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Effect of different coating on quality and shelf life of mango *cv*. Amrapali

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Abstract
The present experiment entitled "Effect of different coatings on quality and shelf life of Mango cv. Amrapali'' was undertaken at Laboratory of Pt. KLS college of horticulture and research station Rajnandgaon, Mahatma Gandhi Udyanikee Evam Vanikee Vishwavidyalaya, Durg (Chhattisgarh) during the year 2023-2024 laid out in completely randomized design with nine treatment replication three times. The investigation consists total 9 treatments i.e. control along with 8 different concentration for *Aloe vera* gel (50 and 75%), tapioca starch and acacia gum (5, 10% and 10,15%), coconut oil and ghee, different concentration coating materials were used. after coating fruits were evaluated for different physiological, bio-chemical and organoleptic parameters at room temperature at lab for storage period the findings under the different treatment influenced in which superiority of 15% acacia gum as minimum 2.76, 4.95, 9.56 and 20.98% plw%, at 4, 8, 12 and 16 DAH. 6.98 of lowest pulp and peel ratio and maximum average number of days taken to ripening 13.96% and maximum shelf life 19.92 15% acacia gum was registered. Similarly, the findings for bio-chemical parameter were significantly influenced where 15% acacia gum has been lowest TSS, total sugar and reducing sugar with 15.75°brixtss, 13.00 total sugars and 4.27% reducing sugars and maximum ascorbic acid 34.35 and 0.21% titrable acidity observed. The orgenoleptic evaluation 75% *Aloe vera* gel and 15% acacia gum score well for i.e. appearance, taste, aroma, flavor and marketability. (7.83, 8.12, 7.75, 7.67 and 7.58) excellent quality respectively for appearance, taste, aroma, flavor, and marketability, also had attractive color. Overall result suggested that coating of different material could be a promising tool to increase shelf life and qualitative variables in mango cv. Amrapali.

Keywords: Aamrapali mango, CRD, *Aloe vera* gel, tapioca starch, acacia gum, coconut oil, ghee, shelf-life

Introduction
Mango (*Mangifera indica* L.) is sub-tropical evergreen fruit crop which is rightly known as "King of Fruits". It is the national fruit of India because it has always had a close connection to the social, religious, artistic, and economic life of Indians. It is a native of South East Asia, mainly the Indo Burma region in the Himalayan foot hills. it is a climacteric fruit of the Anacardiaceous family C.N. (2n=4x=40). This fruit belongs to the genus *Mangifera*, which has three primary species in India: *Mangifera indica* with edible fruits and *M. sylvatica* and *M. caloneura* with inedible fruits (De Candolle, 1904) [10]. Anacardiaceae one of the most important and oldest fruit crop in India for at least 400 year. It is main family of tropical species with 73 genera *Mangifera* genus comprises of 69 species. For more than 4,000 years, mangoes have been cultivated on the Indian subcontinent, appreciated by both royalty and everyday people for their nutritious qualities, delicious flavor, enticing aroma, and health benefits. Their versatility, wide variety, delightful taste, appealing appearance, and high nutritional value have made them popular worldwide. The mango is a delectable fruit enjoyed by both children and adults Mangoes are abundant in carotenoids, vitamin C, organic acids, carbohydrates, and minerals. A 100 g serving of fresh mango pulp contains about 81.7 g water and 70 Kcal calories, 17 g of carbohydrates, 0.5 g of protein, 0.27 g of total fat, 1.80 g of dietary fiber, 27.7 mg of vitamin C, 765 IU of vitamin A, 1.12mg of vitamin E, 4.2 µg of vitamin K, 445 µg of beta-carotene, and 17 µg of alpha-carotene, according to the (USDA National Nutrient Database).

