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# Advanced edible coatings for enhanced post-harvest preservation of climacteric fruits

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**Abstract**
Climacteric fruits are the one which continue to emit ethylene with increased rate of respiration even after harvesting. This natural phenomenon affects the post-harvest life of these fruits as continuation of respiration is highly destructive process for storage of fruits. Hence climacteric fruits are highly putrescible in nature and despite of multiple recommendations of post-harvest storage temperature combinations for prolonging shelf-life, prevalence of storage disorders or other post-harvest losses are pretty high, which make it a candidate for other storage strategies among which edible coating seems a feasible option. Though vast investment of research has also been done on plastic packaging like LDPE, HDPE and shrink film techniques which are effective, but also has an adverse effect on planet due to its non-biodegradability. Minimizing these losses and enhancing the durability of their produce in an eco-friendly way is primary goals for farmers as well as researchers.

**Keywords:** Climacteric fruits, ethylene emission, respiration, edible coating, post-harvest losses

## Introduction
Fruit are the banks of vitamins and minerals which are proven to be great dietary supplements when taken in recommended portions. Higher maintenance costs for preservation in cold stores and other post-harvest preservation practices due to lesser shelf-life adds more to the cost of fruit market; cost-efficient and sustainable preservation of fruits is a pre-requisite to affordable and quality produce to meet the nutritional requirement of Indian population. In this article we will be discussing present scenario of plum production and advanced practices to keep the quality of climacteric fruits for longer period of time. India is a bowl of diverse fruits and export earnings from fruit production brings a major part of revenue to the country, which was 48.33 lakhs in 2020-2021 from export of fresh fruits (APEDA, 2021). Due to higher production of ethylene and quick change in physico-chemical properties leaves them more liable to damage and less durability.
Usage of films and coatings can replace conventional packaging which is a feasible as well as eco-friendly method for prolonging shelf-life of the product (Khalil, H.P.S.A. *et al*.). In this review article effectiveness of different edible coatings for prolonging shelf-life of produce will be discussed.

## Outcomes of different coatings
### Salicylic acid
**Plum:** A study on the outcomes of using salicylic acid for improving shelf-life of plum cv. ‘Santa Rosa’ was conducted. They soaked the produce in different concentrations of salicylic acid (1, 2, 3 and 4 mmol/L) for 5 min and distilled water soaking was done for 5 min as a control to the treatment. Treated fruits were stored at 4 °C and 95% relative humidity (RH) for 25 days. Among different concentrations 4 mmol/L salicylic acid influenced the physical quality parameters with least percentage of weight loss, highest firmness. Chemical properties of the cultivar were also influences as increase in TSS was recorded salicylic acid treated fruits during the storage period which may be the outcome of low levels of the respiration rate, ethylene production and delay in ripening process. The data indicated that the content of titratable acidity decreased significantly during storage at 4 °C. Also, the results obtained for pH value detected a significant increase during storage at 4 °C, but increase in pH was comparatively less at 4mmol/L salicylic acid than other treatments over

the storage period of 25 days. The betterment of physico-chemical health of fruits is an indicative of tendency of salicylic acid to prolong the shelf-life of plum. (Davarynejad *et al*. 2015) [28].

**Banana**

Srivastva and Dwivedi (2000) [32] observed the effect of salicylic acid on banana ripening and other quality attributes. They recorded a decrease in pulp: peel ratio, softening of fruit, reducing sugar content and respiration with application of salicylic acid. Along with this, reduction in activity of major cell wall degrading enzymes, viz. cellulase, xylanase and polygalacturonase was found when applied with salicylic acid.

**Putrescine**

**Sweet cherry:** Putrescine was applied exogeneously to sweet cherry fruit, cultivar "Surati-e-Hamedan" at different concentrations of 0.5, 1, 2, 3 and 4 mM and distilled water as a Control treatment for period of 10 minutes and is stored at 2 °C. Bio-chemical analysis was carried out at an interval of 5 days upto 25 days. Various parameters associated with ripening processes, which includes ethylene production, tissue softening and loss in acidity, significantly decreased by application of putrescine. However, an increase in Soluble solids content was recorded by the application of putrescine. While no effect was noticed on pH of fruit juice (Khosroshahi *et al*., 2008) [31].

**Plum:** An experiment was conducted using putrescine dip as a component for improving shelf-life of plum cv. 'Santa Rosa'. The produce was soaked in different concentrations of putrescine (1, 2, 3 and 4 mmol/L) for 5 min and distilled water was taken as control treatment by soaking produce in it for 5 min. Treated fruits were stored at 4 °C and 95% relative humidity (RH) for 25 days. Among different concentrations 4 mmol/L putrecine showed the least percentage of weight loss, highest firmness and delay in ripening process. The betterment of physico-chemical health of fruits with application of this coating is an indicative of tendency of Putrescine to retain the quality attributes of fruit for prolonged period of time when stored at 4 °C. (Davarynejad *et al*. 2015) [28].

**Peach**

Three different polyamines putrescine (10 m*M*) and spermine (2 m*M*) were used at single concentrations only whereas spermidine was used at three different concentrations (0.1, 1 and 5 m*M*). on peach (*Prunus persica*) cv. Redhaven. Treatments were performed 20 days before harvesting of fruits. Great reduction in amout of ethylene emission in the final days of fruit growth were recorded. At harvest ethylene from polyamine-treated fruits was from almost 3-(spermine) to 30-fold (5 mM spermidine) lower than controls and negligible with 1 mM spermidine.

Fruit growth (diameter, fresh and dry weight), flesh firmness, soluble solids content and ethylene emission were determined on treated and untreated (controls) fruits. Moreover, endogenous polyamine content and S-adenosylmethionine decarboxylase (SAMDC, EC 4.1.1.21) ctivity were determined to check for a possible competition between polyamines and ethylene for their common precursor S-adenosylmethionine (SAM). Both treatments strongly inhibited ethylene emission and delayed flesh softening. On a biochemical level, AVG and exogenous polyamines both reduced the free-to-conjugate ratio of endogenous polyamines, and transiently altered SAMDC activity. The possible use of these compounds to control fruit ripening is discussed also in the light of their rejuvenating effect on peach fruits.

Climacteric Fruits: Features

Fruit

Climacteric Behavior

Ethylene Production (μL/kg·h)

Banana

High

150-300

Mango

High

100-250

Papaya

Moderate

60-120

Tomato

High

50-100

**Climacteric Peak:** The sudden increase in respiration rate that occurs after harvest.

**Ethylene sensitivity: Influences ripening and softening.**

Post-Harvest Challenges

Quick softening and decomposing

Greater susceptibility to attack by microorganisms

Water loss and shriveling Loss of marketable value

**Bar Figure:** Efficacy of the Post-harvest Techologes on Shelf-life of Mango

Preservation Method

Average Shelf Life (Days)

Room Temperature 5 Cold Storage 12 Controlled Atmosphere 18 1-MCP Treatment 20

Edible Coating 15

Conclusion

Climacteric fruits deteriorate rapidly postharvest, which can be effectively controlled by engines preservation. Of all the choices, 1-MCP and controlled atmosphere storage demonstrate the greatest shelf-life extension. Combining methods may provide synergistic advantage for use on a grand scale.

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