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Use of several edible natural coatings on kinnow (*Citrus reticulata* Blanco) fruit

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Abstract
Fruit coating is an effective method in the post-harvest industry to replace the natural wax that is removed during cleaning and processing. Recently, there has been a growing interest in using natural edible coatings instead of non-prescription synthetic waxes for human health and the environment. Today consumers prefer natural products to synthetic ones. Therefore, natural fruit coatings are developed from natural ingredients (Sherak, rosin, gum Arabic, sugar industry water, ethanol) without the use of ammonia or morpholine as an alternative to synthetic coatings. Many studies have shown that fruit coatings significantly slow down changes in weight, hardness, ascorbic acid, and overall physiological loss of sensory quality during storage compared to uncoated fruits. On the other hand, this has led to a positive method, showing small variations in total soluble solids and fruit. Acidity was recorded for all treatments. Furthermore, the difference between natural and synthetic fruit coatings was not important. Therefore, natural fruit coatings are assumed to be a great alternative to synthetic fruit coatings.

Keywords: Kinnow, natural edible coatings, shelf life, post harvest

Introduction
Citrus fruits belonging to the Rutaceae family Cultivated on the globe from 30 million years ago (Liu, Heying and Tanumihardjo, 2012) [16]. Nippur in Mesopotamia originates from the cultivation of citrus fruits (Anitei *et al*., 2007). Loose oranges belonging to the species Citrus reticulata Blanco are commonly called mandarins (Niaz *et al*., 2004). Citrus fruits are widely grown around the world with arable land and production increased sharply from the last decade. According to (FAO 2012) [11], Brazil is the largest producer of citrus fruits in the world, followed by China and the United States, India, and Pakistan that place. Position. In India, 95% of its cultivated area is in Punjab due to favorable temperatures and environmental conditions.

Kinnow is a vital fruit in Punjab, occupying an area of 22 thousand hectares with a production of 3.4 lakh metric tonnes (Gautham Mandal *et al*., 2015) [17] The area devoted to kinnow is increasing due to the very high economic returns of producers. It ripens from December to February, but the severe cold and foggy weather that prevails in northern India during the peak harvest season suppresses the demand for fresh fruit, leading to oversaturation, lower prices, and post-harvest losses. To promote the film collection, producers in the region often practice “tree storage” until mid-March, which allows products to be sold out of season. Kinnow has a very short shelf life, 5-7 days under environmental conditions, and is commercially stored in a cold room by marketers for off-season marketing who develop damage from low-temperature cooling. It is essential to develop an appropriate post-harvest treatment to prolong the life of room storage. Varnish wax is an organic plant-derived product, which was developed by the Indian Institute of Natural Resins and Crowns, Ranchi for use in fruits and vegetables. Citrashine uses commercial citrus wax to improve the storage and individual shrinkage of fruit with plastic wrap, reduce moisture loss, change the surrounding atmosphere can reduce the rate of respiration due to the low content of oxygen in the packaging, and increase the shelf life of fruit shelf life. Therefore, the present review is to know the effect of different edible natural post-harvest treatments and conditioning on the storage time and less infestence microbial effect on Kinnow. (Gautham Mandal *et al*., 2015) [17].

