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Nanocomposites of chitosan-lignin doped with ZnO, TiO_2 and Zn_2SnO_4 for food packaging with UV-blocking, antimicrobial and antioxidant properties

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INTRODUCTION & AIM

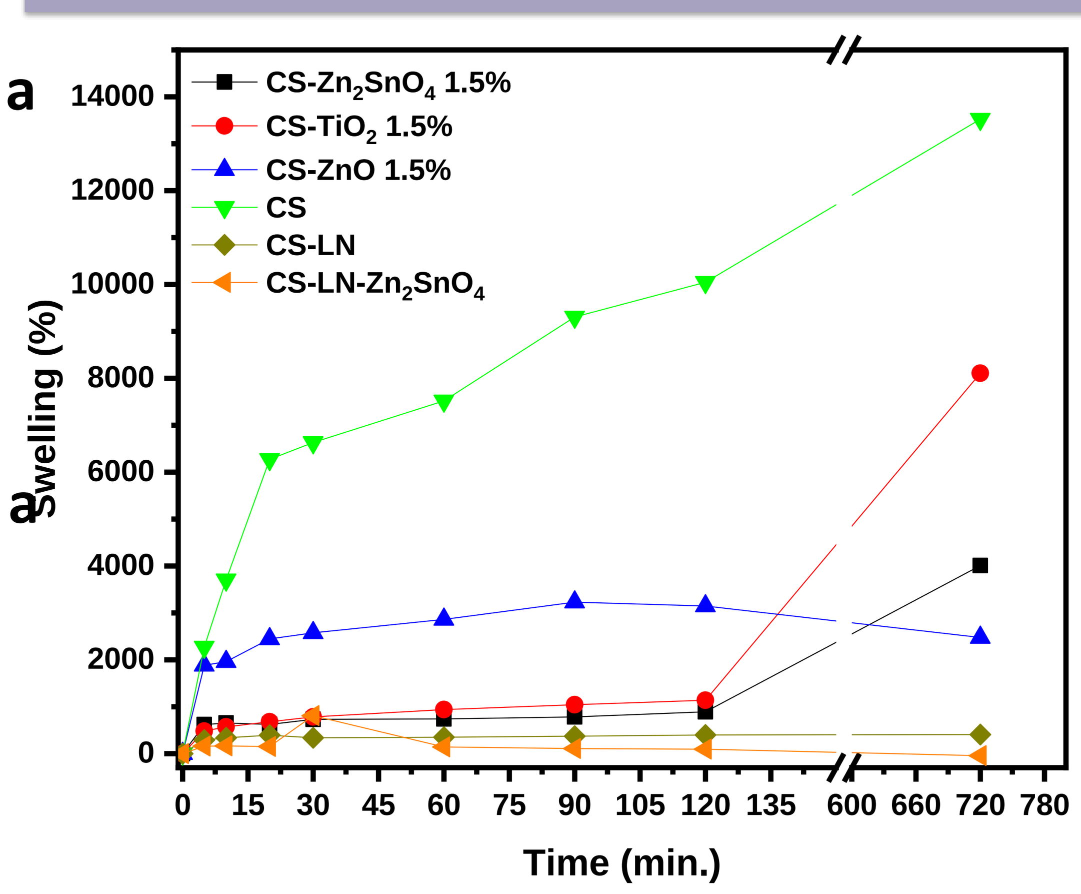
- Food packaging protects against chemical, physical, and biological dangers throughout the food chain. Packaging is necessary to deal with the impacts (odors, shocks, dust, temperature, light, humidity) that food faces.
- The prerequisite of food packaging to be classified as effective, strict requirements must be met, which is why the materials of construction are a challenge for the scientific community.
- The protection of food from solar and therefore ultraviolet radiation, oxidation by atmospheric air and microbial growth are some of the properties that a package must have in order to keep its contents in the best possible condition for a long period of time.
- Films made of chitosan and lignin with embedded ZnO, TiO_2, Zn_2SnO_4 nanoparticles seem to cope with these requirements, giving the potential for the use of new biodegradable materials in the field of food packaging.

METHODOLOGY

- For the synthesis, a solution was prepared with 1% (w/v) chitosan in 2% (v/v) acetic acid. Films incorporated Zn_2SnO_4 at 0.5%, 1.0%, and 1.5% (w/w of chitosan). The same procedure was followed for ZnO and TiO_2.
- 50 mL aliquots of the solution were cast into petri dishes and dried overnight in an oven to form films.
- Preliminary results indicated that 1.5% derivatives showed the best properties and selected for further study.
- For lignin incorporation the best film was selected, that was 1.5% Zn_2SnO_4. The lignin amount that was added was 50%wt of chitosan

