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The Advantage of Surface Coating in Custard Apple

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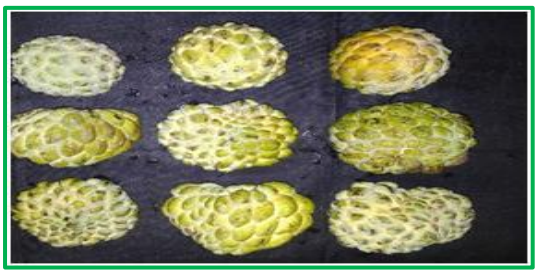
Custard apple (*Annona squamosa* L.) belongs to family Annonaceae. It is native to tropical America. It is known by several vernacular names such as Sugar apple, Sweet soap, Sitaphal and *Sharifa* in different parts of the country. Custard apple thrives well in tropical and warmer sub tropics parts of India. It is cultivated mainly in Maharashtra, Andhra Pradesh, Madhya Pradesh, Bihar, Assam and Orissa. Custard apple is one of the widely found perishable crop of forest areas. Rajasthan is one of the top ten custard apple growing states in our country. Its commercial cultivation is gaining popularity now a day in Rajasthan. In India, total area under custard apple was 44 thousand hectares which led to production of 367 thousand MT.

Custard apple is generally used as table fruit, known for its pleasant distinctive texture of pulp, sub acid and aromatic flavor. Unripe fruits are directly baked on fire and eaten. The fruit pulp is used in preparation of drinks, ice-creams, confectionery, beverages and certain milk products (Paull, 1982). The pulp contains 73.3 per cent moisture, 1.6 per cent protein, 0.3 per cent fat, 0.7 per cent mineral matter and 23.9 per cent carbohydrates. Its calorific value ranges from 822 to 1050 k cal. per kg as compared to 741 k cal. in mango. It is rich in carbohydrates (glucose about 15%) and provide good amount of proteins and minerals like calcium, phosphorus and iron.

Custard apple being highly climacteric in nature, it starts deteriorating rapidly. The shelf life of the ripen fruits is hardly 3-4 days at room temperature. Fruits surface changes its colour form light greenish to blackish due to oxidation and certain injuries. Therefore, a proper storage and postharvest management practice is at most need to prolong the shelf life. Certain attempts have been made to preserve its quality and shelf life. Among them, use of hormones, use of post-harvest fungicides, cold storages, pulp processing, edible coatings, etc, as attempted by several researchers (Gohlani and Bisen, 2012).

Coatings in Custard Apple

Sago Wax



Carnauba Wax

Fruit coatings are one such alternative as they improve not only the external appearance, but also modify the internal fruits atmosphere (Saftner, 1999). It is a comparatively newer post-harvest treatment technique for fruits and vegetables to improve shelf life due to its simple advantages that has practically replaced old commercial post- harvest methods. Use of coatings has gained importance in reducing the moisture loss and maintaining firmness. Coatings make good oxygen and lipid barriers at low to intermediate relative humidity, because the polymers can effectively make hydrogen bonds.

According to Yaman and Bayoindiri (2002) studied the impact of edible coating on cherries. Their study suggested that this coating reduce weight loss and increase firmness, ascorbic acid content, titratable acidity and skin color of cherries. It also prolonged the shelf life of cherries. In past couple of years, use of edible coating was gained popularity worldwide owing to their eco-friendly, safe and degradable nature. These coatings materials are based on polysaccharide, fat and proteins. Starch based materials and waxes are found to be best barrier against transpiration loss. Custard apple is highly perishable; thus fruit surface coating is one such alternative which can enhance glossiness and prolong the shelf life. Edible coatings are an environmental friendly technology that is applied on many products to control moisture transfer, gas exchange or oxidation processes. Edible coatings can provide an additional protective coating to produce and can also give the same effect as modified atmosphere storage in modifying internal gas composition. One major advantage of using edible films and coatings is that several active ingredients can be incorporated into the polymer matrix and consumed with the food, thus enhancing safety or even nutritional and sensory attributes. Edible coating, a new strategy to extend of shelf life and improve food quality. They can provide a selective barrier to moisture, oxygen and carbon dioxides gas transfer, which slows ripening, reduces moisture loss and helps to maintain fresh aroma and flavour.