The collected kinnows are generally transported to the packer to begin the stages of preparing the fruit for marketing; washing, coating, sorting, packaging, storage, and transport (Naseer *et al*., 2010) [20]. During the fruit washing process, most of the natural wax present on the fruit peel is removed. It is essential to replace natural waxes with different covering materials. There are several types of citrus wax formulations available (Boonyakiat *et al*., 2012) [5]. Entire fruit coating for application on kinnow mandarins (PARB *et al*., 2013) [22], which is fully synthetic (mainly based on polyethylene which is a petroleum by-product). But consumer trends are shifting towards more natural products, and petroleum-based waxes, such as polyethylene and paraffin, are becoming increasingly unpopular and limited in use (Hernandez E *et al*., 1994) [15]. Edible coatings based on natural waxes, resins, and polysaccharides are environmentally friendly packaging because they are biodegradable, they can be consumed with the packaged product and the main ingredients are produced from renewable resources, unlike paraffin, oil. Mineral oil, oxidized polyethylene, and plastic, which are produced from a limited supply of fossil fuels (Baldwin *et al*., 1994) [15]. Ammonia is also often used in these synthetic coatings for fresh fruit, but it has some drawbacks. Ammonia-based microemulsions are difficult to prepare because ammonia is very volatile and its vapors are unpleasant, toxic and can cause false alarms in packaging rooms that use its odor to warn that an ammonia-based leak (Hagenmaier *et al*., 2004) [13] In view of the growing interest in healthier, safer, more natural and more environmentally friendly products, natural coatings have been developed in recent years to avoid the use of synthetic waxes (FreshPlaza *et al*., 2013) [12]. The acceptability of consumer products should be at the center of research on edible coatings (Olivas *et al*., 2008). Considering the need for time, PostHarvest Research Center (PHRC), Faisalabad, developed a natural fruit coating (NFC) of natural, ammonia-free ingredients as an alternative to synthetic fruit coating (based on oxidized polyethylene and containing ammonia). Therefore, the present study aimed to compare the effects of newly developed NFC with those of synthetic NFC on the quality of kinnow mandarin (Citrus reticulata Blanco) stored at low temperatures.

Consumers around the world are in high demand for fresh and processed oranges. (Chien & Chou, 2006; Chien, Sheu, & Lin, 2007; Contreras-Oliva, Rojas-Argudo, & Perez-Gago, 2011, 2012) [6, 7, 8, 9]. However, it is well thought- a perishable good and poses many obstacles to its stability. Deterioration of mandarin after harvest is due to the frequency of pathogens Pancillium (green and blue mold) (Valencia-Chamorro *et al*., 2009, 2010) [26]. To improve shelf-life, different techniques are used. Most used techniques in trade are low-temperature storage, polyethylene packaging, and emulsion applications such as wax and chitosan coatings (Navarro-Tarazaga *et al*., 2007, 2008 Thakur, Kaushal and Sharma *et al*., 2002) [21, 25] Its disadvantages as the cold room is costlier, the application of wax (shellac and polyethylene) can lead to peeling, cold injuries, deformation and breakage of the coating (Dou, 2002 *et al*., 2002) [10] and also have high levels of internal volatiles (Porat *et al*., 2004) [23] Shellac requires ammonia as a solvent chitosan has a vegetative origin, as it comes from the exoskeleton of crustaceans.

(Ahmadi *et al*., 2012; Banasaz *et al*., 2013) [1, 4] On the other hand, Herbal waxings are edible, plant-based, and naturally degradable. Psyllium seeds and shells contain polysaccharides that can be used to make new fruit and vegetable edible coatings (Dhar *et al*., 2005). Plantagoovata is a short-lived annual herb grown mainly in India with more than 200 diverse species internationally Psyllium mucus contains a gel-forming fraction and most of it contains highly branched arabinoxylan, Inspired by modern trends in safe, healthy food and environmentally friendly production in the food industry, current research focuses on creating a new and unique psyllium polysaccharide film/coating. His building. The second goal was to introduce methanol garlic extracts into the film as an antimicrobial agent.

(Haffez-ur Rehman *et al*., 2015) In the present scientific study, garlic methanol extract was included in an edible food coating made from psyllium grown locally for the use of kinnow mandarins. Various concentrations of the extract were applied to the coating and the quality of the fruit was checked during storage at room temperature. Results indicated that the slightest change (growth) in storage studies was in Brix, weight loss, Brix / acid ratio, pH, and fetal acidity. The fungal contamination was effectively controlled by 6-8% due to the introduction of garlic extracts. Based on these results, it was concluded that garlic extracts can be used in psyllium-based foods and have significant antifungal potential, but at a relatively higher concentration (> 6%). Psyllium-based food coatings were formed using the method of (Azarakhsh 2014) [3] and others. With some modifications. The coating contains psyllium polysaccharide powder (1.29%), glycerin (1.16%), and a solution of calcium chloride (1% ascorbic acid and 1% citric acid) to 2.0%. Different concentrations of garlic extract (0%, 2%, 4%, 6% and 8%) were then applied to the coating. The ingredients for the coating are dissolved in a hot dish, heating to 65 °C, stirring constantly

