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Effect of edible coatings on quality of blueberry fruits under supermarket storage conditions

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ABSTRACT

Blueberry is a nutrient-rich fruit having very high antioxidant activity due to anthocyanin and phenolic compounds. However, its shelf-life is 7-8 days at ambient conditions. Thus, there is an urgent need for extending its shelf-life and availability. In order to increase blueberries shelf-life the most economic and environment friendly technique such as edible coatings stand first. In the present experiment, four edible coatings were used to evaluate their effects on shelf-life and nutrient status of blueberries. Edible coatings such as carboxymethylcellulose (CMC 1%), xanthan gum (0.3%), guar gum (0.75%) and gum Arabic (10%) were coated on the Misty blueberry fruits and then packed in punnet boxes and stored at supermarket condition (18°C and 85-90% RH). During storage, different physical and quality parameters were observed up to 18 days. Our results revealed that, all the coatings were effective in extending storage-life of coated blueberry fruits. Among the coatings, the CMC-coated Misty blueberry fruits exhibited highest score for fruit firmness (2.53 N), total soluble solids (17.52°B) and sensory evaluation score (7.79), and exhibited lowest fruit decay (1.06 %) and lipoxygenase (LOX) activity (3.34 µmoles/min/g FW). Therefore, it can be concluded that CMC (1%) was the most effective coating as it increased the shelf life of Misty blueberry from 9 days (non-coated fruits) to 18 days.

Key words: Blueberry, Edible coatings, Eating quality, Fruit decay, Fruit firmness, LOX activity

Blueberry is a deciduous or evergreen shrub belonging to Ericaceae family. It bears fruit from April-to-June. Its fruits are round in shape and their colour varies from red at immature stage to purple at ripened stage. Fruits also have protective natural surface waxy coating on the surface. Blueberry is considered as the richest source of antioxidants and anthocyanins (Joseph *et al.* 2014, Wu *et al*. 2006). On the basis of growth habit, blueberry has been categorised into highbush, lowbush and rabbit eye (Sharma and Krishna 2018). Due to its role in treatment of blood cholesterol, cancer like diseases, it is gaining popularity in the medical science because of its tremendous neutraceutical properties. Considering the importance of blueberry, several varieties have been introduced in India at different places in the states of J&K, Himachal Pradesh, Uttarakhand and to some extent in northern-eastern states of Manipur, Nagaland and Arunachal Pradesh (Sharma and Krishna 2018). Because of its specific requirements for soil and climate, its cultivation is not picking up in our country. In India, majorly Misty, Gulf Coast, Biloxi, Star, Jewel, Blue Crop etc, varieties have been introduced but Misty is in the high demand because of its rich nutritional properties and high fruit firmness. Apart from all these merits, the shelf-life of this crop is 7-8 days only under ambient storage conditions; hence, there is an urgent need of extension of shelf-life of blueberry fruits.

The main aim of this study was to evaluate the influence of different edible coatings such as guar gum, gum Arabic, xanthan gum and carboxy methylcellulose on Misty blueberry fruits under supermarket storage conditions (18°C and 85-90% RH).

MATERIALS AND METHODS

The present study was carried out at the research farm of ICAR-Indian Agricultural Research Institute, New Delhi during 2016-17. Freshly harvested Misty blueberry fruits were procured from Katrain (Kullu), Himachal Pradesh. The fruits were harvested at fully maturity and transported in an air-conditioned bus to the ICAR-IARI, New Delhi for further experimentation. After sorting and grading, blueberry fruits were dipped in solution of the four edible coatings, viz. carboxymethycellulose (1%), xanthan gum (0.3%), guar gum (0.75%), gum Arabic (10%) for 20 minutes. The non-treated blueberries were taken as control.The fruits were air-dried at the ambient room temperature followed by packing in plastic punnets (200 fruits per punnet). Coated fruits were stored at 18°C with 85-90% RH (supermarket conditions) for further observations.

Determination of fruit firmness and fruit decay: Fruit

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firmness in the blueberry fruits was estimated using a texture analyzer (model: TA+Di, Stable micro systems, UK) following compression test. Hardness was expressed as maximum force (kgf) during the compression, which was expressed in Newtons (N). Fruit decay loss was determined by counting the disease affected and healthy blueberry fruits in each treatment as suggested by Goncalves *et al.* (2010).

