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# Effect of Opuntia ficus-indica Mucilage Edible Coating on Quality, Nutraceutical, and Sensorial Parameters of Minimally Processed Cactus Pear Fruits

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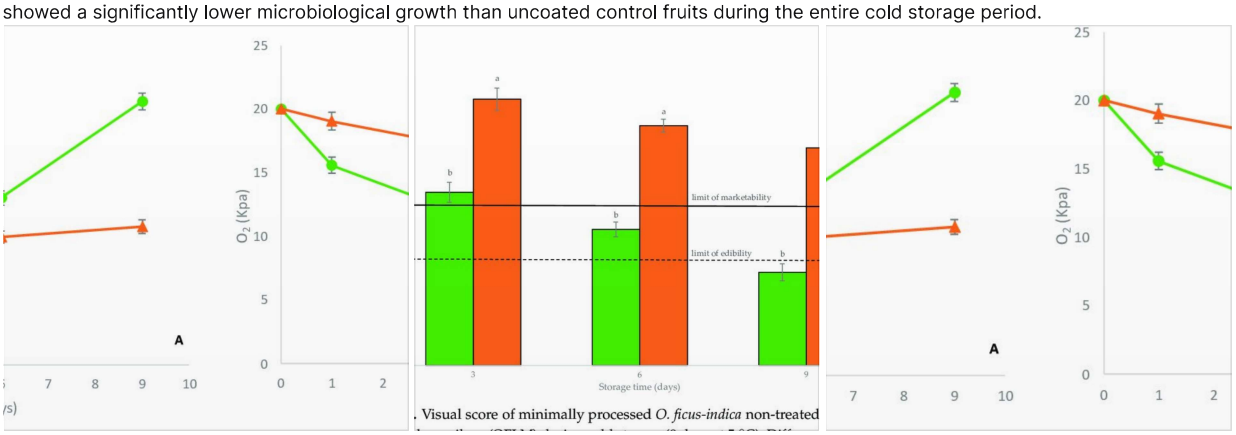
## Abstract and figures

Cactus pear (Opuntia ficus-indica (L.) Mill.) is a non-climacteric fruit with a relatively short postharvest life span, being very sensitive to water loss, darkening and decay. Cactus pear is a spiny fruit, and the presence of glochids limits fruit consumption and diffusion; therefore, minimally processing, as well as peel removing, could be an opportunity to improve its availability, consumption, and diffusion in national and international markets. In this study, cactus pear minimally processed fruits were treated with a mucilage-based coating extracted from Opuntia ficus-indica cladodes and stored at 5 °C for 9 days. The effect of mucilage edible coating on the postharvest life, qualitative attributes, and nutraceutical value of fruit were evaluated by colors, firmness, total soluble solids content, titratable acidity, ascorbic acid, betalains and DPPH (2,2-diphenyl-1-picrylhydrazyl). Results showed that mucilage-based coating improved the quality and preserves the nutraceutical value of minimally processed cactus pear fruits during storage. The edible coating was effective in maintaining fruit fresh weight, total soluble solids content, fruit firmness, ascorbic acid and betalain content, sensorial traits, and visual score. Coated fruits showed a significantly lower microbiological growth than uncoated control fruits during the entire cold storage period.




. Visual score of minimally processed *O. ficus-indica* non-treated

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# Effect of *Opuntia ficus-indica* Mucilage Edible Coating on Quality, Nutraceutical, and Sensorial Parameters of Minimally Processed Cactus Pear Fruits

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**Abstract:** Cactus pear (*Opuntia ficus-indica* (L.) Mill.) is a non-climacteric fruit with a relatively short postharvest life span, being very sensitive to water loss, darkening and decay. Cactus pear is a spiny fruit, and the presence of glochids limits fruit consumption and diffusion; therefore, minimally processing, as well as peel removing, could be an opportunity to improve its availability, consumption, and diffusion in national and international markets. In this study, cactus pear minimally processed fruits were treated with a mucilage-based coating extracted from *Opuntia ficus-indica* cladodes and stored at 5 °C for 9 days. The effect of mucilage edible coating on the postharvest life, qualitative attributes, and nutraceutical value of fruit were evaluated by colors, firmness, total soluble solids content, titratable acidity, ascorbic acid, betalains and DPPH (2,2-diphenyl-1-picrylhydrazyl). Results showed that mucilage-based coating improved the quality and preserves the nutraceutical value of minimally processed cactus pear fruits during storage. The edible coating was effective in maintaining fruit fresh weight, total soluble solids content, fruit firmness, ascorbic acid and betalain content, sensorial traits, and visual score. Coated fruits showed a significantly lower microbiological growth than uncoated control fruits during the entire cold storage period.

