Fabrication of jackfruit seed starch/tamarind kernel xyloglucan/zinc oxide nanoparticles-based biodegradable films for food packaging applications

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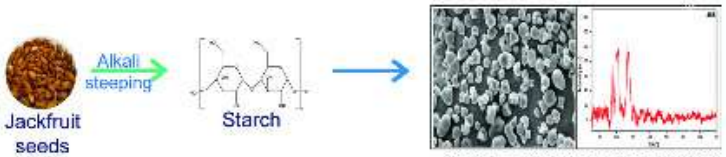
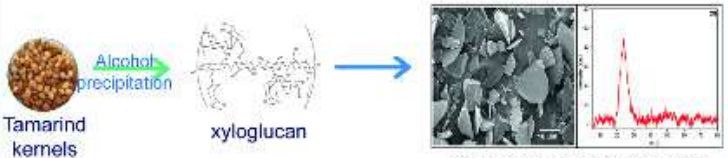
Introduction:

- Non-biodegradable plastics derived from fossil fuels stands out as a serious threat to human health and environment.
- Food packaging sector consumes a major portion of the produced synthetic plastics.
- Agro-food processing industries generates a large volume of wastes every day.
- Valorization of such wastes to develop biodegradable food packaging materials is a promising strategy for transitioning towards a bio-based circular economy.

Raw material extraction and characterization

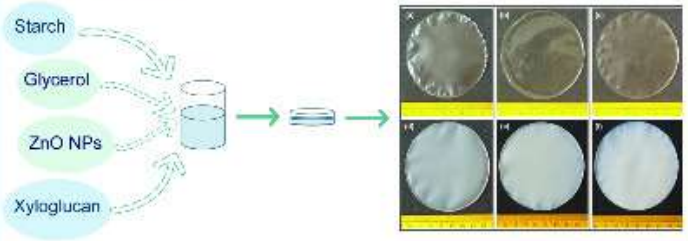


SEM and XRD profiles of JSS



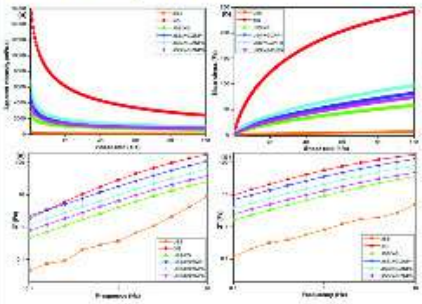
SEM and XRD profiles of XG

Film preparation



Schematic of solvent casting method

Film-forming solution characterization

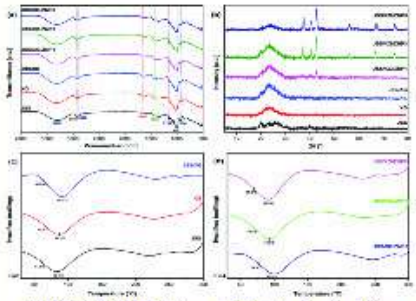


Steady (a & b) and dynamic (c & d) rheological behavior

ZNPs incorporation,

- Increased the viscosity of FFS, indicates formation of dense network structures.
- Enhanced the viscoelastic property of the FFSs.

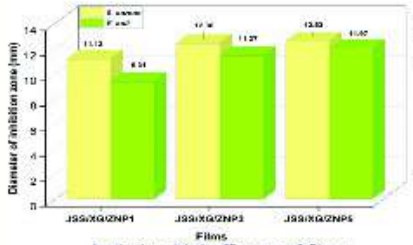
Film characterization



FTIR (a) XRD (b) and DSC (c & d) of films

Addition of ZNPs,

- Increased the formation of intermolecular interactions.
- Enhanced the crystallinity.
- Improved the thermal stability.

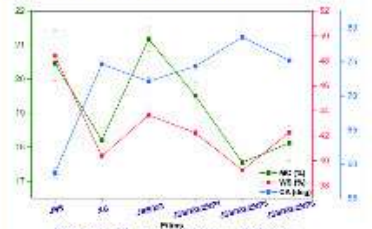


Antimicrobial efficacy of films

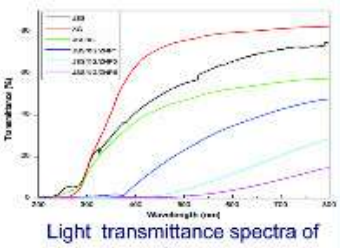
ZNP-loaded films,

- Demonstrated dose-dependent activity against both microorganisms.
- Inhibited more effectively against *S. aureus* than *E. coli*.

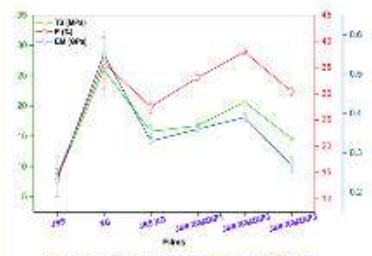
Film characterization



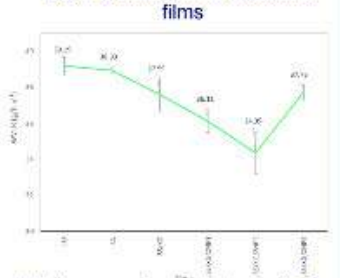
Physical properties of films



Light transmittance spectra of films

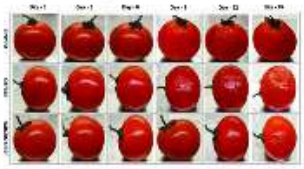


Mechanical properties of films

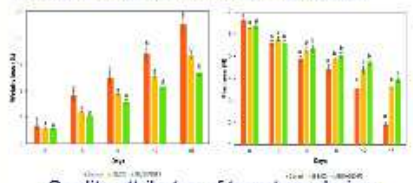


Water vapor transmission rate of films

Coating study



Pictographs of tomatoes during storage



Quality attributes of tomatoes during storage

ZNP-loaded coating,

- Provided an effective barrier against water loss and exchange of gasses.
- Showed 40% lesser weight loss than uncoated fruits at the end of storage.

Conclusion:

- Agricultural by-products, namely jackfruit seed starch and tamarind kernel xyloglucan have been valorized to develop eco-friendly food packaging material.
- The XG blending and ZNP incorporation enhanced the mechanical, water vapor barrier, and thermal properties of the JSS-based films.
- The JSS/XG/ZNP3 coating significantly retained the fruit quality during storage and extends the shelf-life of tomato fruits.