Asia is the leading producer of mangoes, contributing 76.9% of the global output, followed by North America with 17.33% (Sauco, 2002) [18]. India stands out as a significant mango producer, with an annual production exceeding 18 million metric tons, making it one of the top mango-producing countries (Saxena & Gandhi, 2015) [19]. The total area dedicated to mango cultivation in India is estimated at 24.01 million hectares, yielding approximately 224.23 metric tons annually (Anonymous 2024) [6]. The primary mango-producing states in India include Uttar Pradesh (25%), Andhra Pradesh (18%), and Karnataka (14%). In Chhattisgarh, the mango-growing area spans 78.235 million hectares, producing around 471.146 metric tons annually (Anonymous 2024) [6]. The key mango-growing districts in Chhattisgarh are Raigarh, Surguja, Surajpur, Korba, Balrampur, Jashpur, and Kondagaon. Among promising mango hybrids, Amrapali stands out as one of the most suitable varieties for both domestic and international markets, as well as for processing industries. This hybrid was developed from a cross between Dashehari and Neelum in 1965 at the Division of Fruits and Horticultural Technology, Indian Agricultural Research Institute in New Delhi, India. The tree is relatively small and dwarf, with a medium spread and is known for being a consistent and prolific bearer. Its inflorescence is pyramidal, greenish with a crimson tinge, and has a subtle pubescence. The fruits typically mature in the fourth week of July and are small to medium-sized (around 130 g), ovate-oblong in shape, with a slightly more prominent ventral shoulder than dorsal. They have a distinct, obtuse beak, a slight shallow sinus, and a thick peel that is light greenish-apricot yellow. The pulp is firm, deep orange-red, and fiber less, offering excellent quality and sweetness, making it suitable for fresh consumption and nectar production. The stone is small to medium, oblong, and has a fine fibrous texture towards the ventral shoulder, with raised, lightly yellowish veins. The fruit contains 75% pulp and has 2 to 3 times more β-carotenoid pigment (16,830 micrograms per 100 g of pulp) than its parent, along with a high ascorbic acid content (35 mg per 100 g of pulp). This cultivar is well-suited for high-density orcharding with annual pruning. However, a notable drawback of this variety is its shorter shelf life.

Coating are techniques employed in the post-harvest management of fruits. They help to reduce microbial growth, slow down dehydration, and minimize the rate of transpiration in fruits and vegetables (Waewth on grak *et al*., 2015) [21]. There is a growing demand for healthy and eco-friendly post-harvest technologies today (Prasad and Sharma, 2016) [17]. An edible coating is defined as a thin layer of substance that forms a protective barrier around food items and is safe to consume (Guilbert, 1986) [13]. These coatings have been used for a long time to preserve food and enhance its appearance. They modify the storage environment and help prevent post-harvest losses during storage and transportation (Baldwin, 1994) [8]. Using refrigerated storage or controlled atmosphere storage can be expensive, while modified storage slows down the ripening process but may also impact the flavor of the fruit. The application of various films and coatings alters the atmosphere surrounding the fruit at a micro level, reducing weight loss during transport and storage while extending shelf life. These coatings can also inhibit the growth of microorganisms. They create a semi-permeable barrier against oxygen, carbon dioxide, moisture, and volatile compounds. Coatings are commonly used for citrus fruits, apples, tomatoes, and gourds to extend shelf life and enhance appearance without negatively affecting flavor, taste, or aroma. This technique is both cost-effective and easy to implement at the farm level.

Coconut oil and natural ghee (clarified butter) are widely accessible globally and are known for their pleasant taste and aroma. Both are hydrophobic and possess antimicrobial properties (Sprong *et al*. 2001; Akalin *et al*. 2006; Agoramoorthy *et al*. 2007) [20, 3, 2]. *Aloe vera* is a significant medicinal plant known for its stiff lance-shaped leaves, which contain a clear gel in the central mucilaginous pulp that can be used for coating. Acacia gum, or gum arabic, is a natural secretion from the stems and branches of acacia trees and is utilized as an edible coating to enhance the shelf life and microbial safety of fruits. Gum arabic is the most commonly used polysaccharide in the industrial sector due to its unique emulsification, film-forming, and encapsulation properties. When applied as an edible coating, gum arabic demonstrated positive results, significantly delaying the ripening of fruits (Ganvit *et al*., 2014) [12].

