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Effect of chitin nanocrystals on the barrier and mechanical properties of egg white protein films.

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INTRODUCTION and OBJECTIVES

It is important to develop more sustainable packaging solutions to replace the current non-renewable fossil-based plastic packages. Proteins have proven to be appropriate raw materials for bioplastics development, but obtained films exhibit weak mechanical and water vapor barrier properties (Hernandez-Izquierdo & Krochta, 2008). Chitin nanocrystals (ChNCs) have been previously used as reinforcing filler in other bio-based films (Chang et al., 2010; Oun & Rhim, 2017; Salaberria et al., 2015; Yanat et al., 2023) but its functionality in EWP films has not been analysed yet. For this reason, the aim of this study was to assess the effect of adding ChNCs on the properties of EWP films forming by compression moulding.

MATERIALS AND METHODS

1.- FILMS PRODUCTION

Mixing → Stabilization → Compression moulding → Film extraction

- Mixing: EWP:GLY:H_2O (1:0.5:0.5 w/w) **+ ChNCS**
- Stabilization: 24 h / 5°C
- Compression moulding: 1st cycle: 130°C at 150 bars; 2nd cycle: 20°C at 150 bars

Labtech LP-S-50 Hot Press

ChNCs

- LIQUID DISPERSION (L): 1%, 2%
- CONTROL (EWP)
- SOLID STATE (S): 2%, 2.5%, 5%

Percentages by weight relative to the protein

2.- FILMS CHARACTERIZATION

- Oxygen Transmission Rate (OTR): Mocon OX-TRAN 2/22
- Water Vapour Transmission Rate (WVTR): Mocon PERMATRAN-W 3/34
- Mechanical properties: Texturometer TA-TX2