Determination of total soluble solids: The total soluble solids of blueberry samples were measured using Fisher digital Hand Refractometer (0-50). The estimated values were expressed as degree Brix (°B) at 20°C.

Lipoxygenase (LOX) activity and sensory evaluation: The lipoxygenase activity in the blueberry fruits was estimated using the method of Axelrod *et al.* (1981) with slight modifications, and expressed as µmoles/min/g fresh weight. Sensory evaluation was done for the estimation of extent of acceptability of the coated fruits to consumers. Semi-trained panellists were asked to evaluate the samples on Hedonic scale (0-9) on the basis of colour, flavour, texture, and taste at 3 days interval.

Statistical design and analysis of data: The experiments were statistically examined in factorial CRD design with each treatment involving of 50 fruits with 4 replication, i.e. 200 fruit/treatment. The results were compared from ANOVA by calculating the C.D. (Panse and Sukhatme 1984).The data were analyzed using the SAS (Statistical Analysis System).

RESULTS AND DISCUSSION

Fruit firmness and fruit decay: It is evident that edible coatings significantly influenced the fruit firmness Misty blueberry, being the highest in CMC-coated fruits (2.53 N) and the lowest in control blueberry fruits (2.05 N) (Table 1). The fruit firmness values decreased during the storage period, being the highest on 3rd day of storage (3.08 N) and the lowest on 18th day of storage (1.17 N). The potential barrier of CMC coating in controlling transpiration was appreciably greater than the remaining coatings and control fruits paved the way for the best firmness value. Similarly, Vishwasrao and Ananthanarayan (2016) also reported that 1% HPMC + 0.3% of palm oil composition significantly delayed loss of fruit firmness in guava fruits.

The treatment, storage interval and their interaction significantly influenced the fruit decay of Misty blueberry. The actual fruit decay started from 9th day of storage in CMC-coated fruits (1.06 %) which was the lowest among the coated fruits and on 6th day of storage in gum Arabic and guar gum-coated fruits (Fig 1). The highest fruit decay was reported in untreated fruits (9.77 %). Further, the fruit decay increased gradually with the increase in storage period, being the highest on 18th day of storage (12.07%) and the lowest on 3rd day of storage (0.91%) (Fig 1). With reference to storage period and treatment interaction, the highest fruit decay was recorded in untreated blueberry fruits on 18th day of storage (18.50%) and the lowest (0%) in CMC and gum Arabic-coated fruits on 3rd day of storage. due to the effective barrier capacity of CMC-coating over the other coatings and control fruits of blueberry, the decay has been reduced considerably in such fruits. The reduction in post-harvest diseases of Kinnow mandarin coated with plant extracts were attempted by Jhalegar *et al.* (2014). Similarly, Abugoch *et al.* (2016) also reported reduction in the growth

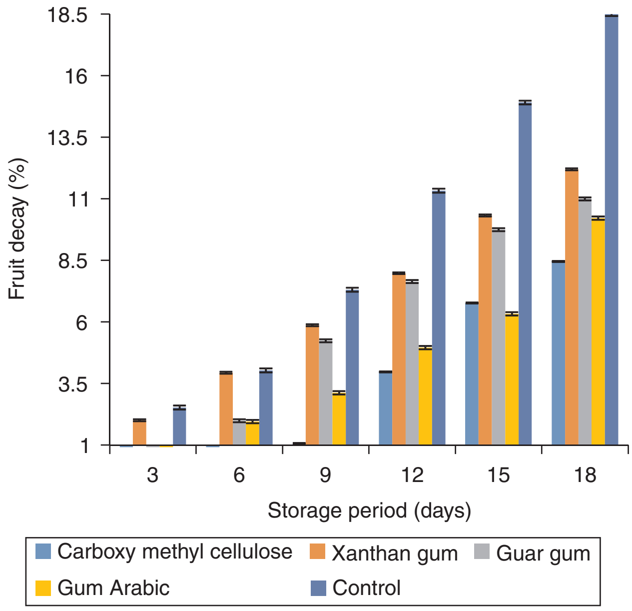

Fig 1 Influence of edible coatings on fruit decay of Misty blueberry during storage at supermarket conditions (18°C and 85-90% RH).

