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Effect of different Surface Coating Treatments on Physical Parameters of Guava (*Psidium guajava* L.) cv. Allahabad Safeda Fruits

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ABSTRACT: The experiment was conducted during 2019-2020 at the Instructional cum Research Department of Fruit Science, RVSKVV- K.N.K. College of Horticulture, Mandsaur (M.P.). Guava freshly harvested fruits were coated with different coatings Guar gum (0.5%, 1.0%, 1.5% and 2.0%), Shellac (0.5%, 1.0%, 1.5% and 2.0%), Aloe veragel (25%, 50%, 75% and 100%) and Carboxyl Methyl Cellulose (0.5%, 1.0%, 1.5% and 2.0%), comprising of seventeen treatments with three replications in Completely Randomized Design. Periodically effects of different surface coating materials were observed for Physical parameters for fruits like- fruit length (cm), Fruit width (cm), Fruit volume (ml), specific gravity, physiological loss in weight (PLW %), Decay loss (%), Shelf-life of fruit (days). Out of four types of edible coating (*i.e.* Guar gum, Aloe vera, Carboxyl Methylcellulose, Shellac), Guar gum was found to be more beneficial as compared to other edible coatings throughout storage period. The application of edible coating (Guar gum) has proved to be best post-harvest application storage of guava cv. Allahabad Safeda from the point of fruit size (length & diameter), fruit volume (ml), specific gravity, PLW (%), decay loss (%) and shelf-life of fruit. The effect of surface coatings revealed that the post-harvest application of guar gum (2%) were found to be superior over other treatments with respect to physical, shelf life and quality parameters at ambient conditions resulting in prolonging the shelf-life of guava fruit cv. Allahabad Safeda. The Post-harvest quality conservation of guava is still a challenge in the production chain due to reduced post-harvest life attributed to its high respiratory rate, ethylene peak, fast loss of firmness and incidence off-decay during storage.

Keywords: Fruit volume, specific gravity, Aloe vera coating, Carboxyl methylcellulose, Shellac, Guar gum, shelf life.

INTRODUCTION

Guava (*Psidium guajava* L.) is one of the predominant fruit crop in tropical and subtropical tracts of the world and claims superiority over different fruits by virtue of its commercial and nutritional values. It is also known as "The Apple of Tropics". Botanically, it belongs to the family Myrtaceae which comprises at least 150 genera and more than 5,650 species. It occupies fourth position in terms of area 2.65 lakh ha and production 40.54 lakh MT after mango, banana and citrus. The guava fruit is an excellent source of ascorbic acid but with poor calorific value (66 cal/100 g), protein content (1%), dry matter (17%) and moisture (83%). The fruit is also rich in minerals like phosphorus (2337 mg/100 g), calcium (14-30 mg/100 g), iron (0.6-1.4 mg/100 g) as well as vitamins like niacin, pantothenic acid, thiamine, riboflavin and vitamin A. Edible coatings have high potential to carry active ingredients such as anti-browning agents, colorants, flavours, nutrients, spices and antimicrobial compounds that can extend product shelf-life and reduces the risk of pathogen growth on fruit surfaces (Pranoto *et al*., 2015). There has been increasing interest for the use of Aloe vera gel as an edible coating material for fruits and vegetables driven by its antifungal activity (Jasso Rodriguez de *et al*., 2005). The positive effect of this edible coatings is based on their hygroscopic properties, which enables formation of O_2 and CO_2 by creating modified atmosphere (MA) and acting as moisture barrier between the fruit and the environment and thus reduced weight loss, browning, softening and growth of yeast and molds (Morillon *et al*., 2002). Shellac resin is secreted by the insect *Laccifer lacca* found in India. Shellac is composed of aleuritic and shelloic acids is

compatible with waxes and gives coated products a high gloss appearance (Hagenmaier and Shaw 1991). Guar gum is a galactomannan rich flour, water soluble polysaccharide obtained from the leguminous Indian cluster bean (*Cyamopsis tetragonoloba* L.). It is one of the most important thickener and versatile material for many food applications due to its different physico-chemical properties as well as its high availability, low cost and biodegradability. This galactomannan has similar properties as carrageenan, alginate, xanthan gumand gum arabic as an edible coating but guar gum has the advantage of being cheaper than all the others (Rodge *et al*., 2012). Carboxy Methyl Cellulose (CMC) is a derivative of cellulose and prepared by reaction of cellulose with sodium hydroxide and chloroacetic acids. Characteristics of CMC are generally odorless, tasteless, flexible, transparent, and non-toxic. It is widely used in food and pharmaceutical industries (Sunardi *et al*., 2017). The post-harvest losses can be minimized by checking the rate of transpiration, respiration, microbial infection and protecting membranes from disorganization (Bisen and Pandey 2008).