RESULTS

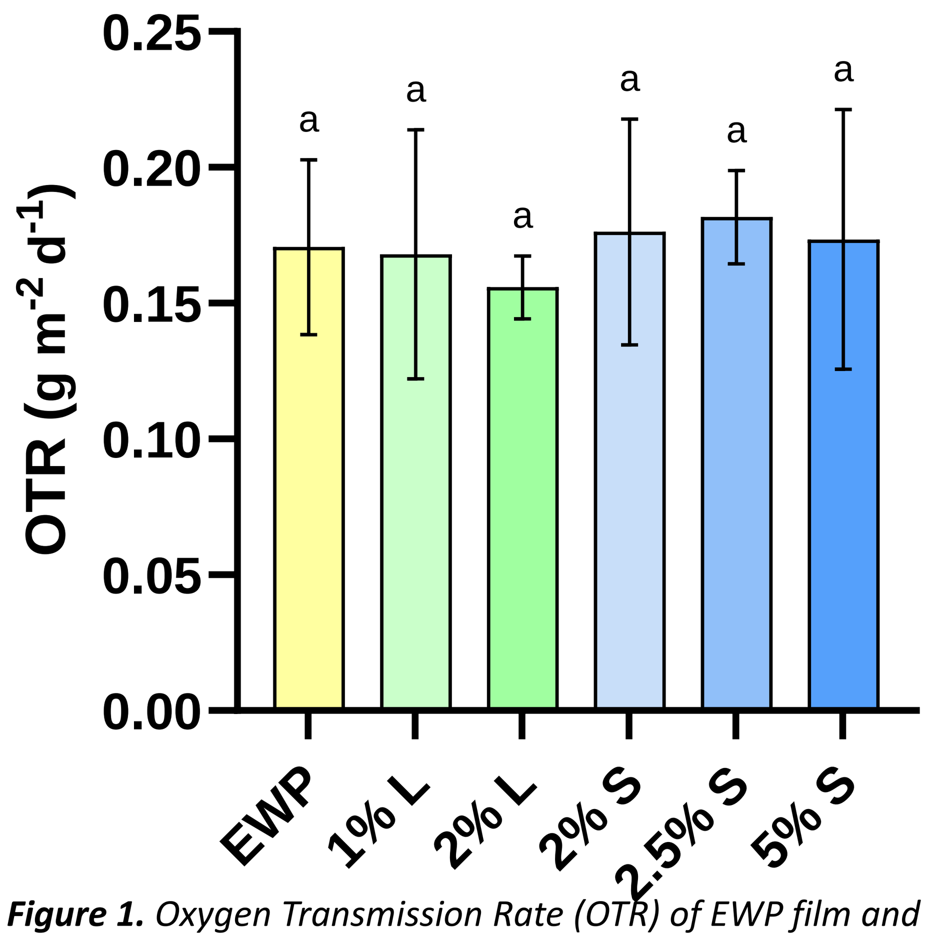

Figure 1. Oxygen Transmission Rate (OTR) of EWP film and EWP films reinforced with ChNCs in liquid and solid state (Measurements realized at 23°C and 55% RH).

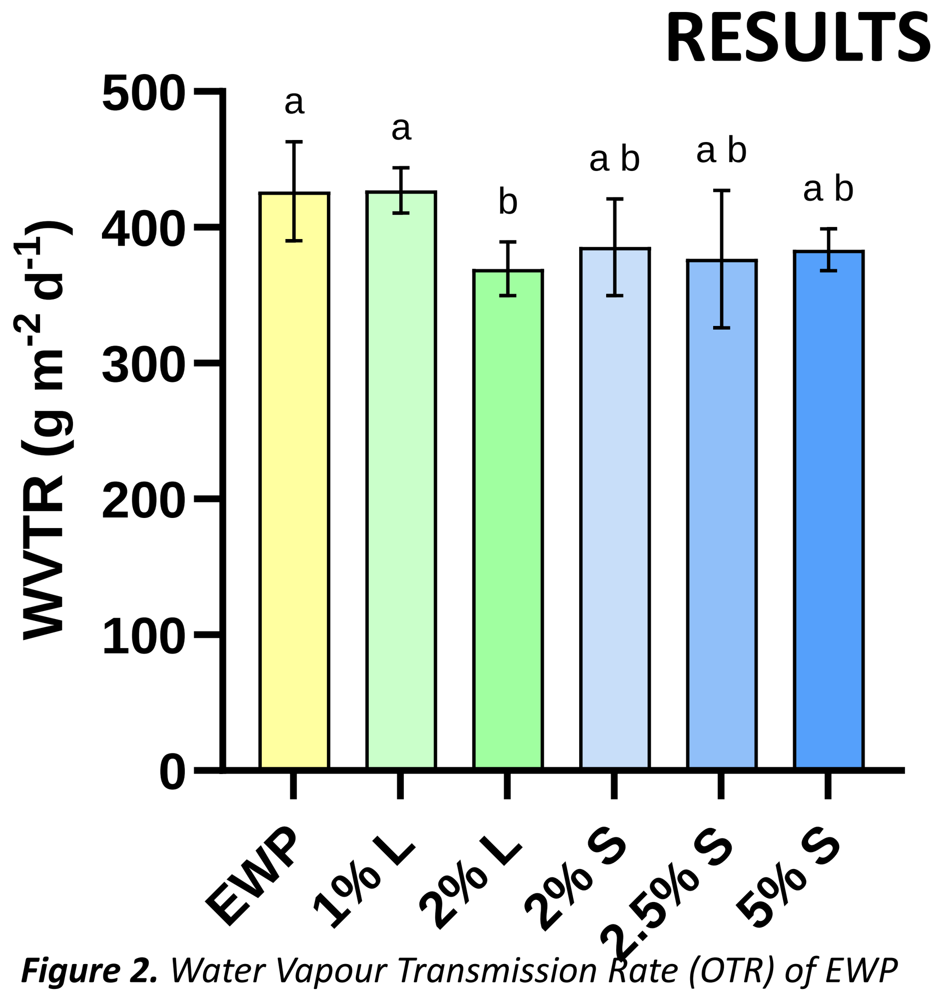

Figure 2. Water Vapour Transmission Rate (OTR) of EWP film and EWP films reinforced with ChNCs in liquid and solid state (Measurements realized at 23°C and 55% RH).