(Muhamad. A. Ali *et al*., 2015) This study allows the effects of the natural coating of newly formed fruits (9% total solids) and synthetic effects (21% total solids polyethylene wax ammonia) to be compared to the subsequent quality of tangerine. It's done. Ground (Citrus reticulata Blanco). Mandarin roots are covered with a natural or synthetic fruit coating or left unbleached and stored at 5 □ 2 °C, 85-90% relative humidity for 63 days, after each treatment with 5 repetitions. To do. The results show that the coating of both fruits significantly reduces the weight, density, ascorbic acid, and physiological loss of overall sensory quality during storage compared to uncoated fruits, solids (p< 0.05). Total solubility and fruit acidity were observed at all treatments that were shown to be delayed. Besides, the difference between natural and synthetic fruit layers was not significant (p> 0.05). Therefore, natural fruit coverings can be assumed to be a good alternative to synthetic fruit coverings.

(Sara Riaz *et al*., 2018) [20] Fruits and vegetables, along with other physiological factors, are exposed to post-harvest losses due to their high water content. Among the various means of controlling leaks, the development of edible coatings is an essential and innovative technique for achieving the desired goals. Xerophyte, opuntia cactus a prickly pear, contains a significant amount of polysaccharides and can be used to form edible coatings. The mission of this study was to extract polysaccharides from a cactus to develop edible coatings for potential use in citrus. To this end, we have developed edible coatings using different concentrations of extracted cactus polysaccharides. These coatings are applied to citrus fruits (Kinnow mandarin) and stored for 35 days. The results show that the maximum water content is observed at T3 (2% cactus polysaccharide), i.e. 86.94 ± 2.10%. The maximum pH of coated citrus fruit was found to be 3.19 ± 0.02% for T1 (3.19% cactus polysaccharide). In conclusion, as demand for fresh fruits and vegetables increases due to public awareness, edible coatings with cactus polysaccharides play a significant role in extending shelf life while maintaining the quality of various products

