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Influence of plant extract and edible coatings on quality of nectarine (*Prunus persica*) fruits

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ABSTRACT

A study was carried out on the influence of plant extract and edible coating on nectarine fruits during 2019–20 at ICAR-IARI, New Delhi. We attempted the use of different hydrocolloid-based coatings like carboxy methylcellulose (CMC) and chitosan (CH) alone and in combination with mixed plant extract (MPE) of moringa, eucalyptus and marigold on Snow Queen nectarine fruits. Fruits were coated with these coatings and stored at supermarket conditions (18 ± 2ºC and 85–90% RH) for 16 days. During storage, observations on weight loss, fruit firmness, quality attributes and sensory evaluation were recorded at 4 days interval. The results revealed that the weight loss (WL) and fruit firmness decreased with the increase in storage period, and fruits coated with layer-by-layer coatings of CMC-CH-MPE exhibited the highest lowest WL and highest fruit firmness at the end of storage. The total soluble solids (TSS) and ascorbic acid content increased up to some period, and then these attributes showed declining trend. In all, layer-by-layer coating of CMC-CH-MPE was the best treatment for reducing WL, maintaining fruit firmness and quality of Snow Queen up to 16 days of storage at supermarket conditions.

Key words: Carboxy methylcellulose, Chitosan, Fruit firmness, Supermarket conditions, Weight loss

Nectarine (*Prunus persica* var. *nucipersica*) is an important stone fruit, after peach and plum. It belongs to Rosaceae family, and is commonly called as a smooth-skinned peach.Nectarines are typical climacteric fruit with physiological ripening pattern which are highly perishable due to its succulent nature (Sharma and Krishna 2018). Hence, postharvest quality losses in nectarines are high predominantly due to metabolic changes, mechanical damage, and decay during storage. Thus, there is a need to develop methods for extending the shelf-life of nectarine, maintain its quality throughout the storage and extending its marketability. The methods used to extend shelf-life of fruits include, use of hot water treatment, irradiation, cold storage and edible coatings (Li and Yu 2000, Kumar *et al*. 2017).

Of these technologies, use of edible coatings appears to be a promising and safe method to extend shelf-life as well as quality of fruits. It is an environment-friendly technology that is applied on many fruits to control moisture loss, gas exchange or oxidation processes and also provides an additional protective covering to the commodity (Dhall 2012, Jhalegar *et al*. 2015, Kowalczyk *et al*. 2018). Furthermore, edible coatings besides acting as a protective layer on fruits, also impart shiny appearance thus attracts the consumer and improves the marketability of the produce (Dhall 2012, Kumar *et al*. 2017, Kumar *et al*. 2018). Although, several types of coatings have been developed but commonly used edible coatings are hydrocolloids carboxy methylcellulose, xanthan gum, gum Arabic, and carrageenan (Dhall 2012). Now-a-days advancement in the use of edible coatings is practiced by incorporating edible herbs, vitamins, antimicrobial compounds, nutrients, and antioxidant compounds. Use of plant extracts along with edible coatings is a new eco-friendly approach. Hence, we attempted to use hydrocolloid-based coatings alone and in combination with mixed plant extract (MPE) to study the efficacy on nectarine fruits stored under supermarket conditions.

MATERIALS AND METHODS

An experiment was conducted during 2019–20 at research farm of ICAR-IARI, New Delhi. For this, the fruits of commercially grown variety of nectarine, Snow Queen were procured from Regional Horticultural Research Station, Dr. Y. S. Parmar University of Horticulture and Forestry, Bajaura, Himanchal Pradesh. The nectarine fruits were manually harvested at commercial maturity stage, packed and transported to New Delhi. The details of treatments (edible coatings and plant extract) are as under: MPE alone (Mixed plant extract) of moringa, marigold and eucalyptus, chitosan (CH) alone, carboxy methylcellulose (CMC) alone, chitosan-MPE (Layer-by-layer), CM-MPE (Layer-by-layer), CMC-CH (Layer-by-layer), CMC-CH-MPE (Layer-by-layer) and control (Water dip).

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Preparation of edible coatings: The coating of chitosan (CH1%) was prepared by dissolving 10 g of chitosan in 900 ml of distilled water containing 10 ml of glacial acetic acid with the aid of magnetic stirrer and finally volume was made up to 1000 ml. The coating of carboxy methylcellulose (CMC 1.5%) was prepared by dissolving 15 g of CMC in mild hot distilled water and the volume was made up to 1000 ml.