Mango fruits ripen rapidly due to climacteric respiration, typically within 5 to 15 days after harvesting. This short post-harvest life restricts their long-distance transport. Additionally, their moderate to high susceptibility to decay, sensitivity to low temperatures (below 13 °C), and perishable nature limit their availability in many countries. There is significant potential to extend the shelf life of mangoes through various coating materials. However, research on the use of different coatings for mangoes has been limited, primarily focusing on gum arabica and *Aloe vera* gel. Very little investigation has been conducted on the use of tapioca starch, coconut oil and ghee coating materials for mango cv. Ammrapali.

Materials and Methods

The present study entitled “Effect of different coatings on quality and shelf life of mango cv. Amrapali” was carried out under the department of Fruit Science Laboratory of Pt. KLS, College of Horticulture and Research Station in Rajnandgaon, (C.G.), during the year 2024. The laboratory experiment was conducted in completely randomized design (CRD) with three replications and nine treatments consisting a control Viz. T_0 (control), T_1 (50% *Aloe vera* gel), T_2 (75% *Aloe vera* gel), T_3 (5% Tapioca starch), T_4 (10% Tapioca starch), T_5 (10% Acacia gum), T_6 (15% Acacia gum), T_7 (Coconut oil), T_8 (Ghee). Freshly harvested mature fruits of mango cv. Kesar were immediately shifted to laboratory, washed with tap water and dried in air at room temperature. *Aloe vera* gel solutions of 50 and 75% were prepared by mixing 50 and 75 ml gel matrix (colourless hydroparenchyma homogenised in blender) with 100ml water. To prepare 5 and 10% tapioca starch solution, 5 g of tapioca starch granules were soaked in distilled water for overnight and the solution was homogenized thoroughly in mixture and finally water was added to reach the desired concentration. Acacia gum solutions of 10 or 15% concentration were obtained by dissolving 10 or 15 g Acacia gum powder in 100 ml distilled water (El-Anay, *et al*., 2009) [11]. For coating purposes, 100% pure coconut oil and ghee were melted and applied in a uniform thin layer over the surface of the fruit by hand.

Results

Physical parameters

Physical loss in weight

The physiological reduction of fruits weight was observed to rise the storage time continue with respect to treatments and application of coating influence significantly the physiological loss in weight compared to control. Fruits in T_6 coated with 15% acacia gum registered minimum physiological loss in weight (2.76, 4.94, 9.56 and 20.98%) respectively during days of storage and proved to be significant among all other treatments which are followed by treatment (T8) ghee having the respective physiological weight loss (2.99, 5.52, 10.92 and 21.70%) at 4, 8, 12 and 16 days during storage and having recorded physiological weight losses percentage at respective period. The maximum physiological weight loss in T0 (5.10, 10.17, 14.60 and 27.89%) were recorded which was untreated (control) at 4, 8, 12 and 16 days of storage. The lowest physiological loss in weight was noted in the fruits coated with 5% acaciagum whereas the highest PLW was noted in the fruits without coating. This reduction in weight loss is probably due to the effects of the coating as semi permeable barrier against O_2, CO_2, moisture and solute movement thereby reducing respiration, water loss and oxidation reaction rates (Ganvit, 2014) [12]. Similar results were also obtained by (Baldwin *et al*., 1999) [7].

Pulp and peel ratio

The significant difference was observed among the treatments for pulp and peel ratio. T_0 significantly recorded higher pulp and peel ratio of fruit (9.56) and lowest pulp and peel ratio was recorded in T_6 15% acacia gum (6.98) which was followed by with T_8 ghee (7.71).The application of acacia gum at a concentration of15% on mango fruits was found to extend their shelf life by reducing water loss and inhibiting microbial growth (Kumar *et al*., 1998) [15].

Average number of days taken to ripening (days)

The mean data indicated that there were significant differences among all the coating treatments. Unripe fruits coated by 15% acacia gum T_6 had significantly higher percent of average number of days taken to ripening of fruits after harvest 13.96% followed by T_8 ghee 12.06%. The fruits uncoated T_0 control had significantly the lower percent of average number of days taken to the ripen fruits at days after harvest 6.42%during storage period. The results indicated that 15% acacia gum had significantly the lowest percent of ripened fruits at 16 day after harvesting. Possibly, the coating material modified gaseous exchange and retarded the physiological changes associated with production of ethylene, chlorophyll degradation and carotenoid synthesis, thus ultimately delayed ripening and colour change of fruits (Lopez *et al*., 2000; Hoa *et al*., 2002) [14].