MATERIALS AND METHODS

A. Experimental Location

The experiment was conducted during 2019-2020 at the Instructional cum Research Department of Fruit Science, KNK College of Horticulture, Mandsaur (M.P.).

B. Collection of Research Material

Guava fruits cv. Allahabad Safeda used for research were procured from the orchard, KNK College of Horticulture, Mandsaur (M.P.). Guava fruits were selected for uniformity in size, shape and colour. Diseased, sunburn, bruised and injured fruits were discarded. The fruits were randomized and divided into seventeen treatment lots of 45 fruits for the following treatments in three replicates (each replicate contained 15 individual fruits).

C. Experimental Design and Treatments

The experiment was laid out in completely randomized design (CRD) with three repetitions and consisting of seventeen treatments comprising of surface coatings. T_1: Guar gum 0.5 %, T_2: Guar gum 1.0%, T_3: Guar gum 1.5%, T_4: Guar gum 2.0%, T_5: Shellac 0.5%, T_6: Shellac 1.0%, T_7: Shellac 1.5%, T_8: Shellac 2.0%, T_9: Aloe vera 100%, T_{10}: Aloe vera 75%, T_{11}: Aloe vera 50%, T_{12}: Aloe vera 25%, T_{13}: CMC 0.5%, T_{14}: CMC 1.0%, T_{15}: CMC 1.5%, T_{16}: CMC 2.0%, T_{17}: Control stored at Room temperature.

D. Collection of Plant Material and Preparation of Surface Coatings

The coatings of guar gum, Shellac, Aloe vera gel and Carboxyl Methyl Cellulose of the required concentrations for each treatment were prepared. Forty five fruits were dipped in each solution for 10 minutes and then air dried.

Preparation of guar gum solution and fruit application was done according to the method of Wijewardane (2013). 0.5 g, 1.0 g, 1.5 g and 2.0 g guar gum powder were dissolved in 100 ml water for the preparation of 0.5%, 1.0%, 1.5% and 2.0% solutions, respectively. Similarly, 0.5%, 1.0%, 1.5% and 2.0% shellac coating solution was prepared by dissolving 0.5 g, 1.0 g, 1.5 g and 2.0 g of shellac powder in 100ml of 20% Iso propyl alcohol. Aloe vera gel preparation was undertaken as per method described by Ramachandra and Rao (2008). Accordingly, coatings of Aloe vera gel were made in 25%, 50%, 75% and 100% with water. Carboxyl Methyl Cellulose coating solution was prepared on the percentage of weight basis with distilled water. 0.5 g, 1.0 g, 1.5 g and 2.0 g Carboxyl methyl cellulose coating powder was mixed with 100ml of water for the preparation of 0.5%, 1.0%, 1.5% and 2.0% solutions, respectively. Coated fruits then allows for air drying at ambient conditions.

E. Data Collection & data Analysis

The data recorded on physico-chemical characters and sensory quality evaluations of guava cv. Allahabad Safeda during the storage period were statistically analyzed. Data pertaining to the effect of various post harvest treatments and storage period *i.e*, 0, 3rd, 6th, 9th and 12th day on Physico-chemical changes and sensory quality evaluation of guava cv. Allahabad Safeda. Physiological loss in weight during storage was calculated by subtracting the final fresh weight from the initial fresh weight of the fruits. Cumulative weight losses were expressed as a percentage loss of original weight. The shelf-life was recorded as the days from harvest to a stage when fruits had reached optimum eating stage and after which spoilage was inevitable and expressed as mean number of days. The design adopted was (CRD) completely randomized design using the established statistical analysis as per the procedure. Significance was tested by 'F' value at 5 percent level of significance.

RESULTS AND DISCUSSION

A. Fruit Length (cm)

Data pertaining due to the effect of post-harvest treatment on fruit length of guava fruits during the storage condition is presented in (Table 1) fruit length of guava fruits experienced a linear decline during storage period up to 12 days. The result indicates that the maximum fruit length (5.62, 5.55, 5.41 and 5.21 cm) was found in treatment T_4 (Guar gum 2%) from 3rd, 6th, 9th and 12th day during the storage days interval respectively followed by Treatment T_3 (Guar gum 1.5%) and T_9 (Aloe-vera 100%). However, the minimum fruit length (5.40, 5.12, 4.75 and 4.48 cm) was observed in treatment T_{17} (control) from 3rd, 6th, 9th and 12th day of storage period, respectively. The results are in confirmation with the results achieved by Mohamed *et al.* (2013), Saha *et al.* (2016); Zhu *et al.* (2018).

