

Influence of turmeric essential oil on the physicochemical characteristics of chitosan films.

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Introduction

Chitosan, derived from chitin, is a biopolymer known for its biodegradability, biocompatibility, and non-toxicity. Its applications span various fields, including food packaging, pharmaceuticals, and biomedical engineering. Enhancing the properties of chitosan films has garnered significant attention, especially for applications in food preservation and packaging [1].

Chitosan films are increasingly favored in the packaging industry due to their ability to provide a barrier against moisture and gases while being environmentally friendly. These films also exhibit antimicrobial properties, which can extend the shelf life of perishable products. However, the mechanical strength and thermal stability of pure chitosan films can be limiting factors [2].

Turmeric essential oil is extracted from the *Curcuma longa* plant and contains bioactive compounds such as curcumin, which is known for its strong antioxidant and anti-inflammatory effects. These properties make turmeric essential oil an appealing candidate for enhancing the functional properties of chitosan films. Furthermore, its natural origin aligns with the growing consumer demand for clean-label products in food packaging [3].

Chitosan films can be prepared through a casting method, where chitosan is dissolved in an acidic solution, mixed with turmeric essential oil, and poured into molds. The mixture is then dried to form a film. The concentration of turmeric essential oil is a crucial factor, as it can influence the film's properties significantly. Researchers often explore different concentrations to determine the optimal level for enhancing film characteristics [4].

The incorporation of turmeric essential oil into chitosan films can enhance their mechanical properties. Studies have shown that specific concentrations of turmeric essential oil improve tensile strength and elongation at break. These enhancements are attributed to the intermolecular interactions between the chitosan matrix and the active compounds in the essential oil [5].

Water vapor permeability is a critical factor in food packaging, affecting the shelf life of products. The addition of turmeric essential oil can modify the hydrophilicity of chitosan films, influencing their moisture barrier properties. Research

indicates that at optimal concentrations, turmeric essential oil can reduce water vapor permeability, providing a better barrier for moisture while still allowing some breathability essential for packaged food [6].

Thermal stability is another important physicochemical characteristic of chitosan films. The presence of turmeric essential oil can alter the thermal properties of chitosan films. Differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA) are commonly used to evaluate thermal behavior [7].

One of the significant advantages of incorporating turmeric essential oil into chitosan films is the enhancement of their antimicrobial properties. The bioactive compounds in turmeric oil exhibit antimicrobial effects against various foodborne pathogens. When added to chitosan films, these properties can help inhibit microbial growth, contributing to food safety and prolonging the shelf life of packaged products [8].

The enhanced physicochemical characteristics of chitosan films with turmeric essential oil make them suitable for various food packaging applications. These films can be used for wrapping perishable items, snacks, and even pharmaceuticals. The natural antimicrobial properties combined with improved mechanical and barrier properties make them an attractive option for sustainable packaging solutions [9].

Further research is essential to optimize the concentration of turmeric essential oil for various applications. Investigating the synergistic effects of combining turmeric oil with other natural additives could also yield enhanced properties. Additionally, studies on the long-term stability and real-world performance of these films in different environmental conditions would provide valuable insights for industrial applications [10].

Conclusion

The incorporation of turmeric essential oil into chitosan films significantly influences their physicochemical properties, enhancing their mechanical strength, thermal stability, water vapor permeability, and antimicrobial activity. These improvements position chitosan films as a viable option for sustainable food packaging, catering to consumer demands for natural and effective materials. As research continues to explore the optimal formulations and applications of turmeric-infused chitosan films, the potential for innovative and eco-friendly packaging solutions in the food industry is promising.

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