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Development of novel HPMC edible coatings containing antifungal GRAS salts to control Alternaria black spot and preserve fruit quality of cold-stored 'Rojo Brillante' persimmons

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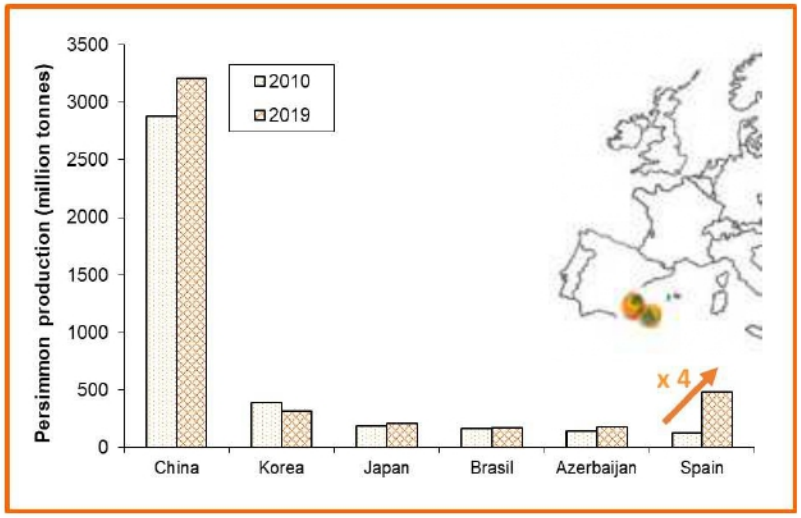
INTRODUCTION



Persimmon cv. Rojo Brillante
deastringency technology
maintains crisp texture

Chill sensitive

Alternaria black spot

Spain is the second producing country and the main exporter in the world of persimmons (*Diospyros kaki* Thunb.)

Persimmon production is mainly based on the 'Rojo Brillante' cultivar

This cultivar has a short harvest period and the main challenge for the industry is to extend the fruit storage life, which requires effective methods to preserve fruit quality and control postharvest Alternaria black spot (ABS) caused by the pathogenic fungus Alternaria alternata

The **objective** of this work was to develop new hydroxypropyl methylcellulose (HPMC)-lipid edible composite coatings containing selected food additives with antifungal properties effective to reduce the development of ABS on 'Rojo Brillante' persimmons artificially inoculated with the pathogen and preserve the quality of intact fruit during cold storage commercial conditions

MATERIALS AND METHODS

Coating formulation

Selected GRAS salts and doses from previous *in vitro* studies

2.0% (w/w) sodium benzoate (SB)
1% ammonium carbonate (AC)
1% potassium carbonate (PC)
1% potassium bicarbonate (PBC)
1% sodium bicarbonate (SBC)
1% potassium silicate (PSi)
0.1% sodium methyl paraben (SMP)
0.1% sodium ethyl paraben (SEP)

Emulsions containing
- HPMC
- Oleic acid (OA)
- Glycerol
- Tween 80
- GRAS salt

Characterization of emulsions
- ✓ pH (6-9), viscosity (100-134 mPa.s) and stability
- ✓ Fruit wetting

Effect of coatings on disease development

Persimmon 'Rojo Brillante'
Selection, washing, and random distribution

Inoculation
(three equidistant wounds in the same side)
(20 µl 1 x 10^6 spores/mL)

Edible coating application
- Incubation: 24 h – 20ºC after fungal inoculation
- Application by immersion for 30s
- Drained on a mesh screen and allowed to air-dry
- 3 replicates x 10 fruit per treatment

CONTROL: Inoculated but not coated

Incubation
14 days at 20ºC and 90% RH

Evaluation
- INCIDENCE (% infected fruit)
- SEVERITY (mm, lesion diameter)

Effect of coatings on fruit quality

Persimmon 'Rojo Brillante'
Selection, washing, and random distribution

Edible coating application
- Application of selected coatings by immersion for 30s
- Drained on a mesh screen and allowed to air-dry