Preparation of mixed plant extract: First, 10 g dried powder of each plant i.e. moringa, marigold, eucalyptus, was dissolved in 40 ml of methanol and filtered and volume was make up to 50 ml. Mixed plant extracts was prepared by mixing each methanolic plant extracts in equal proportion.

Coating of nectarine fruits: Nectarine fruits having similar colour, size and with absence of visual defects, were selected and randomly divided into 8 lots with 60 fruits in each lot, and coated with different plant extracts and edible coatings at room temperature for 10 min, dried under fan, placed in plastic trays which were finally kept at supermarket conditions (18 ± 2ºC, 85–90% RH) for 16 days. Layer-by-layer coating of fruits was carried out by dipping the fruits in one coating for 10 min, air-drying for15–20 min, dipping in another coating, air-drying for 15–20 min and finally storing in supermarket conditions as above. All the treatments were replicated thrice and each replication had 20 fruits. The control fruits were simply dipped in distilled water. Observations on different attributes were recorded at 4 day's interval. For observations, nectarines were removed randomly from each replication/treatment and analyzed for weight loss, firmness, soluble solid content, titratable acidity, ascorbic acid and sensory evaluation.

Determination of fruit firmness and weight loss (WL): Fruit firmness of treated and untreated nectarines was determined by using a texture analyzer (model: TA+Di, Stable micro systems, UK) using compression test and the results were expressed as Newton (N). Weight loss (WL) of Snow Queen nectarine fruits was determined by weighing the fruits on an electronic balance and values were reported as percent (%) of weight loss as:

$$(A - B)/A \times 100$$

where A, initial weight; B, final weight of the nectarine fruits.

Determination of fruit quality attributes: The quality attributes such as TSS, and ascorbic acid content of nectarine fruits stored at supermarket conditions were determined in two randomly selected fruits at 4 day's interval and replicated thrice.The total soluble solids (TSS) in fruit samples were determined using Hand Refractometer (0–50) and expressed in degree Brix (ºB) at 20°C. Ascorbic acid content of the fruits was determined by using the method given by Smruthi and Sharma (2018) and expressed as mg/100 g pulp.

Sensory evaluation: Sensory attributes of stored nectarine fruits were sensory evaluated by score card method. According to the fruits color, texture, appearance or taste and overall quality the fruits were given the score. The score was finalized by using 9 point hedonic scale method (Totad *et al*. 2019).

Statistical design and data analysis: The experiment was laid out in factorial CRD design with each treatment consisting of 60 fruits with 3 replications. The data obtained from the experiments were analysed as per design and the results were compared from ANOVA by calculating the MSDusing the SAS (Statistical Analysis System).

RESULTS AND DISCUSSION

Effects on weight loss and fruit firmness: The WL was lowest in nectarine fruits treated with layer-by-layer coating of CMC-CH-MPE on 4th day storage (2.66 ± 0.78%) and the highest in control fruits at 16th day of storage (19.73±0.71%). Irrespective of coatings, the WL loss increased with the increase in storage period. Interestingly, nectarine fruits treated with layer-by-layer coating of CMC-CH-MPE recorded only 9.63±0.67% WL on 16th day of storage, which means this treatment has greater impact on reducing WL than other ones. Other coating either alone or in combination with MPE showed lower WL than control fruits but higher than layer-by-layer coating of CMC-CH-MPE (Table 1). Fruit firmness during storage was significantly higher in CMC-CH-MPE layer-by-layer-coated fruits (7.24 N) as compared to uncoated fruit (5.03 N). Throughout the storage period fruit firmness was maintained at higher level in layer-by-layer-coated fruits whereas in uncoated

Table 1 Effect of mixed plant extract and edible coatings on weight loss (%) of Snow Queen stored at super market conditions (18 ± 2º C and RH 85–90%)

Treatment	Storage days				
	4th day	8th day	12th day	16th day	Mean
Mixed plant extract (MPE)	5.16±0.77	9.23±0.61	14.82±0.81	18.78±0.71	9.60±0.16
Chitosan (CH)	4.79±0.66	8.24±0.58	14.55±0.71	17.51±0.72	9.02±0.16
Carboxy methylcellulose (CMC)	4.49±0.70	7.88±0.72	13.52±0.69	15.34±0.68	8.25±0.16
CMC-MPE	4.40±0.71	7.44±0.59	12.56±0.60	14.54±0.73	7.79±0.16
CH-MPE	3.77±0.66	6.75±0.80	11.40±0.83	13.31±0.72	7.05±0.16
CMC-CH	3.46±0.57	5.52±0.61	8.56±0.70	11.71±0.77	5.85±0.16
CMC-CH –MPE	2.66±0.78	4.55±0.73	7.33±0.74	9.63±0.67	4.83±0.16
Control	5.57±0.73	11.14±0.78	16.82±0.82	19.73±0.71	10.65±0.16
Mean	4.29±0.15	7.59±0.15	12.44±0.15	15.07±0.15	