Table 1: Effect of different surface coating treatments on fruit length (cm), fruit width (cm) and fruit volume (ml) of Guava cv. Allahabad Safeda during storage.

Treatments		fruit length (cm)					fruit width (cm)					fruit volume (ml)				
		0 Day	3rd Day	6th Day	9th Day	12th Day	0Day	3rd Day	6th Day	9th Day	12th Day	0 Day	3rd Day	6th Day	9th Day	12th Day
T_1	Guar gum 0.5 %	5.61	5.52	5.40	5.15	4.95	6.49	6.27	6.18	5.90	5.78	121.0	114.0	111.0	100.0	98.0
T_2	Guar gum 1.0%	5.63	5.54	5.46	5.21	5.01	6.52	6.34	6.26	6.04	5.83	125.0	116.0	112.0	104.0	100.0
T_3	Guar gum 1.5%	5.61	5.57	5.49	5.29	5.09	6.54	6.45	6.36	6.15	5.94	120.0	118.0	113.0	107.0	103.0
T_4	Guar gum 2.0%	5.65	5.62	5.55	5.41	5.21	6.55	6.52	6.45	6.29	6.08	124.0	121.0	117.0	112.0	108.0
T_5	Shellac 0.5%	5.55	5.47	5.32	4.90	4.72	6.56	6.20	5.95	5.55	5.34	123.0	113.0	106.0	98.0	95.0
T_6	Shellac 1.0%	5.62	5.50	5.37	5.07	4.85	6.44	6.26	6.10	5.70	5.49	125.0	114.0	108.0	101.0	99.0
T_7	Shellac 1.5%	5.52	5.52	5.42	5.19	4.98	6.52	6.33	6.24	5.86	5.65	125.0	116.0	111.0	104.0	100.0
T_8	Shellac 2.0%	5.61	5.53	5.47	5.24	5.04	6.58	6.42	6.33	5.99	5.78	119.0	117.0	112.0	105.0	101.0
T_9	Aloe vera 100%	5.59	5.55	5.48	5.27	5.07	6.51	6.46	6.35	6.21	6.00	121.0	116.0	113.0	106.0	102.0
T_{10}	Aloe vera 75%	5.57	5.52	5.42	5.18	4.97	6.49	6.40	6.28	6.11	5.90	125.0	115.0	113.0	104.0	100.0
T_{11}	Aloe vera 50%	5.55	5.50	5.37	5.12	4.92	6.54	6.32	6.22	6.04	5.83	122.0	114.0	112.0	101.0	98.0
T_{12}	Aloe vera 25%	5.53	5.48	5.36	5.08	4.89	6.45	6.26	6.18	5.97	5.76	123.0	113.0	110.0	100.0	97.0
T_{13}	CMC 0.5%	5.61	5.48	5.35	5.05	4.86	6.54	6.23	6.05	5.68	5.47	122.0	114.0	107.0	99.0	96.0
T_{14}	CMC 1.0%	5.52	5.49	5.39	5.18	4.98	6.51	6.29	6.12	5.79	5.58	121.0	115.0	109.0	100.0	97.0
T_{15}	CMC 1.5%	5.55	5.52	5.42	5.23	5.03	6.58	6.37	6.19	5.96	5.75	125.0	116.0	111.0	102.0	99.0
T_{16}	CMC 2.0%	5.56	5.53	5.45	5.29	5.09	6.52	6.42	6.27	6.04	5.83	120.0	117.0	112.0	104.0	100.0
T_{17}	Control	5.58	5.40	5.12	4.75	4.58	6.51	6.15	5.85	5.34	5.13	124.0	112.0	103.0	95.0	87.0
SE(m) ±		**0.013**	**0.015**	**0.016**	**0.014**	**0.015**	**0.012**	**0.012**	**0.015**	**0.012**	**0.016**	**1.066**	**1.221**	**1.163**	**1.379**	**1.314**
C.D. at 5%		**0.038**	**0.045**	**0.047**	**0.039**	**0.042**	**0.036**	**0.034**	**0.042**	**0.036**	**0.046**	**3.078**	**3.524**	**3.357**	**3.981**	**3.791**

Table 2: Effect of different surface coating treatments on Specific gravity, Physiological loss in weight (%) and Fruit decay loss (%) of Guava cv. Allahabad Safeda during storage.