Effect on shelf-life (days)

Significantly maximum shelf-life of mango fruits (19.92 days) was recorded with T_6*i.e.*coating with 15% acacia gum and it was followed by with T_8 *i.e.* (18.00 days), whereas minimum shelf-life of (13.33 days) was recorded with T_0 *i.e.* shelf life of mango fruits were observed maximum in fruits coated with 15% acacia gum whereas, the lowest shelf life were observed in fruits coated. The fruits coated with 15% acacia gum solution had reduced water loss which reflected as minimum percent PLW, delayed ripening processes which resulted in longer shelf life. Similar results were also (Ali *et al*., 2010 and EI-Anay *et al*. 2009) [4, 11].

Bio-chemical parameter of mango

Total soluble solids (%)

The superiority of treatment T_6 (15% acacia gum) recorded with minimum total soluble solids content (15.75%), which was followed by Treatment T_8 ghee (15.83%) and while maximum content registered in control, T_0 (19.17%) at similar respective days. The lowest TSS was noted in fruits coated with 15% acacia gum. Modification of gaseous exchange in 15% acacia gum coated fruits might have decreased respiration rates which resulted in lowered PLW and delayed ripening due to delayed conversion of starch to sugars at ripening and reflected as lower TSS as compared to control. Slowdown in the synthesis and use of metabolites resulting in lower TSS due to coating was reported by (Yaman and Bayoindirli, 2002) [22].

Titrable acidity (%)

The data table of various coating treatments during the present experiment from as per assays states that the acidity percent of mango fruit is significantly affected and the acidity content of mango possess vice versa to the increasing of storage period. The maximum acidity (0.21%) was recorded under the treatment T_6 (15% acacia gum) which was closely followed by T_8 (0.20%) while minimum in T_0 (control) (0.08%), during storage period. The minimum acidity of pulp was recorded in mango fruits without coating. Organic acids, such as malic or citric acid, are primary substrates for respiration; a reduction in acidity is expected in highly respiring fruit (AI-Juhaimi *et al*., 2013) [5]. The uncoated fruits had higher PLW due to higher rate of respiration. The higher acidity in pulp of fruit is noted in coated fruit. It is considered that coating reduces the rate of respiration and may therefore delayed the utilization of organic acid (Patel *et al*., 2016) [16]. Which results higher acidity in coated fruit.

Ascorbic acid (mg/100 g pulp)

During the present investigation the superiority of treatment T_6 (15% acacia gum) recorded with maximum ascorbic acid content (34.30 mg/100 g pulp) which was closely followed by the treatment T_8 (ghee) (33.35 mg/100 g pulp), whereas the minimum ascorbic acid content (27.60 mg/100 g pulp) were observed under the T_0control.This might be due to low oxygen permeability of coating which delayed the deteriorative oxidation reaction of ascorbic acid content. coating reduce the respiration of fruit and retains the ascorbic acid in fruit. result was also noted by (Brishti *et al*.., 2013) [9].

Total sugar (%)

As per the observation there is not much significant difference between coating treated fruits, however, the superiority of total sugar content was observed in T_0 (control) with maximum 16.47% during storage period which is closely followed by T_8 (ghee) 13.55%, while the minimum amount of total sugar 13.00% in T_6 (15% acacia gum) treated mango fruits during storage period.

Total sugars in mango fruits increase during ripening mainly due to two mechanisms, conversion of starch to simple sugars (sucrose, fructose and galactose) due to the activity of amylase; and, biosynthesis of sucrose. Among sugars,

sucrose is the predominant sugar in ripe mango fruits. It is possible that due to 15% acacia gum coating, the conversion of starch into sugars as well as biosynthesis of sucrose slowed down as a result of modified gaseous exchange and reduced respiration rates and reflected as lower total sugars content at ripening. In uncoated fruits, the uninterrupted hydrolysis of starch in to sugars and biosynthesis of sucrose led to higher total sugars in the fruits at ripening. (Ganvit *et al*., 2014) [12].