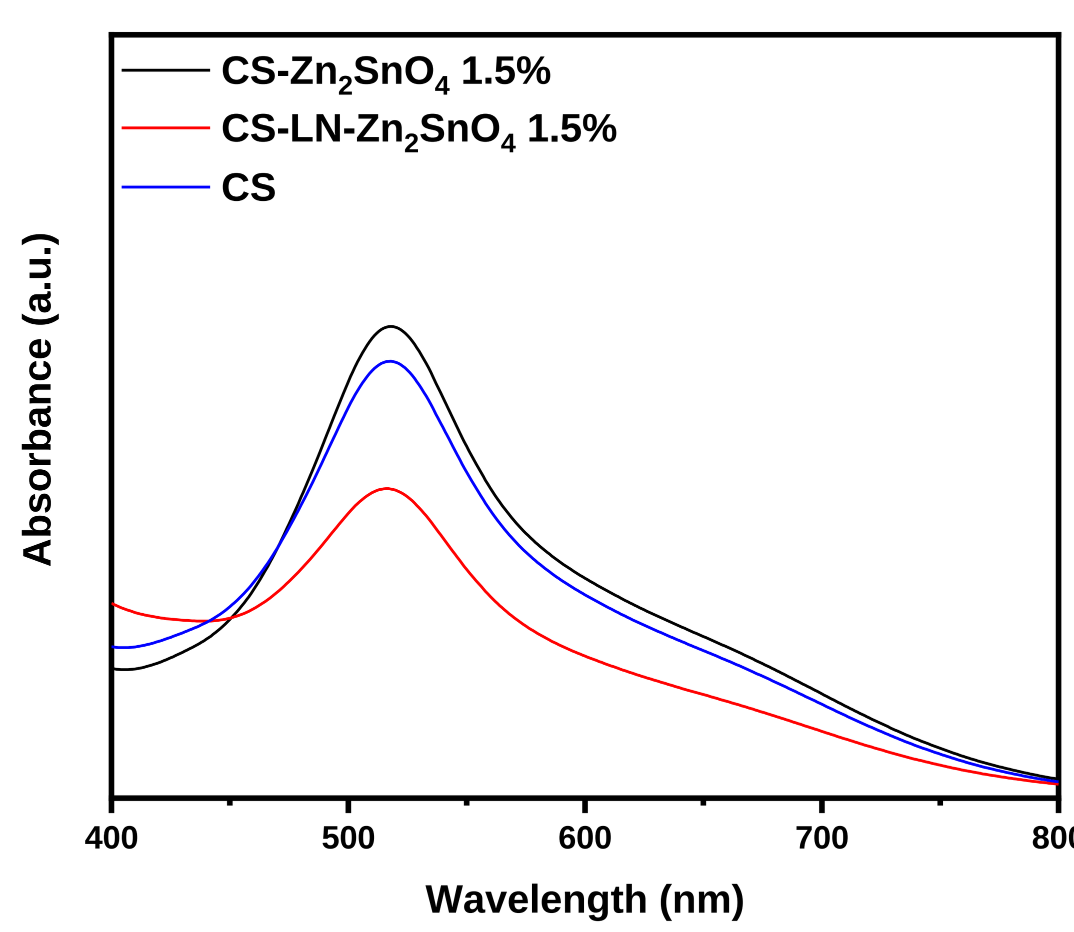
RESULTS

a



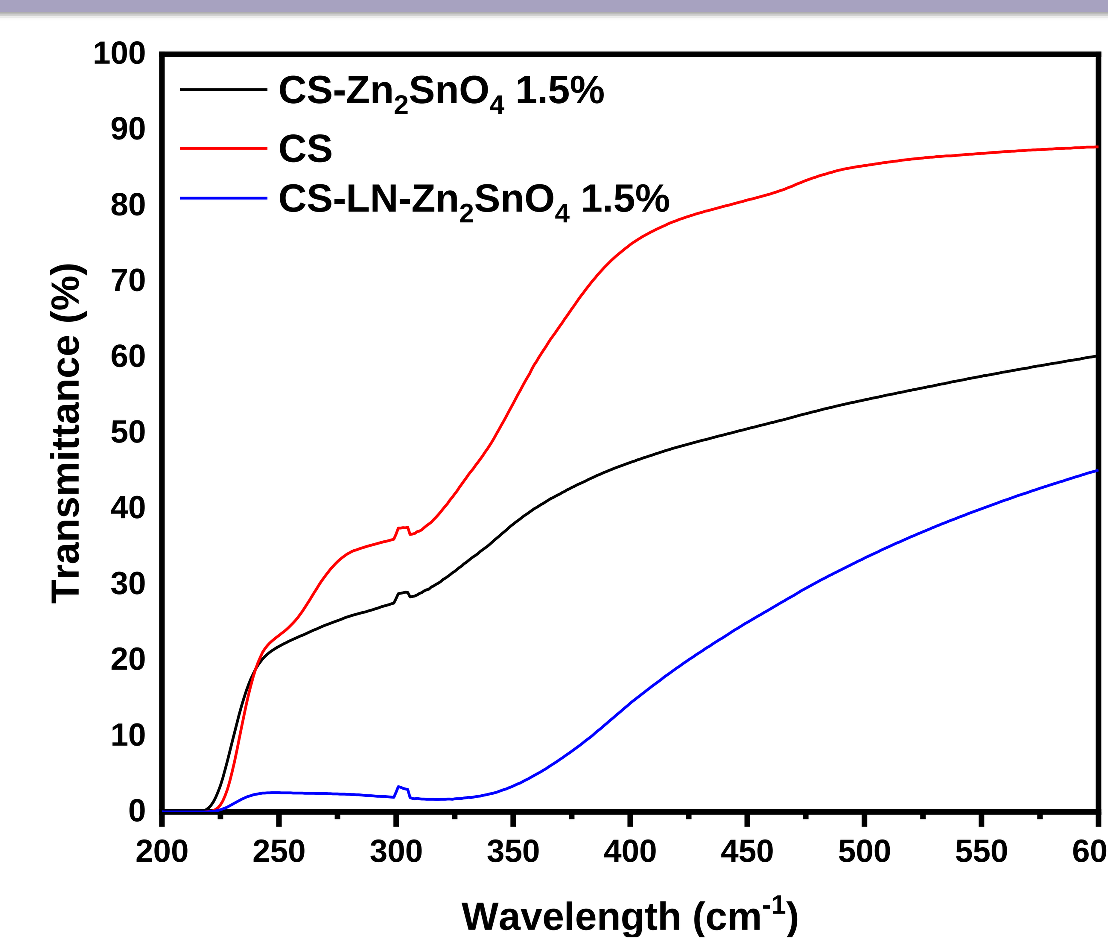
The results showed that as the addition of ZnO, TiO2, Zn_2SnO_4 and lignin decreased the **water sorption capacity** due to the interaction between the additives and CS. This reduction in water sorption is a desirable property for packaging materials, as it can help