Treatments		Specific gravity					Physiological loss in weight (%)					Fruit decay loss (%)				
		0 Day	3rd Day	6th Day	9th Day	12th Day	0 Day	3rd Day	6th Day	9th Day	12th Day	0 Day	3rd Day	6th Day	9th Day	12th Day
T_1	Guar gum 0.5 %	0.87	0.84	0.78	0.73	0.68	0.00	5.86	9.53	14.77	20.93	0.00	0.00	0.00	0.00	0.00
T_2	Guar gum 1.0%	0.87	0.85	0.79	0.76	0.70	0.00	5.50	9.42	14.58	20.17	0.00	0.00	0.00	0.00	0.00
T_3	Guar gum 1.5%	0.86	0.85	0.81	0.78	0.73	0.00	4.70	8.78	13.56	19.53	0.00	0.00	0.00	0.00	0.00
T_4	Guar gum 2.0%	0.91	0.86	0.83	0.79	0.75	0.00	4.43	8.12	13.10	18.90	0.00	0.00	0.00	0.00	0.00
T_5	Shellac 0.5%	0.88	0.79	0.74	0.71	0.66	0.00	6.80	10.88	16.20	22.33	0.00	0.00	0.00	0.00	2.23
T_6	Shellac 1.0%	0.86	0.80	0.76	0.73	0.68	0.00	6.66	10.35	15.91	22.00	0.00	0.00	0.00	0.00	0.00
T_7	Shellac 1.5%	0.85	0.82	0.77	0.75	0.70	0.00	5.90	10.05	15.54	21.60	0.00	0.00	0.00	0.00	0.00
T_8	Shellac 2.0%	0.85	0.83	0.79	0.76	0.71	0.00	5.75	9.86	15.23	20.97	0.00	0.00	0.00	0.00	0.00
T_9	Aloe vera 100%	0.86	0.84	0.80	0.77	0.72	0.00	4.72	9.28	14.88	20.10	0.00	0.00	0.00	0.00	0.00
T_{10}	Aloe vera 75%	0.86	0.82	0.78	0.75	0.71	0.00	4.93	9.55	15.10	20.73	0.00	0.00	0.00	0.00	0.00
T_{11}	Aloe vera 50%	0.87	0.81	0.77	0.74	0.69	0.00	5.29	9.79	15.23	21.10	0.00	0.00	0.00	0.00	0.00
T_{12}	Aloe vera 25%	0.85	0.83	0.75	0.73	0.68	0.00	5.65	10.10	15.69	21.47	0.00	0.00	0.00	0.00	0.00
T_{13}	CMC 0.5%	0.85	0.80	0.75	0.72	0.67	0.00	6.30	10.42	15.93	21.87	0.00	0.00	0.00	0.00	2.23
T_{14}	CMC 1.0%	0.87	0.81	0.77	0.73	0.69	0.00	6.43	10.12	15.65	21.57	0.00	0.00	0.00	0.00	0.00
T_{15}	CMC 1.5%	0.86	0.82	0.79	0.75	0.70	0.00	5.80	9.86	15.38	21.40	0.00	0.00	0.00	0.00	0.00
T_{16}	CMC 2.0%	0.86	0.83	0.80	0.77	0.71	0.00	5.62	9.45	15.07	20.90	0.00	0.00	0.00	0.00	6.67
T_{17}	Control	0.80	0.75	0.71	0.68	0.62	0.00	8.50	12.30	18.27	24.43	0.00	0.00	4.44	6.67	13.34
SE(m) ±		**0.011**	**0.012**	**0.012**	**0.011**	**0.011**	**0.162**	**0.154**	**0.206**	**0.308**	**0.162**	**0.00**	**0.00**	**0.90**	**0.90**	**2.20**
C.D. at 5%		**0.031**	**0.034**	**0.033**	**0.032**	**0.031**	**0.468**	**0.444**	**0.595**	**0.888**	**0.468**	**0.00**	**0.00**	**0.31**	**0.31**	**0.76**

B. Fruit Width (cm)

The data presented in (Table 1) indicated that the fruit width of guava fruits experienced a linear decline during storage period up to 12 days. The result indicates that the maximum fruit width (6.52, 6.45, 6.29 and 6.08 cm) was found in treatment T_4 (Guar gum 2%) from 3rd, 6th, 9th and 12th day during the storage days interval respectively followed by Treatment T_3 (Guar gum 1.5%) and T_9 (Aloe-vera 100%). However, the minimum fruit width (6.15, 5.85, 5.34 and 5.13 cm) was observed in treatment T_{17} (control) from 3rd, 6th, 9th and 12th day of storage period, respectively. Similar finding were also reported by Bhowmick *et al.* (2015); Chacon *et al.* (2017)

