



## Review

# Revolutionizing tropical fruits preservation: Emerging edible coating technologies

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## ABSTRACT

Tropical fruits, predominantly cultivated in Southeast Asia, are esteemed for their nutritional richness, distinctive taste, aroma, and visual appeal when consumed fresh. However, postharvest challenges have led to substantial global wastage, nearly 50 %. The advent of edible biopolymeric nanoparticles presents a novel solution to preserve the fruits' overall freshness. These nanoparticles, being edible, readily available, biodegradable, antimicrobial, antioxidant, Generally Recognized As Safe (GRAS), and non-toxic, are commonly prepared via ionic gelation owing to the method's physical crosslinking, simplicity, and affordability. The resulting biopolymeric nanoparticles, with or without additives, can be employed in basic formulations or as composite blends with other materials. This study aims to review the capabilities of biopolymeric nanoparticles in enhancing the physical and sensory aspects of tropical fruits, inhibiting microbial growth, and prolonging shelf life. Material selection for formulation is crucial, considering coating materials, the fruit's epidermal properties, internal and external factors. A variety of application techniques are covered such as spraying, and layer-by-layer among others, including their advantages, and disadvantages. Finally, the study addresses safety measures, legislation, current challenges, and industrial perspectives concerning fruit edible coating films.

## 1. Introduction

The importance of tropical fruits in human nutrition and their role in ensuring food security and sustainability is indisputable [1]. Furthermore, their substantial impact on the global market, driving economic growth and income, particularly in developing countries, has been consistently demonstrated over decades [2,3]. Southeast Asia is identified as the origin and primary producer of numerous cultivated tropical fruits [4], while Central America and the Caribbean emerge as key players in the global export volumes of major tropical fruits (2013–2022) [5]. Trade in fresh tropical fruits reached 7.1 million tonnes in 2018, surging to approximately 8.3 million tonnes in 2022, with further increments projected for the future [5]. The distinction between 'major' and 'minor' tropical fruits delineates their dominance in the global trade market. Major tropical fruits encompass mango (*Mangifera indica*), pineapple (*Ananas comosus*), papaya (*Carica papaya*),

avocado (*Persea americana*), and bananas/plantains (*Musa*). On the other hand, minor tropical fruits include lychee (*Litchi chinensis*), durian (*Durio*), longan (*Dimorcarpus longan*), guava (*Psidium guajava*), mango-steen (*Garcinia mangostana*), rambutan (*Nephellium lappaceum*), and passion fruits (*Passiflora edulis*) [3]. With increasing demand for tropical fruits, consuming them in their fresh state is paramount. The significance of consuming fresh tropical fruits has been underscored by [6] including nutritional benefits, medicinal value, and sources of antioxidants against malnutrition infections including cancer, cardiac arrest, and aging effects.

However, the freshness of fruits is attributed to their high moisture content as illustrated in Table 1 [10], rendering them susceptible to physical damage, microbial activities, and decay during a relatively short storage life [11]. Fruit deterioration across the supply chain, encompassing harvest, handling, storage, and distribution for direct consumption or industrial processing, poses a substantial threat to food

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