Table 1 Effect of edible coatings on fruit firmness of Misty blueberry stored at supermarket conditions (18°C and 85-90% RH)

Treatment	Fruit firmness (N)						Mean
	Storage period (days)						
	3	6	9	12	15	18	
Carboxy methyl cellulose	3.21	3.01	2.84	2.57	2.19	1.34	2.53
Xanthan gum	3.04	2.62	2.41	2.12	1.45	1.09	2.12
Guar gum	3.10	2.85	2.66	2.33	1.65	1.15	2.29
Gum Arabic	3.14	2.95	2.75	2.45	2.09	1.30	2.45
Control	2.93	2.64	2.36	2.05	1.36	0.95	2.05
Mean	3.08	2.82	2.61	2.31	1.75	1.17	
CD (P=0.05)	Treatment (T) = 0.13; Storage days (S) = 0.15; T × S = N/A						

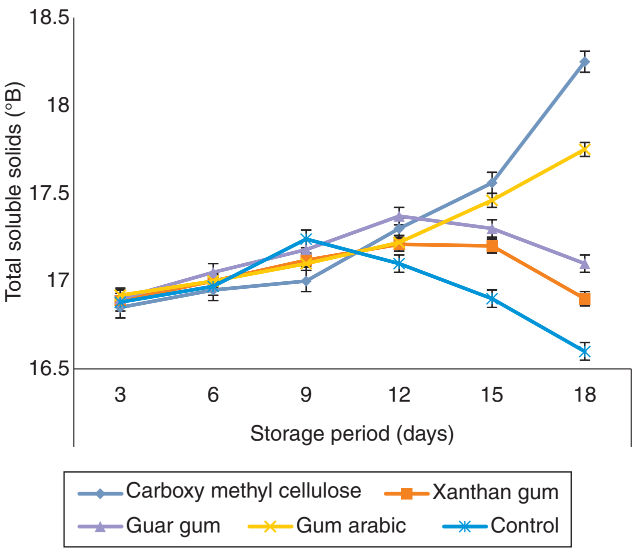

Fig 2 Effect of edible coatings on total soluble solids (TSS) of Misty blueberry stored at ambient conditions (18°C and 85-90% RH).

of molds and yeasts by quinoa protein (0.62%) + chitosan (2%) + sunflower oil (3.8%) coating on fresh blueberries.

Eating quality attributes: The fruits of Misty blueberry exhibited the highest TSS in CMC-coated fruits (17.52°Brix) and the lowest in non-coated blueberry fruits (17.09°Brix) (Fig 2). There was increase trend of total soluble solid contents with the increase in storage period and the lowest TSS on 3rd day of storage (16.91°Brix) and the highest on 18th day of storage (17.55°Brix). In general, non-coated blueberry fruits showed increasing trend in TSS up to 12th day of storage (17.25°Brix) but showed declining trend thereafter but the CMC and gum Arabic- coated fruits showed continuous increase in TSS till storage. Similarly, Duan *et al.* (2011) also reported the potential effects of edible coatings (Semperfresh, acid-soluble chitosan, calcium caseinate, water-soluble chitosan, and sodium alginate) on the total soluble solids of fresh blueberries during storage period.

Lipoxygenase activity: CMC coating influenced LOX activity significantly, due to lower respiration rate which helped in less energy consumption and thereby such fruit