Control-uncoated
HPMC-OA
HPMC-BW-PBC 2%
HPMC-BW-SEP 0.1%

Storage
15 and 30 days at 1ºC
+
7 days at 20ºC and 90% RHC

Evaluation
- Weight loss (%)
- Firmness (N) – Chilling Injury
- Respiration - CO_2 production (mg/kg h)

RESULTS – Disease development

Table 1. Incidence and severity reduction with respect to control fruit (uncoated) of Alternaria black spot on 'Rojo Brillante' persimmons artificially inoculated with *Alternaria alternata*, coated 24 h later with hydroxypropyl methylcellulose (HPMC)-oleic acid (OA) composite edible coatings containing antifungal food additives and incubated for 14 days at 20 °C and 90% RH.

Coating treatment	Disease incidence reduction (%)	Disease severity reduction (%)
HPMC-OA	18.2 ± 9.1 bc	0.0 ± 0.0 c
HPMC-OA-AC	21.4 ± 17.1 bc	0.0 ± 0.0 c
HPMC-OA-PC	53.6 ± 6.8 a	11.8 ± 0.7 b
HPMC-OA-PBC	60.7 ± 6.8 a	27.9 ± 0.5 a
HPMC-OA-SB	17.9 ± 13.5 bc	1.5 ± 1.2 c
HPMC-OA-SBC	7.6 ± 4.4 c	0.0 ± 0.0 c
HPMC-OA-PSi	8.3 ± 6.4 c	0.0 ± 0.0 c
HPMC-OA-SMP	5.3 ± 3.4 c	0.0 ± 0.0 c
HPMC-OA-SEP	36.4 ± 3.0 ab	22.1 ± 0.6 a

Mean ± SE. Means of two repeated experiments are shown.
Means in columns with different letters are significantly different according to Fisher's protected LSD test ($P < 0.05$) applied after an ANOVA.

Selected coatings to evaluate their performance under commercial prolonged cold-storage conditions and their effect on persimmon quality

Control

HPMC-OA-PBC

HPMC-OA-SEP

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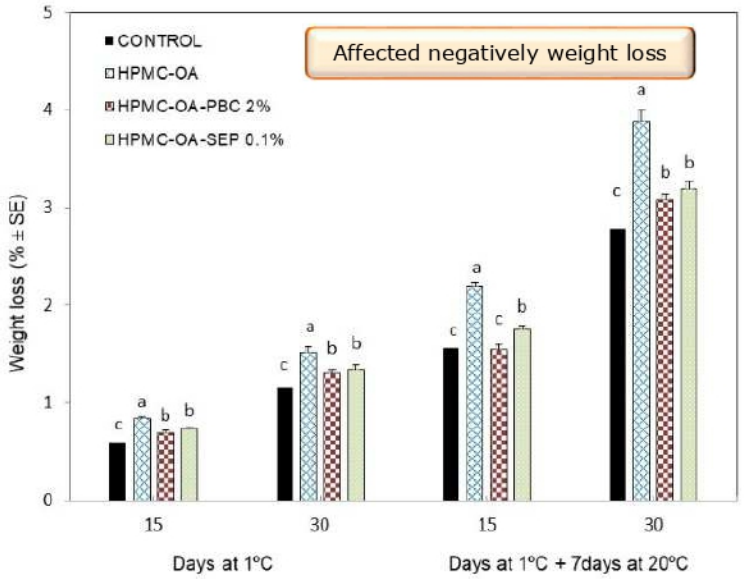
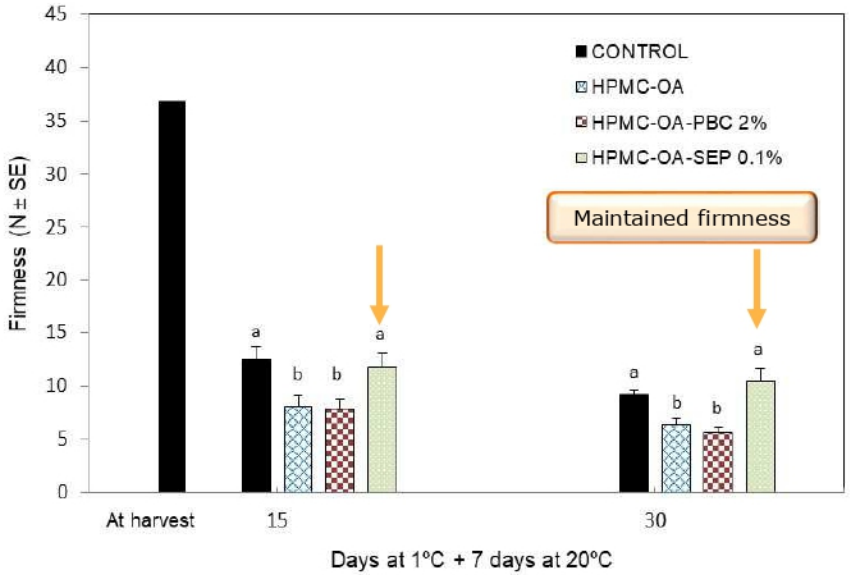
RESULTS – Fruit Quality





