.05% (w/v) genipin

❖ **Red turpentine oil test (T-454)**



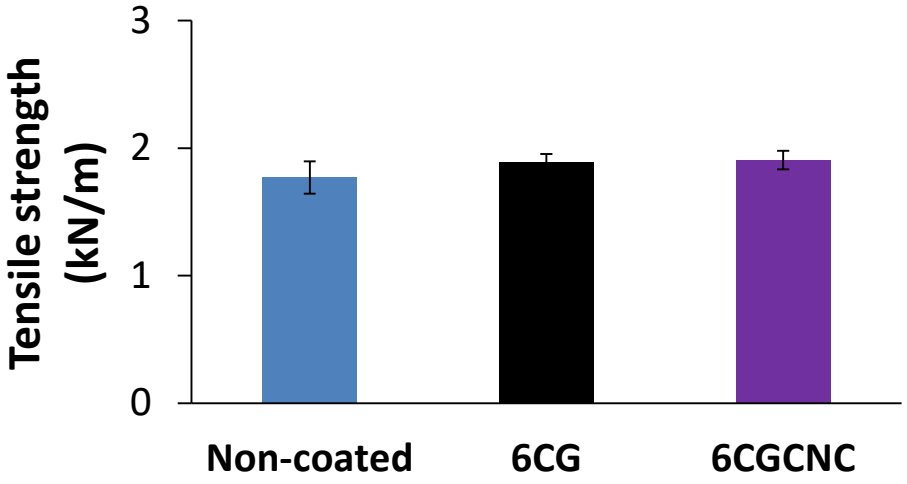
Gicquel *et al.* (2017)

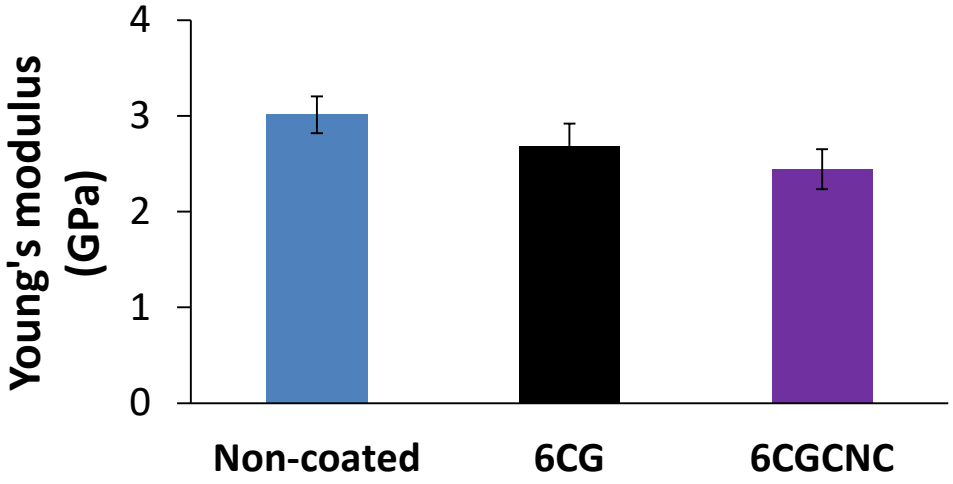


Both 6CG and 6CGCNC coatings reduced the grease permeability, being 6CG the most effective

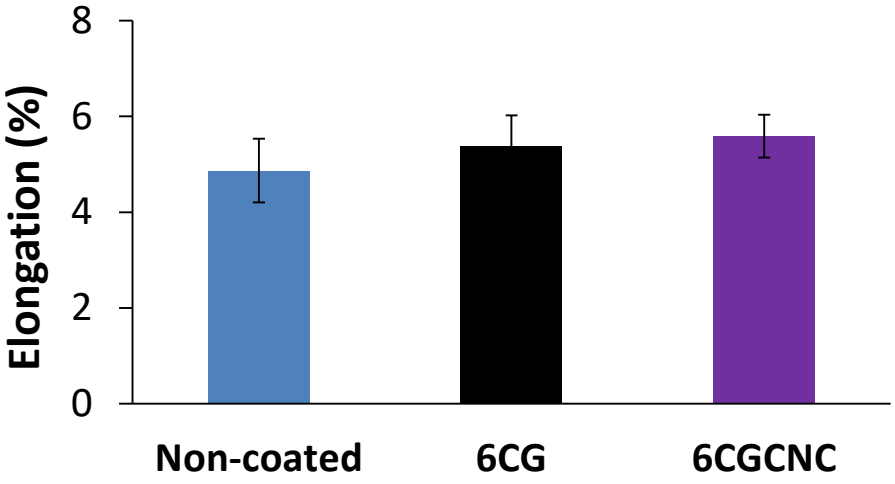
Mechanical properties

1% wt. chitosan + 0.05% (w/v) genipin | **1:1 chitosan:CNC + 0.05% (w/v) genipin**