Tukey MSD (5%) for Treatment (T) = 0.72; Storage (S) = 0.51; T × S = 1.23

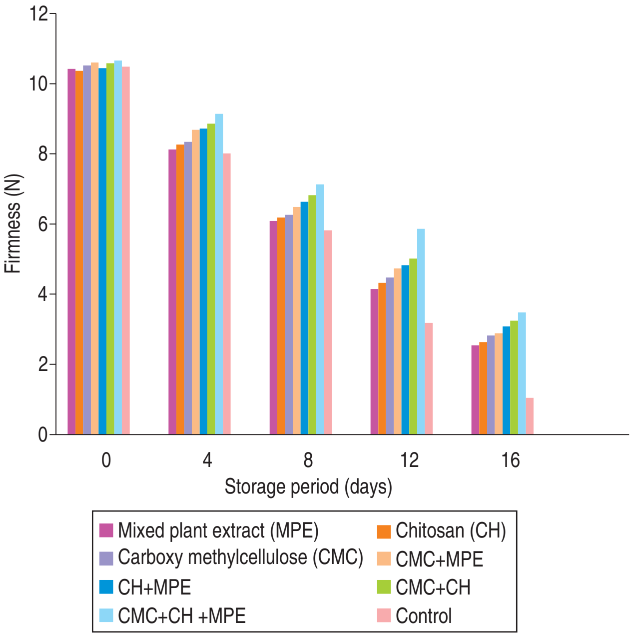

Fig 1 Effect of plant extracts and edible coatings on fruit firmness of Snow Queen stored at supermarket storage conditions (18±2ºC and 85–90% RH).

fruits, firmness decreased at a sharp rate with increase in storage period. Other coatings either alone or in combination with MPE showed higher fruit firmness than control fruits but lower than layer-by-layer coating of CMC-CH-MPE (Fig 1). The interaction between treatment and storage period was significant.

The WL occurs as a result of dehydration and loss of water from fruit surface. WL increases with increased fruit ripening and storage periods (Martinez-Romero *et al.* 2006). CMC-CH-PME coated fruits significantly reduced WL during ripening and supermarket storage conditions compared to uncoated fruit which may be due to formation of a barrier to water diffusion between fruit and environment (Akbudak and Eris 2004, Jayarajan and Sharma 2019). It might have reduced loss of moisture by evaporation or transpiration than other coatings or control fruits. Furthermore, CMC-CH-MPE coated fruits maintained higher fruit firmness than other coatings or uncoated fruits which may primarily be due to less moisture loss and maintenance of cell integrity which results in lower structural as well as compositional changes (Dhall 2012, Kumar *et al.* 2017, Jayarajan and Sharma 2018, Totad *et al*. 2019).

Effects on quality attributes: The result of postharvest application of mixed plant extract and edible coatings on total soluble solids (°B) of Snow Queen depicted that there was a steady increase in the total soluble solids up to some point of storage and thereafter, there was a slow decline (Table 2). The highest TSS (13.07°B) of the fruits was recorded in control on 8th day of storage and the lowest in the fruits coated with CMC-CH-MPE on 0th day of storage (9.14°B) Similarly, the coatings have made significant impact on the ascorbic acid content of the fruits, the maximum ascorbic acid content (7.33 ± 0.17 mg 100 g/FW) was observed in layer-by-layer coated fruits with CMC-CH-MPE which was non- significantly followed by CMC-CH coated fruits (7.29 ± 0.17 mg 100 g/FW) and the minimum ascorbic content was recorded in control fruits (5.60 ± 0.17 mg 100 g/FW) (Table 2). As the days advanced, the ascorbic content of the control and treated fruits showed steady decline. The highest ascorbic acid content was recorded on 8th day of storage (8.73±0.12 mg 100 g/FW) and lowest at the end of the storage (5.66 ± 0.13 mg 100 g/FW) (Table 2). The CMC-CH-MPE coated fruits exhibited the highest TSS and ascorbic acid content of the fruits as compared to control fruits due to the decreased metabolic rate exhibited by coated fruits. Coated-fruit exhibited a reduction of organic acid loss due to the low oxygen permeability and lowered respiration rate and thus prevents acid oxidation (Jhalegar *et al*. 2015, Kumar *et al.* 2018).