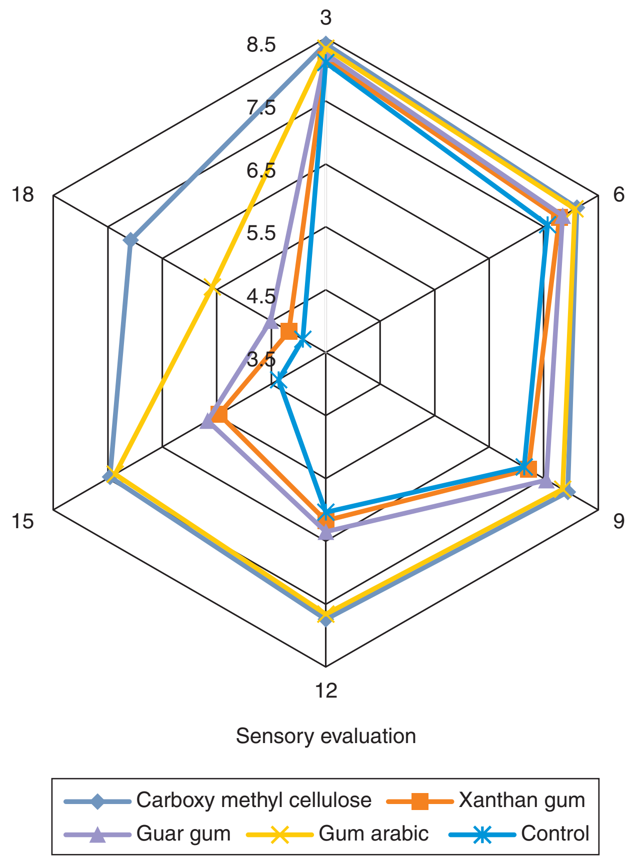

Fig 3 Sensory evaluation of Misty blueberry fruits as influenced by edible coatings during storage at supermarket conditions (18°C and 85-90% RH).

were less senescent showing lower LOX activity (3.34 µmoles/min/g FW) than other coatings or untreated fruits (4.15 µmoles/min/g FW) (Table 2). Further, the lipoxygenase activity gradually increased with respect to storage period, being the highest on 18th day of storage (5.58 µmoles/min/g FW) and lowest on 3rd day of storage (2.14 µmoles/min/g FW). The combined effect of storage period and treatment was also significant as the highest lipoxygenase activity was recorded in untreated blueberry fruits on 18th day of storage (6.22 µmoles/min/g FW) and the lowest in CMC-coated fruits on 3rd day of storage (2.03 µmoles/min/g

Table 2 Lipoxygenase activity of Misty blueberry fruits as influenced by edible coatings during storage at supermarket conditions (18°C and 85-90% RH)

Treatment	Lipoxygenase activity (µmoles/min/g FW) fresh weight)						Mean
	Storage period (days)						
	3	6	9	12	15	18	
Carboxy methyl cellulose	2.03	2.56	2.92	3.39	4.42	4.71	3.34
Xanthan gum	2.14	2.85	3.32	3.91	4.64	6.14	3.83
Guar gum	2.09	2.75	3.27	3.73	4.26	5.86	3.66
Gum Arabic	2.16	2.61	3.16	3.57	3.75	4.95	3.37
Control	2.26	2.91	3.42	4.54	5.51	6.22	4.15
Mean	2.14	2.74	3.22	3.83	4.52	5.58	
CD (P=0.05)	Treatment (T) = 0.12; Storage days (S) =0.13; T × S = 0.28						

FW) (Table 2). Zhou *et al.* (2014) also reported that the LOX activity has been increased in blueberry fruits stored at room-temperature.

Sensory evaluation: Sensory evaluation of Misty blueberry fruits during storage at supermarket conditions was influenced significantly by treatment, storage interval individually as well as by their interaction. The highest acceptability was reported in CMC-coated fruits (7.79) and the lowest in non-coated blueberry fruits (6.19) (Fig 3). The overall acceptability score decreased with the increase in storage period, being the highest on 3rd day of storage (8.25) and the lowest on 18th day of storage (5.05). The interaction, treatment x storage period was also significant as the highest sensory score was recorded in CMC-coated blueberry fruits on 3rd day of storage (8.41) and the lowest in non-coated fruits on 18th day of storage (3.92). Guerreiro *et al.* (2017) also reported that edible coatings improved the sensory quality of apple slices by protecting slices against microbial spoilage.

It is concluded from the present study that different edible coatings were significantly helpful in prolonging the shelf-life of coated Misty blueberry fruits under supermarket conditions. Among the coatings, the CMC-coated fruits were in prime position as the storage increased from 9 days (non-coated fruits) to 18 days along with the retention of different quality parameters such as physical, physiological and biochemical factors.

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