Both 6CG and 6CGCNC coatings slightly reduced the paper rigidity



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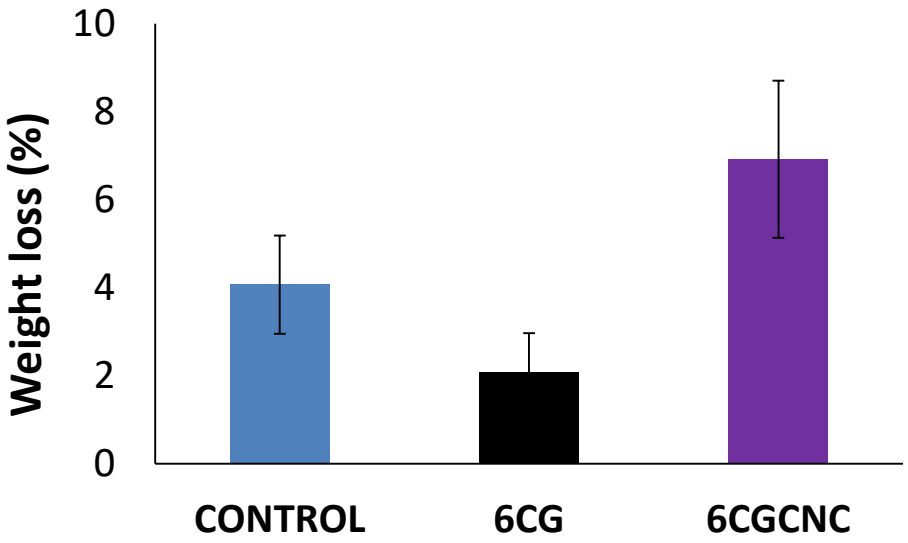
Acidic stability

1% wt. chitosan + 0.05% (w/v) genipin | 1:1 chitosan:CNC + 0.05% (w/v) genipin

7 days in acidic aqueous solution (pH = 3.5; distilled water adjusted with HCl)

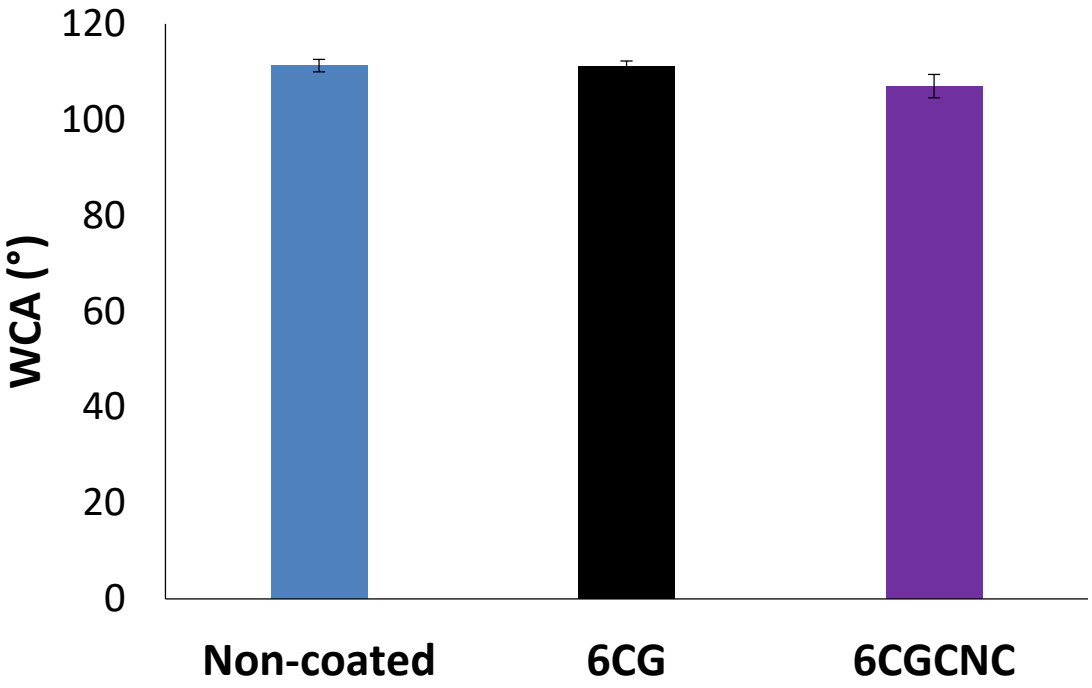


6CG reduced the weight paper loss in acidic media while 6CGCNC increase it.