Effects on sensory score: The overall acceptability of the coated nectarine fruits showed a slight increase up to some period of storage and then showed declining trend thereafter (Fig 2). The fruits coated with layer-by-layer

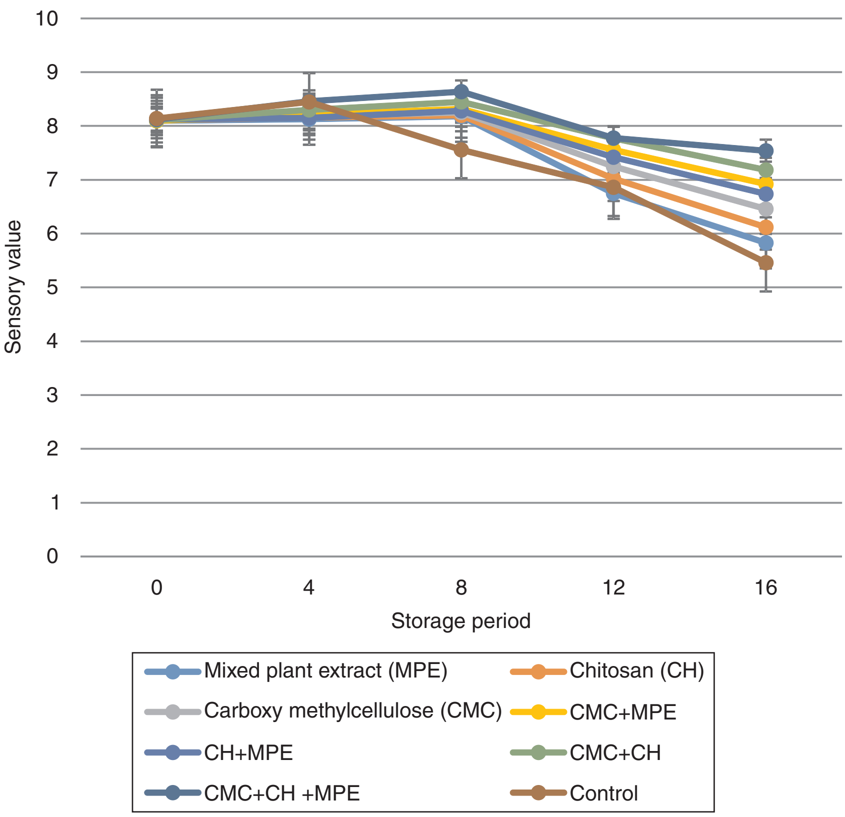

Fig 2 Influence of plant extracts and edible coatings on sensory quality of Snow Queen stored at 18±2ºC and 85–90% RH.

Table 2 Total soluble solids and ascorbic acid content of Snow Queen as influenced by the mixed plant extract and edible coatings during storage at supermarket conditions (18 ± 2°C and RH 85–90%).

Treatment	Storage days											
	0th day	4th day	8th day	12th day	16th day	Mean	0th day	4th day	8th day	12th day	16th day	Mean
	Total soluble solids (°B)						Ascorbic acid content (mg 100g^{-1} FW)					
Mixed plant extract (MPE)	11.46±0.53	11.76±0.72	12.54±0.67	11.53±0.63	10.63±0.67	11.58±0.18	5.80±0.70	6.23±0.65	7.68±0.06	5.50±0.75	5.13±0.75	6.07±0.17
Chitosan (CH)	10.73±0.61	10.87±0.70	11.40±0.80	10.13±0.71	9.80±0.70	10.59±0.18	6.13±0.70	6.40±0.80	7.80±0.04	5.90±0.80	5.33±0.75	6.31±0.17
Carboxy methylcellulose (CMC)	11.13±0.61	11.27±0.71	12.18±0.55	11.35±0.57	10.48±0.72	11.28±0.18	6.40±0.80	6.83±0.75	7.95±0.10	6.07±0.70	5.53±0.70	6.56±0.17
CMC+MPE	10.79±0.78	11.47±0.78	11.06±0.84	9.78±0.68	8.60±0.66	10.34±0.18	6.63±0.70	7.23±0.65	8.02±0.11	6.27±0.65	5.70±0.56	6.77±0.17
CH+MPE	9.79±0.68	10.09±0.74	10.87±0.68	12.18±0.62	11.23±0.64	10.83±0.18	6.87±0.70	7.23±0.65	8.30±0.01	6.50±0.70	6.07±0.70	6.99±0.17
CMC+CH	9.81±0.78	10.10±0.70	10.59±0.62	12.26±0.69	11.51±0.66	10.86±0.18	7.07±0.70	7.43±0.65	8.56±0.03	6.73±1.01	6.63±0.84	7.29±0.17
CMC + CH + MPE	9.14±0.75	9.31±0.62	9.77±0.65	12.52±0.68	11.82±0.81	10.51±0.18	7.23±0.65	7.47±0.65	8.73±0.12	6.81±0.72	6.42±0.68	7.33±0.17
Control	11.56±0.70	12.17±0.63	13.07±0.65	11.35±0.61	10.78±0.68	11.78±0.18	5.50±0.80	5.80±0.70	7.44±0.12	4.77±0.65	4.50±0.66	5.60±0.17
Mean	10.55±0.14	10.88±0.14	11.43±0.14	11.39±0.14	10.61±0.14		8.06±0.13	6.83±0.13	6.45±0.13	6.07±0.13	5.66±0.13	
Tukey MSD (5%) for	Treatment (T) = 0.73; Storage (S) = 0.59; T × S =1.32						Treatment (T) =0.73; Storage (S) = 0.59; T × S =1.32					