to prevent moisture loss or gain in food and other perishable items.

b



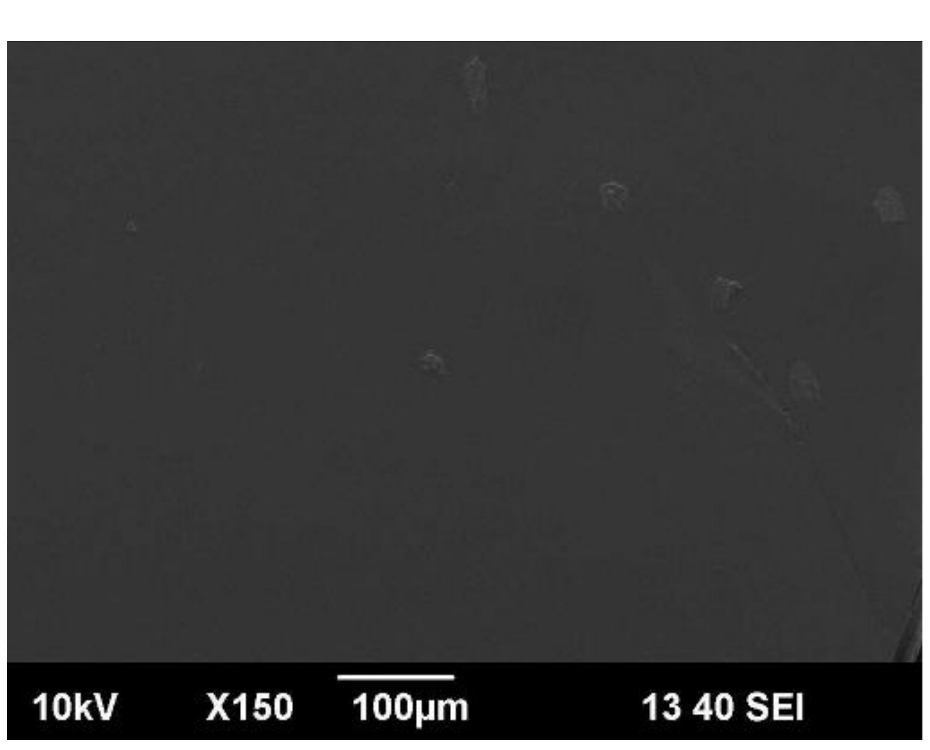
The **antioxidant activity** of the biofilm was evaluated using the DPPH radical scavenging assay. It was found that the addition of lignin increased the antioxidant properties, since lignin donates hydrogen from Phe-OH to capture DPPH molecules.