Different Coatings

Sago Coating: Sago starch is commonly used as a functional ingredient in food industries such as a thickener, stabilizer and gelling agent. To increase starch added value is to make modifications starch to obtain properties suitable for a particular application and it is one of the naturally abundant polysaccharides which easily decomposed and easily obtained with a relatively low prize. In general, starch coatings show a good gas barrier characteristic and well-attached on the surface of the fruit and vegetables. However, due to their hydrophilic nature, they have low water-resistance which influences its stability and mechanic characteristic. Sago starch has great potential to be explored in the development of edible coatings. In addition, the high amylose composition of sago starch that is 27 per cent has potential as a strong film-forming material. Sago coating reduce growth of microorganisms and coating provides semi permeable barrier against oxygen, carbon dioxide, moisture and volatiles. Various studies indicated that coating the fruits with the highest percentage of sago starch has the potential to maintain fruit qualities by retarding the moisture loss, retaining fruit firmness and delaying the color and biochemical changes effectively. As reported by Wong *et al.* 2014 in prolonging the shelf life of Chok Anan mangoes.

Carnauba Wax: The carnauba tree is a fan palm of the north eastern Brazilian savannas, where it is called the ‘tree of life’ for its many useful products. After 50 years, the tree can attain a height of over 14 meters (45 feet). It has a dense, large crown of round, light green leaves. Wax obtained from carnauba tree i.e., carnauba wax, which is the exudates of Brazilian palm tree leaves (*Copernica cerifera*) has a very high melting point and is used as an additive to other waxes to increase toughness and luster (Hernandez, 1991). Carnauba wax application improves appearance and controlsfruit transpiration rate, which reduces weight loss and maintains firmness with consequent increase in fruits shelf-life (Hagenmaier and

Baker, 1994). Carnauba wax has been a good alternative for improving fruit storability. It is considered a GRAS (Generally Recognized as Safe) (FDA, 2014) substance and emulsions have been used for coating fresh fruits and vegetables since the 1950s. The optimal concentration of carnauba wax used for coating depends on the food, considering its own organoleptic, physical and composition characteristics. Generally, its use in the food area is extensive and numerous studies attest to its application in different products (Goncalves *et al*. 2010). The fruits coated with carnauba wax shows different respiration behavior as compared to uncoated fruits, which suggest that coating treatments can reduce weight loss, maintain firmness and slow down physicochemical changes inside the fruits related to ripening process. It can also protect the fruits from bruising and maintains the appearance of the fruit. Combination of carnauba and polyethylene wax brought the best preservation compared to other selected supplemental components (Lam *et al.* 2009).

Leaf Extracts of Custard Apple: Custard apple leaf extract is used as coating to increase antimicrobial properties which maintain the fruit quality and shelf life of fruit and reduce the fruit shrinkage. Leaf extracts possess many secondary metabolites which enhance defense system and also reduce the microbial activities from the fruit surface during storage. Guava leaf extracts, papaya leaf extracts, custard apple leaf extracts etc. are commercially using as supplement material in coating formulation to enhance efficacy of coating materials.

Bautista-Banos *et al.* (2000) reported that among 19 different botanical species tested, the aqueous leaf extracts of custard apple (*Annona reticulata* L.) and papaya (*Carica papaya* L.) among others, inhibited germination and spore formation of *R. stolonifer*. Same conidial inhibition was observed when *C. gloeosporioides* was grown on these two extracts. *Fusarium oxysporum, Penicillium digitatum* and *Rhizopus stolonifer* are important postharvest fungi causing severe diseases during storage of fruits and vegetables (Snowdon, 1990). Hence custard leaf extract plays important role in inhibiting the fungi growth during storage period.

Benefits of Waxing in Custard Apple

Enhanced Appearance: Waxing gives custard apples, a shiny, attractive appearance, making them more visually appealing to consumers.

Extended Shelf life: The wax coating helps preserve the fruits freshness by reducing moisture loss and slowing down the ripening process, thereby extending its shelf life.

Protection: The wax layer acts as a barrier against external factors such as bacteria, fungi, and physical damage, thus protecting the fruit during transportation and storage.

Maintained Quality: Waxing helps maintain the fruits texture, flavour and nutritional content by minimizing dehydration and preventing bruising or spoilage.

Marketability: Waxing enhances the marketability of custard apples by giving them a polished look, which can attract more customers and potentially increase sales.

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