Sericin Coatings: A Sustainable Approach to Extending Tomato Freshness

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ABSTRACT

Tomatoes, rich in nutrients like lycopene and beta-carotene, face challenges in shelf-life due to respiration and microbial attack. This article explores the potential of sericin-based edible coatings to extend the shelf-life of tomatoes while maintaining their quality. A combination of sericin, chitosan, Aloe vera gel and glycerol was formulated into an edible coating, which was applied to tomatoes. Results indicated that coated tomatoes exhibited significantly lower weight loss (35%) and better firmness compared to uncoated samples (61%) after 45 days. Key quality parameters, including pH, total soluble solids, and antioxidant levels, improved in coated fruits. Additionally, microbial growth was reduced, affirming the protective benefits of the coating. This approach not only enhances tomato preservation but also utilizes sericin, a silk industry by-product, promoting sustainability.

INTRODUCTION

The shelf-life of tomatoes is often compromised by respiration, microbial attack and senescence (Kumar & Saini, 2021). Therefore, controlling respiration through methods such as temperature manipulation and low-temperature storage is crucial for extending shelf-life (Dhall, 2016).

Recent consumer trends favour natural, biodegradable coatings over synthetic options

(Ferreira *et al*., 2016). Among various materials explored for edible coatings, sericin-a protein derived from silk waste-has shown promise due to its biocompatibility, biodegradability and nontoxicity (Sothornvit & Chollakup, 2009).

Sericin is proven effective as a coating material has been recognized in various studies, indicating improvements in the shelf-life of whole fruits, such as bananas and strawberries (Cuervo Osorio *et al.*, 2021). Unlike lipid-based coatings that can impart greasiness and alter flavour, sericin is a fat-free option that enhances palatability (Hassan *et al*., 2018; Oduro, 2021).

Tarangini *et al*., 2022 describes those Coated tomatoes exhibited significantly lower weight loss (35%) compared to uncoated samples (61%) after 45 days and maintained better firmness, indicating reduced ripening. Key quality parameters, including pH, total soluble sugars (TSS), titratable acidity (TA) and antioxidant levels, showed favourable trends in coated tomatoes. Additionally, microbial growth was lower in coated samples, demonstrating the protective benefits of the coating. FTIR and SEM analyses confirmed the integrity of the coating without altering the tomato peel structure, highlighting its potential for sustainable fruit preservation.

Despite its potential, sericin is underutilized, especially in countries like India where much of it is discarded, increasing environmental burdens from silk industry waste (Barajas-Gamboa *et al*., 2016). By harnessing sericin for edible coatings, the silk industry can not only mitigate waste but also generate additional income.

Preparation of Additives

A 1% chitosan solution was prepared according to Khatri *et al*. (2020) by dissolving the polymer in distilled water with 0.6% glacial acetic acid, followed by homogenization at 60°C and 800 rpm. Fresh Aloe vera leaves were collected and thoroughly washed, then the gel was extracted from the outer cortex. The colourless hydro parenchyma was ground in a mixer and filtered through muslin cloth to remove fibers. The filtered Aloe vera gel was pasteurized at 70°C for 45 minutes, then cooled to room temperature. Finally, it was stored at 5°C in the refrigerator for use in further experiments.

Enzymatic treatment of sericin

Silk sericin was extracted and recovered from CSTRI using their patented method (Joseph *et al*., 2019) and then treated with alkaline protease supplied by CSTRI. The treatment was conducted at pH 9, incubated for 90 minutes at 60°C, and then cooled to room temperature. To inactivate the enzyme, the solution was heated to 100°C for 10 minutes. Following this, the mixture was centrifuged at 10,000 rpm for 10 minutes to separate the enzyme, and the resultant sericin was collected from the supernatant.

Preparation of edible coating solution

The edible coating solution was prepared by combining 20 ml of a 1.5% sericin solution with 20 ml of a 1% (w/v) chitosan solution, followed by vigorous mixing to ensure homogenization. Then, 1% Aloe vera solution and 1.5% glycerol were added, and the mixture was blended thoroughly using a hot plate magnetic stirrer at 800 rpm while maintaining a temperature of 70°C until the final volume was reduced by half. The final pH of the coating solution was adjusted to 4.5, enhancing its viscosity and film-forming ability.

Dip coating of tomatoes

For the dip coating experiment, tomatoes were immersed in the edible coating solution at room temperature (25 ± 2°C) for 2 minutes before being air-dried by holding the pedicel.

A control group of uncoated tomatoes was also prepared. Samples from both coated and control groups were analysed weekly for water loss, lycopene content, and total phenolic content.

Preservation of tomatoes and Fruit quality assessments

For preservation, 120 tomatoes were divided into coated and uncoated groups, air-dried for 5 hours at 25 ± 2°C, and placed in an incubator with 70% relative humidity. Coated fruits were preserved for up to 45 days, with evaluations for weight loss and firmness. Various fruit quality parameters, including pH, total soluble solids (TSS), titratable acidity (TA), and antioxidant capacity, were measured at set intervals, with all data collected in triplicate for accuracy.

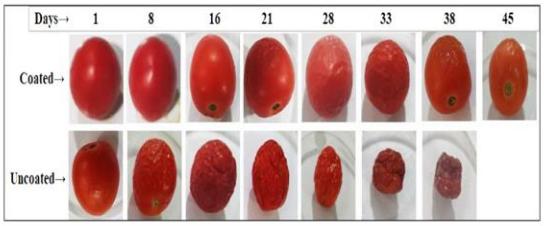

Fig.1 Comparative images of Sericin-based edible coating tomatoes with and without coating (Tarangini *et al*., 2022).

CONCLUSION

Sericin-based edible coatings effectively prolong the shelf-life of tomatoes while preserving their quality and safety. The study highlights sericin's dual benefits: reducing food waste and providing a biodegradable alternative to synthetic coatings. By incorporating sericin, the silk industry can mitigate waste and generate additional revenue, contributing to a circular economy. The promising results of this research advocate for broader adoption of natural coatings in food preservation, aligning with consumer trends toward sustainable and safe food products. Future research should focus on optimizing coating formulations and exploring their applications in other perishable fruits and vegetables.

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