C. Fruit Volume (ml)

The data presented in Table 1 indicated that the fruit volume of guava fruits experienced a linear decline during storage period up to 12 days. The result indicates that the maximum fruit volume (121, 117,112 and 108 ml) was found in treatment T_4 (Guar gum 2%) from 3rd, 6th, 9th and 12th day during the storage days interval respectively followed by Treatment T_3 (Guar gum 1.5%) and T_9 (Aloe-vera 100%). However, the minimum fruit volume (112, 103, 95 and 87 ml) was observed in treatment T_{17} (control) from 3rd, 6th, 9th and 12th day of storage period, respectively. Similar results were also noticed by Dutta *et al.* (2017).

D. Specific gravity

Specific gravity of guava fruits experienced a linear decline during storage period up to 12 days presented in Table 2. The result indicates that the maximum specific gravity (0.86, 0.83, 0.79 and 0.75) was found in treatment T_4 (Guar gum 2%) from 3rd, 6th, 9th and 12th day during the storage days interval respectively followed by Treatment T_3 (Guar gum 1.5%) and T_9 (Aloe-vera 100%). However, the minimum specific gravity (0.75, 0.71, 0.68 and 0.62) was observed in treatment T_{17} (control) from 3rd, 6th, 9th and 12th day of storage period, respectively. Similar results were reported by Bhomick *et al*. (2015); Kaur *et al*. (2019).

E. Physiological loss in weight (%)

The data presented in Table 2 indicated that the physiological loss in weight during storage is characterized by reduction in fruit weight by the way of loss of moisture through evaporation and/or transpiration. All the treatments show significant increased in the physiological loss in weight with the increase in storage period *i.e*. 0 to 12th days. However, the treated fruits maintained the lower value of the physiological loss weight as compared to the control. The result indicates that the lowest physiological loss in weight (4.43, 8.12, 13.10, and 18.90%) was found in treatment T_4 (Guar gum 2%) from 3rd, 6th, 9th and 12th day during the storage days interval respectively and highest physiological loss in weight (8.50, 12.30, 18.27 and 24.43%) was observed in treatment T_{17} (control) from 3rd, 6th, 9th and 12th day of storage period, respectively. However, Treatment T_3 (Guar gum 1.5%) was found *at par* with T_4 (Guar gum 2%). Similar finding have been reported by Baldwin *et al.* (1999); Dutta *et al*. (2017); Zhu *et al*. (2018) in guava fruits.

F. Fruit Decay (%)

The data presented in Table 2 indicated that the all treatment shows longer storage life than the control. Decayed fruit percent (2.23%) were observed in treatments T_5 (Shellac 0.5%) and T_{13} (CMC 0.5%) at the end of the storage period (12th day), respectively. Whereas the maximum fruit decay (13.34%) was observed in treatment T_{17} (control) on 12th day of storage. Similar results were reported by Saha *et al*. (2016); Singh *et al*. (2018); Minh *et al.* (2019).

G. Shelf-life of fruit (days)

The post harvest treatments had significant difference on the shelf life of guava fruits. The result indicates that the highest shelf-life (7.15) was found in treatment T_4 (Guar gum 2%) respectively followed by Treatment T_3 (Guar gum 1.5%) and T_9 (Aloe-vera 100%). However, the lowest shelf-life (4.00) was observed in treatment T_{17} (control) throughout storage period is presented in Table 2. Similar finding were reported by Nasution *et al.* (2015); Kumar *et al.* (2017); Abrahamand Banerjee (2018).

CONCLUSION

It can be concluded that application of various edible coatings may be used for extending post-harvest shelf life of guava fruits during storage. Out of four types of edible coating (*i.e.* Guar gum, Aloe vera, Carboxyl Methylcellulose, Shellac), guar gum was found to be more beneficial as compared to other edible coatings throughout storage period.

FUTURE SCOPE

The high level of post-harvest losses of guava requires innovative approaches to maintain its quality through judicious use of post-harvest treatments. The post-harvest losses can be minimized by checking the rate of transpiration, respiration, microbial infection and protecting membranes from disorganization. Guava fruits are required to be managed appropriately in order to get a regulated market supply through post-harvest treatments to improve the storage life.

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Conflict of Interest. None.

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