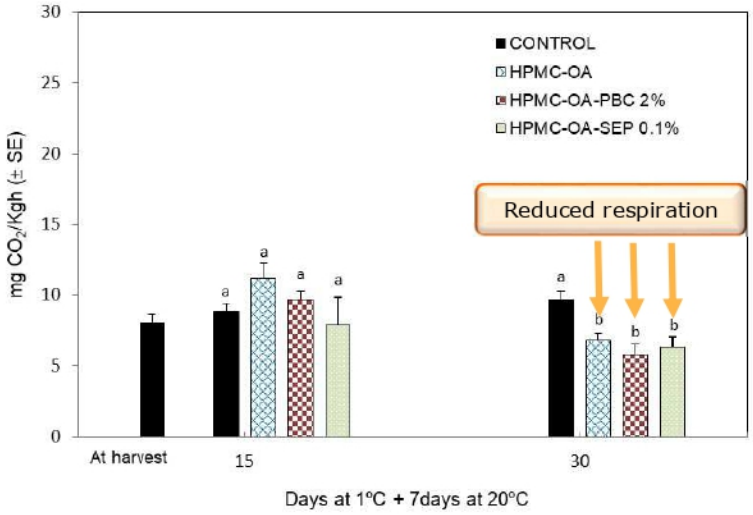
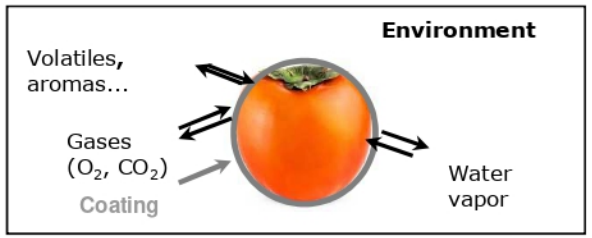


Fig. 1. Weight loss, firmness and respiration (CO_2 production) of 'Rojo Brillante' persimmons uncoated (Control) or coated with hydroxypropyl methylcellulose (HPMC)-oleic acid (OA) edible composite coatings containing potassium bicarbonate (PBC) or sodium ethyl paraben (SEP) and stored for up to 30 days at 1 °C followed by 7 days of shelf life at 20 °C. For each storage period, columns with different letters are significantly different by Fisher's protected LSD test ($P < 0.05$) applied after an ANOVA.



CONCLUSIONS

- The results confirm the importance of coating composition to control postharvest decay and maintain fruit quality of persimmon 'Rojo Brillante'
- The coating containing 1% PBC was the most effective to reduce persimmon black spot after 14 days at 20ºC
- The addition of the GRAS salts to the HPMC-OA coating matrix modified the performance of the coatings on fruit quality. Overall, the HPMC-OA coating containing 0.1% SEP maintained fruit firmness without affecting negatively weight loss. Therefore, this coating could be a promising treatment to extend the postharvest life of 'Rojo Brillante' persimmon
- Further research should focus on improving the physical characteristics of this HPMC-BW-SEP edible composite coating in order to enhance its performance during cold storage and evaluate its effectiveness for ABS reduction in semicommercial or commercial trials with naturally infected fruit

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