c



The incorporation of lignin into the CS films showed a drastic decrease in transmittance, showing to be a **great barrier against UVC and UVB radiation**, probably due to the presence of phenolic compounds.

d



SEM images of CS-LN-Zn_2SnO_4 showed **smooth surfaces**, confirming the successful homogenization of material, which was caused by the interaction of functional groups of –NH2 in chitosan and –OH in lignin.

e

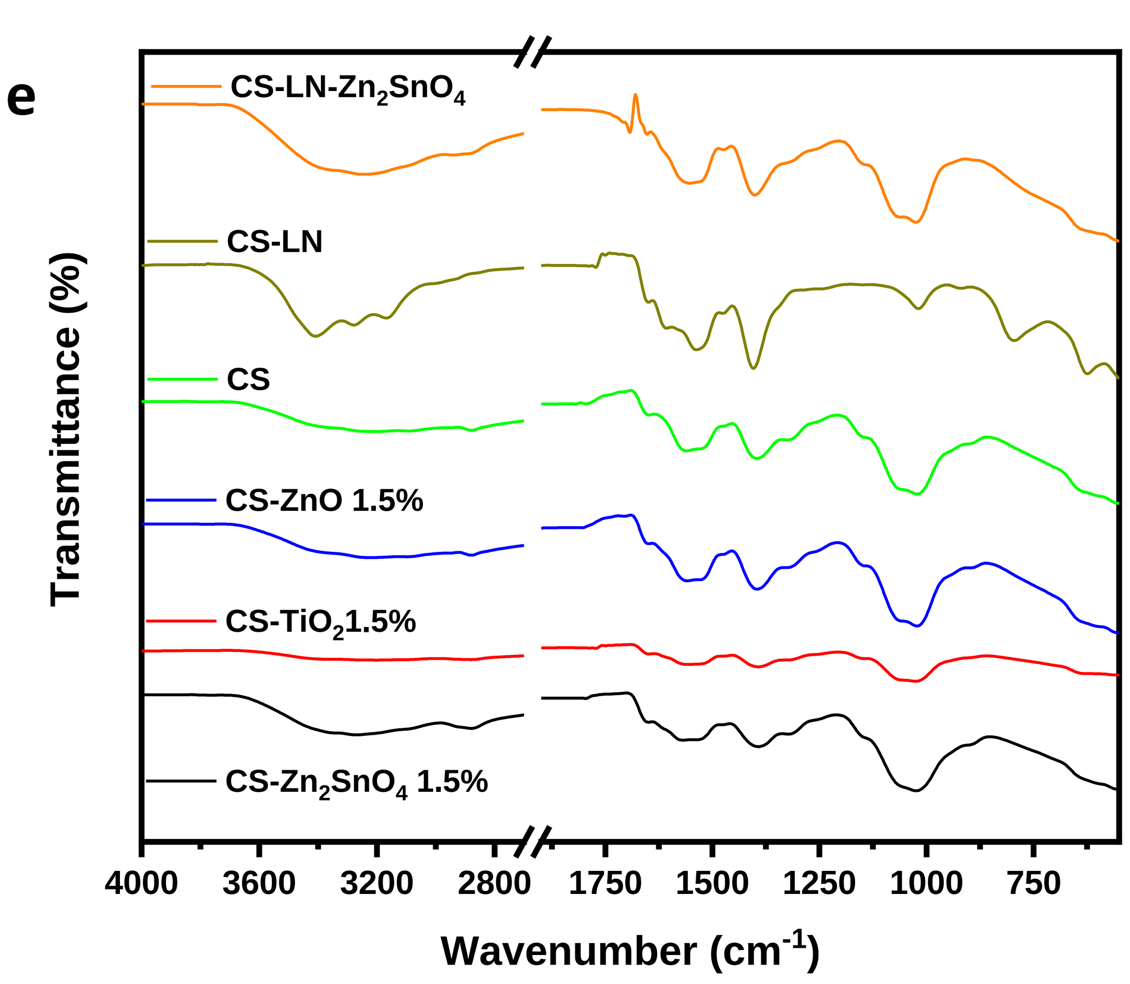


Figure a) water sorption capacity, b) DPPH scavenging, c) UV transmittance spectra, d) SEM images of CS-LN-Zn_2SnO_4 e) FTIR spectra,

CONCLUSION

This research achieved the preparation of CS-based biofilm employing, providing a promising substitute for the standard plastic films currently accessible in the market. It was found that the obtained CS-LN-Zn_2SnO_4 film exhibited a good potential in blocking UV radiation waves, which prevents food degradation and oxidation. Moreover, the presence of LN in CS presented homogenous and smoothed surfaces as shown in SEM micrographs, thus decreasing the water sorption, which is crucial for water vapor resistance ability for food preservation. In conclusion, CS-LN-Zn_2SnO_4 film presented high antioxidant properties.