Reducing sugars (%)

During the experiment the treatment T_0control has superiority with maximum reducing sugar percent (6.01%) during storage period under present experiment. While the minimum reducing sugar content (4.27%) was recorded in T_6 (15% acacia gum) which was followed by Treatment T_8 (ghee) (4.41%) shows significant differences in reducing sugar content. Hydrolysis of starch to simple sugars and rate of conversion might be higher in uncoated fruits (control) due to normal respiration and sequences of ripening processes. But in case of 15% acacia gum coated fruits, modified respiration processes might be delayed hydrolysis of starch to sugars. The differences in reducing sugars content among the fruits coated with different coating will probably due to differences in molecular characters and the specific ability of coating materials used to modify the gaseous exchange in fruits (Patel *et al*., 2016) [16].

Tables

Tables 1: Effect of different coating treatments on percentage of weight loss, Pulp: peel, Days taken to ripening, shelf life of mango.

Treatments	Physiological loss in weight (%)				Pulp: Peel	Days taken to ripening	Shelf life
	4days	8days	12 days	16 days			
T_0 Control	5.10	10.17	14.60	27.89	9.56	6.42	13.00
T_1 50% *Aloe vera* gel	4.57	7.39	11.71	22.81	8.32	9.33	16.58
T_2 75% *Aloe vera* gel	3.19	6.76	10.92	21.98	8.11	9.50	16.92
T_3 5% Tapioca starch	4.27	9.55	13.49	25.70	8.32	7.44	16.08
T_4 10% Tapioca starch	4.10	8.27	12.94	24.73	8.01	8.92	16.75
T_5 10% Acacia gum	3.30	7.28	11.80	22.21	7.92	11.11	17.00
T_6 15%Acacia gum	2.76	4.94	9.56	20.98	6.98	13.96	19.92
T_7 Coconut oil	4.10	7.41	11.93	23.52	8.17	10.75	17.58
T_8 Ghee	2.99	5.52	10.72	21.70	7.71	12.06	18.00
S.Em±_	1.14	1.46	0.94	0.95	0.51	0.40	0.54
C.D at 5%	NS	NS	2.80	2.83	NS	1.21	1.61
C.V.%	NS	NS	13.73	7.03	NS	6.47	5.66

Tables 2: Effect of different coating treatments on percentage of Total Soluble Soilds, Ascorbic acid, Total sugar, Reducing sugar, Acidity of mango.

Treatments	TSS	Ascorbic acid (%)	Total sugar	Reducing sugar (%)	Acidity (%)
T_0 Control	19.17	29.60	16.47	6.01	0.08
T_1 50% *Aloe vera* gel	17.75	30.94	15.41	5.24	0.12
T_2 75% *Aloe vera* gel	17.25	31.96	14.51	4.99	0.14
T_3 5% Tapioca starch	17.25	27.91	15.63	5.00	0.10
T_4 10% Tapioca starch	16.50	28.52	14.95	4.70	0.10
T_5 10% Acacia gum	15.92	32.36	13.78	4.61	0.18
T_6 15%Acacia gum	15.75	34.30	13.00	4.27	0.21
T_7 Coconut oil	16.33	32.96	13.89	4.63	0.19
T_8 Ghee	15.83	33.35	13.55	4.41	0.20
S.Em±_	0.29	0.50	0.06	0.06	0.00
C.D at 5%	0.88	1.51	0.18	0.18	0.02
C.V.%	3.06	2.74	0.72	2.16	4.99

Conclusion

The findings and observations make during present investigation evident clearly that wax coating proves great coating material, especially 15% acacia gum was found superior among all. Coating of 15% acacia gum reduces the rate of ripening process contributes for prolonged shelf-life and storability of mango fruits up to 16 days of storage without affecting their physico-chemical composition. During the sensory evaluation 15% acacia gum and 75% *Aloe vera* gel coated fruits performed excellently up to 16 days of storage period. In present investigation, based on superiority of wax coating on fruit by assessment on various aspects, it is concluded that the coating with 15% acacia gum and 75% *Aloe vera* gel is best among all other lipids and secondary metabolites based coating materials also proved to lengthen self-life along with maintain quality for extended period.

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