The use of ChNCs did not significantly ($p>0.05$) modify the OTR of EWP films as shown in Figure 1. However, the addition of ChNCs produced significant differences in the WVTR of EWP films (Figure 2). The use of low percentages (1%) not modified the WVTR but it was reduced by 14.5% when ChNCs were added at 2% in a liquid dispersion. The use of ChNCs in solid state also improved the WVTR, but the differences were not statistically significant.

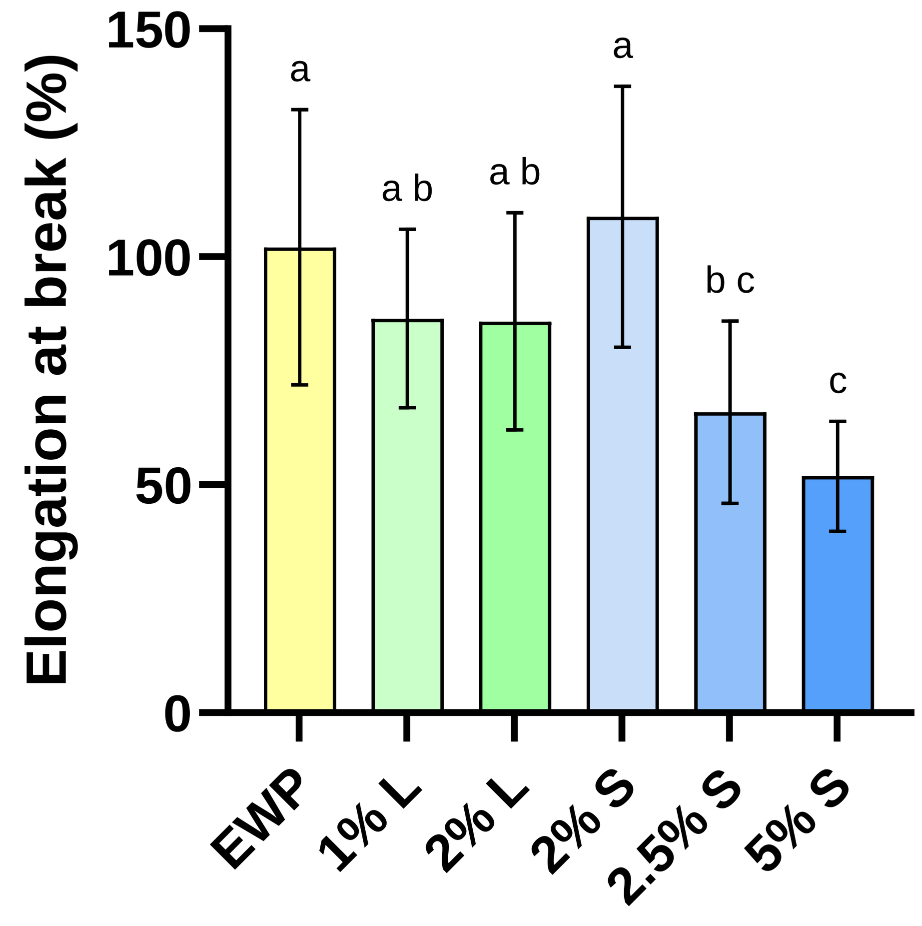

Figure 3. Elongation at break of EWP film and EWP films reinforced with ChNCs in liquid and solid state

Reinforcing the structure of the EWP films with low percentages of ChNCs (1 and 2%) not produced changes in elongation at break (Figure 3). However, increasing percentages of 2.5 and 5% caused a decrease in elongation at break of 33.7% and 49.5%, respectively, producing higher stiffness EWP films.

CONCLUSIONS

- The use of ChNCs not affected the OTR of EWP films but reduced the WVTR, with the maximum found when they were added in a liquid dispersion at 2%.
- The addition of ChNCs in the EWP film-forming solution resulted in a reduction of elongation until film breakage. This led to an increase in the modulus of elasticity, which translates into an increase in film stiffness.
- Reinforcing EWP films with ChNCs enhances some properties of those films, increasing the possible application as food packaging.

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