Method of Natural fruit coatings preparation

(Muhamad.A. Ali and Adnan Zulfikar 2015) NFC was prepared by a simple atmospheric method using the following components: Chelac (2 percent), rosin (2 percent), gum acacia (1 percent), sodium hydroxide (2 percent), castor oil (1.5 percent), ethanol (26 percent), Palsgaard® emulsifier (0, 5 percent) and Distilled water (65 percent). The total solids content of the final formulation was 9 percent. NFC was prepared as follows. Sodium hydroxide was added to distilled water to make it alkaline. 70 percent (26 percent) of total ethanol was added to this alkaline water. Next, this alkaline water was divided into three equal parts. Shellac, rosin, and acacia gums were added separately to each serving of this alkaline water. After dissolving each component separately, they were combined to make an alkaline mixture. After heating castor oil to about 75 deg C, Palsgaard® emulsifier was added. The remaining 30 percent of the formulation was added to the emulsified oil with ethanol and then to the alkaline mixture. Gentle mixing was performed throughout the mixing process to ensure the uniformity of the mixture. The regulatory status of the various ingredients in the final formulation revealed that this NFC showed slight differences from Fomesa in all the physical, biochemical, and sensory parameters tested. It has the added benefit of being Fomesa's naturally free ammonia, which contains ammonia in synthesis. It has the potential to be an excellent alternative to Fomesa in terms of safety when harvesting tangerine after use. It can safely be a good alternative of Fomesa for postharvest application on kinnow mandarins. (Haffez-ur Rehman *et al*., 2015) Garlic extract: Peeled garlic (200 g) and 500 ml of methanol were mixed for 2 minutes and left for 24 hours in a stirring chamber/incubator at 25 deg C @120 rpm. The extract was concentrated on a rotary evaporator at 50 ° C for further use to reduce fungal activity on fruit (Syed Wasim Ahmad Shah *et al*., 2015) The effect of a guagam-based coating containing carboxymethyl cellulose (CMC) and silver nanoparticles on the stability of mandarin after harvest (Citrus reticulata cv. Blanco) at 4 ° C and 120 days at 10 ° C (relative humidity 85% -90%). Physicochemical and microbiological quality is monitored after storage every 15 days. Overall results revealed increased total soluble solids (TSS), total sugar, decreased sugar, and weight loss, but this increase was relatively negligible for coated fruits stored at 4 ° C. Ascorbic acid, total phenol, and antioxidant activity were significantly improved with the coating Fruits stored at 4 ° C. Except coated kinnow stored at 4 ° C, the acidity that can be titrated during storage is significantly reduced. No high-intensity fruit rot or cold was observed in the control sample stored at 10 ° C. All aerobic psychotropic bacteria and yeasts and molds were detected in all treatments during storage, but growth was not significant in fruits coated with 4 deg centigrade. (Syed Wasim Ahmad Shah *et al*., 2015) Two new coatings have been identified that improve the shelf life of fresh kinnow fruit. The results showed that CMC-Ag and guar-gum-Ag coatings are best used to control dehydration and slow microbial growth of kinnow. The antibacterial properties of CMC-Ag and guar-gum-Ag coatings are also shown in the results obtained. Experimental results show that when used in combination with a silver coating of nanoparticles in combination with cryopreservation (4 C), excellent preservation of kinnow mandarin is maintained when compared to 60 days of coated kinnow preserved at 10 deg centigrade. It was shown that the shelf life is extends by about 120 days. This study may be an effective strategy to improve ascorbic acid, total phenol, and antioxidant activity by combining CMC and silver nanoparticle coatings based on guagam with cold storage (4 deg C). This suggests that there is. Further metabolic assessment studies should be undertaken to provide detailed metabolic images to understand the mechanism of action of CMC-Ag and guar-guar-Ag coatings on cellular responses during cryopreservation.

(Goutam Mandal *et al*., 2015) [17] An experiment was conducted to study the effect of different post-harvest treatments on the storage life of late-harvested kinnow under ambient conditions. Uniform and healthy fruits were harvested in the middle of March in 2009. The fruits were washed and treated with lac-wax, citrashine, and individually shrink wrapped in LDPE (19μ) and packed in 4 kg CFB boxes and stored under ambient conditions. During storage of kinnow, the physiological loss in weight was increased and firmness, TSS, and acidity found decreased continuously. Maximum PLW was observed in control, whereas, shrink-wrapped and lac-wax treated fruits effectively reduced PLW and maintained higher firmness and TSS up to 14 days under ambient conditions and remain moderately acceptable up to the 21 days of storage. The individually shrink-wrapped fruits showed a higher organoleptic score up to 21 days of storage. Results indicated that individually shrink-wrapped, lac-wax and citrashine coated fruits could be stored up to 21 days in ambient conditions without much loss of quality. However, control fruits developed shriveling and slight off-flavor after 14 days of storage.

Conclusion

Previous research has confirmed that wax coatings slow physicochemical changes and other metabolic activities in fruits during storage, which eventually slows physicochemical changes, including the sugar level in the juice. The application of various types of naturally produced edible coatings can effectively maintain the TSS levels of fruit, total sugars, and reducing sugars and fewer problems for fungi than synthetic chemicals and show a positive result for consumer health. The increase in TSS of fruit and sugars is mainly due to the higher degree of physiological alterations of the fruit, greater loss of water, and higher rates of respiration and transpiration during fruit storage. Vit. C content and acidity have been decreased during citrus storage, but the wax coatings retain their levels during cold storage.

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