6CG: 6 layers chitosan-genipin
6CGCNC: 6 layers chitosan-genipin-cellulose nanocrystals

Water contact angle

1% wt. chitosan + 0.05% (w/v) genipin | 1:1 chitosan:CNC + 0.05% (w/v) genipin



Both 6CG and 6CGCNC did not affected the paper wettability

6CG: 6 layers chitosan-genipin
6CGCNC: 6 layers chitosan-genipin-cellulose nanocrystals

Antioxidant activity

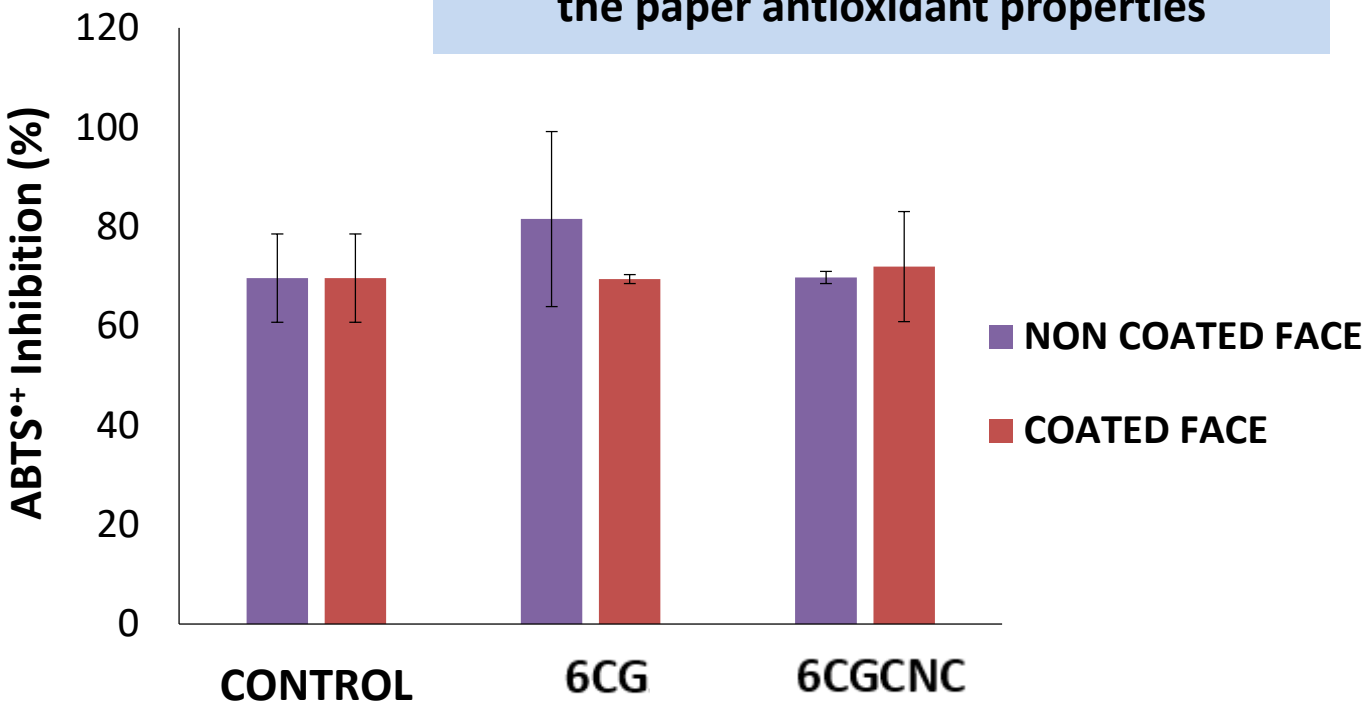
1% wt. chitosan + 0.05% (w/v) genipin | 1:1 chitosan:CNC + 0.05% (w/v) genipin

7 days in $ABTS^{\bullet+}$ solution

Ethanolic media

1 cm^2

Both 6CG and 6CGCNC did not improved the paper antioxidant properties



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6CG: 6 layers chitosan-genipin
6CGCNC: 6 layers chitosan-genipin-cellulose nanocrystals

Major remarks

- ✓ CG and CGCNC coated papers presented a greenish coloration resulted from the chitosan-genipin crosslinking.

CONTROL

6CG

- ✓ CG and CGCNC increased the weight gain of paper without compromising the paper mechanical performance.
- ✓ CG and CGCNC reduced:
  - water vapor, grease and air permeability
- ✓ CG presented the lowest weight loss when exposed to acidic conditions.
- ✓ CG and CGCNC did not affect the paper wettability and antioxidant properties.

Acknowledgments

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