**Keywords:** cactus pear; fresh-cut; betalains; antioxidant activity; microbiological growth



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## 1. Introduction

Cactus pear (*Opuntia ficus-indica* (L.) Mill.) is cultivated for fruit production over 100,000 ha located in semi-arid areas in both hemispheres. Despite this large diffusion, cactus pear marketing is seasonal, and due to the poor post-harvest performances of the fruit, covers no more than two months in each ripening season of each cultivar [1].

In the last decades, there was an increasing interest in cactus pear fruits consumption, due to its nutritional and functional properties and its positive effects on human health [2,3]. Cactus pear is a spiny fruit, and the presence of glochids limits fruit consumption and diffusion in the international and local markets, especially in countries where cactus pear is not cultivated [1,4]. Therefore, minimally processing, such as peel removal of cactus pears fruits, could be an opportunity to improve its availability, consumption, and diffusion in national and international markets.

In recent years, the significant changes in human lifestyles produced an increase in the popularity of fresh-cut foods that are ready-to-eat; among them, the consumption of minimally processed fruit and vegetables has undergone a sharp increase and the interest of the industry in the production of fresh-cut cactus pears has led to a significant increase in per capita consumption, but its market volume still accounts for a small percentage of the total production [5]. Cactus pear is a non-climacteric fruit with a relatively short

postharvest life span; being very sensitive to water loss, darkening and, decay; fresh fruits are also very sensitive to chilling injury [6].

The postharvest life of peeled cactus pear fruits is quite short, due to the processing operations that alter fruit integrity and cause the release of intracellular enzymes, which trigger a series of biological events leading to metabolic dysfunctions, microbial proliferation, tissue browning, off-flavor development, texture breakdown and nutraceutical value loss [5].

Among new postharvest management strategies of environmentally friendly fresh fruit handling, the application of edible coatings has been reported to be very effective [7]. Edible coatings can act as a semipermeable barrier against gases and water vapor; can modify fruit tissue metabolism by affecting respiration rate, decreasing moisture and firmness loss, preserving the color, transporting antimicrobial, antioxidant, and other preservatives, controlling microbial growth, and maintaining fruit quality for a longer period [7,8]. Several studies reported that the applications of edible coatings improve quality, extended storage, and shelf life of various fruit such as papaya [9], kiwifruit [10], and strawberries [11]. Del Nobile et al. [12] showed that cactus pear fruits immersion into either agar or fish protein strongly reduced the shelf life, most probably due to water migration from the surrounding hydrogel to the fresh-cut produce. On the contrary, alginate coating prolonged the shelf life of minimally processed cactus pear fruits to about 13 days.

A novel edible coating for fruit storage developed using the mucilage extracted from cladodes of *Opuntia ficus-indica* was recently investigated on kiwifruit slices [10], breba fig [13], strawberry [7,14], banana [15], and mandarin [16].

Those studies reported that *O. ficus-indica* edible coating positively affects fruit quality, reducing water transpiration and browning, maintaining fruit fresh weight, visual score values, fruit firmness, nutraceutical attributes, and controlling microbial growth, resulting in a longer storage period.

*O. ficus-indica* mucilage is a complex carbohydrate mixture composed of variable amounts of L-arabinose, D-galactose, L-rhamnose, and D-xylose, as well as galacturonic acid, which is a potential ingredient for the food industry, due to its nutritional and technological properties, such as viscosity [17]. Mucilage is, in fact, a hydrocolloid with a great water retention capacity. O.*ficus-indica* mucilage also containing amounts of polyphenols could be an interesting natural edible coating with a high nutraceutical value, useful for fruit and food preservation [7].

Despite the positive effect of *Opuntia ficus-indica* mucilage-based coating on postharvest life of several fruits, there is a lack of knowledge on the impact that this coating treatment may have on the overall qualitative, sensorial, and nutraceutical value of minimally processed cactus pear fruits during cold storage. Therefore, the aim of the present study was to evaluate the effect of the application of *O. ficus-indica* mucilage, as an edible coating, on pomological, physiochemical, sensorial, and nutraceutical parameters, and microbial growth of minimally processed cactus pear fruits during cold storage at 5 ± 0.5 °C and 90% RH.

## 2. Materials and Methods

### *2.1. Cactus Pear Fruit Samples*

Cactus pear fruits were collected from 10-year-old *Opuntia ficus-indica* plants, cv. Gialla, spaced 6 × 5 m apart and trained to a globe shape. The commercial orchard was located in Roccapalumba, Palermo, Italy (37°48′ N, 13°38′ E, 350 m a.s.l) on sandy-loam Mediterranean red-soils. Plants were subjected to ordinary horticultural care, and the orchard was drip-irrigated. Cactus pear fruits were harvested in mid-October at commercial maturity, which was based on breakage peel color (green–yellow) and were quickly moved to the nearby laboratory.

After harvest, fruits were promptly sorted for homogenous size and no defects. Cactus pear selected fruits were then washed in tap water, sanitized by immersion in 200 mg $kg^{-1}$