coating of CMC-CH-MPE showed good acceptability on the 8th day of storage (8.64). Maximum acceptability in terms of color, taste, texture, flavor and overall acceptability was achieved by the CMC-CH-MPE coatings. CMC-CH-MPE coatings resulted in higher sensory scores primarily because such fruits might have exhibited superior quality in terms of color, taste, texture, flavor and overall acceptability (Maqbool *et al*. 2011, Jayarajan and Sharma 2018, Totad *et al.* 2019).

These results suggest that CMC-CH-MPE can be successfully used as an edible coating for extending the shelf-life and improving the quality of nectarines during storage at supermarket conditions.

REFERENCES

Akbudak B and Eris A. 2004.Physical and chemical changes in peaches and nectarines during the modified atmosphere storage. *Food Control* **15**: 307–13.

Dhall R K. 2012. Advances in edible coatings for fresh fruits and vegetables: a review. *Critical Reviews in Food Science and Nutrition* **53**: 435–50.

Jayarajan S and Sharma R R. 2018.Impact of nitric oxide on shelf life and quality of nectarine (*Prunu spersica* var. *nucipersica*). *Acta Physiologia ePlantarum* **40**: 207.

Jayarajan S and Sharma R R. 2019. Influence of in-package use of ethylene absorbents on shelf life and quality of nectarine during supermarket conditions. *Fruits* **74**(4): 180–86.

Jhalegar M J, Sharma R R and Singh S K. 2015.Effect of surface coatings on postharvest quality of Kinnow mandarin. *Indian Journal of Horticulture* **72**(2): 267–72.

Kowalczyk D, Kordowska-Wiater M, Złotek U and Skrzypek T. 2018. Antifungal resistance and physico-chemical attributes of apricots coated with potassium sorbate-added carboxy methylcellulose based emulsion. *International Journal of Food Science and Technology* **53**(3): 728–34.

Kumar P, Sethi S, Sharma R R, Srivastav M and Varghese E. 2017. Effect of chitosan coating on postharvest life and quality of plum during storage at low temperature. *Scientia Horticulturae* **226**:104–09.

Kumar P, Sethi S, Sharma R R, Srivastav M, Singh D and Varghese E. 2018. Edible coatings influence the cold-storage life and quality of 'Santa Rosa' plum (*Prunus salicina* Lindell). *Journal of Food Science and Technology* **55**(6): 2344–50.

Li H and Yu T. 2000. Effect of chitosan on incidence of brown rot, quality and physiological attributes of postharvest peach fruit. *Journal of the Science of Food and Agriculture* **81**: 269-74.

Maqbool M, Ali A, Alderson PG, Zahid N and Siddiqui Y. 2011. Effect of a novel edible composite coating based on gum arabic and chitosan on biochemical and physiological responses of banana fruit during cold storage. *Journal of Agricultural and Food Chemistry* **59**: 5474–82.

Martinez-Romero D, Alburquerque N and Valverde J M. 2006. Postharvest sweet cherry quality and safety maintenance by *Aloe vera* treatment: a new edible coating. *Postharvest Biology and Technology* **39**: 93–100.

Sharma R R and Krishna H. 2018. *A Textbook of Temperate Fruits*. CBS Publishers, New Delhi, India

Totad M G, Sharma R R, Sethi S and Verma M K. 2019. Effect of edible coatings on 'Misty' blueberry (*Vaccinium corymbosum*) fruits stored at low temperature. *Acta Physiologiae Plantarum* **41**: 183.