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Effect of Organic Coating on Shelf Life and Quality of Organically Grown Mango cv. Kesar

Kalindi Patel*, S. J. Patil, C. R. Patel and Falguni Patel
ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat) 396450
*Corresponding Author E-mail: patelkalindi1991@gmail.com
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ABSTRACT
The experiment was laid out in Completely Randomized Design (CRD) with Factorial concept having sixteen treatment combinations, comprising of four levels of organics viz., 80% N through Castor cake + Azotobacter+ PSB (50 gm each/tree), 80% N through Neem cake + Azotobacter+ PSB (50 gm each/tree), 80% N through Vermi-compost + Azotobacter + PSB (50 gm each /tree and 80% N through Biocompost + Azotobacter + PSB (50 gm each /tree) and four levels of organic coatings viz., 75% Aloe vera gel, 5% Acacia gum, 5% Tapioca starch and Control (No coating). The treatments were repeated thrice. The effect of these treatments on different parameters of quality and shelf life of fruits were studied. The results of present investigation revealed that among the different organics and coating, application of 80% N through Neem cake + Azotobacter + PSB (50 gm each /tree) and 5% Acacia gum coating were found to be most beneficial for improving quality and shelf life of fruits. Similar trend was observed on quality parameters such as Total Soluble Solids, acidity, TSS: acidity ratio and firmness. Minimum physiological loss in weight in same treatment. The interaction between organics and coating was found non significant.

Key words: *Mango, Coating, Castor cake, Neem cake, Vermi compost, Bio compost, Azotobacter, PSB.*

INTRODUCTION

Mango (*Mangifera indica L.*) is the premier fruit of the world which belongs to the family Anacardiaceae. It is grown almost in 111 countries around the world but this fruit occupies a unique place among the fruit crops grown for well over 4000 years in Indian subcontinents. Out of these, 69 species of mango are edible and commercial mango cultivars. The climatic condition of South Gujarat although considered marginal for mango cultivation have tremendous possibilities of high quality cultivars. Besides this fruit possesses a good sources of vitamin-A, β-carotene, vitamin – B complex, vitamin – C, minerals, digestible sugars and trace elements. Mango trees respond well to organic manure applications. Organic manures such as vermi compost, castor cake, neem cake, bio-compost are used for promoting healthy tree growth and fruit formation.

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The organic manures also act as a carrier medium for the development of several beneficial microorganisms such as *Azospirillum*, *Azotobacter*, *Rhizobium* and *Phosphobacteria*.

Application of various films and coatings modify the fruit atmosphere at micro level, reduce weight loss during transport and storage and extends shelf life. It can also reduce growth of micro organisms. Coating provides semi permeable barrier against oxygen, carbon dioxide, moisture and volatiles. Use of coating is well known in citrus, apple, tomato, and gourd vegetables to extend shelf life and improve appearance without adversely affecting flavor, taste and aroma. It is very cheap and effective technique and applicable at farm level.

MATERIALS AND METHODS

This investigation was carried out at Fruit Science Laboratory, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari which is situated on the coast of Arabian Sea at 20^{0}-57^{0} N latitude and 72^{0}-54^{0}E longitude with an altitude of about 10 meters above the mean sea level. The laboratory work was carried out at Post Harvest Technology Laboratory, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari. Freshly harvested mango cv. Kesar fruits were selected from the organic orchard of RHRS farm, N.A.U., Navsari and immediately brought to the laboratory. Before coating, mango fruits were washed with tap water and dried in air. The mangoes were manually coated by hand with a sponge according to each specific treatment and the coated fruits were dried in air. After coating the fruits were kept under room temperature.

To prepare 75% *Aloe vera* gel, *Aloe vera* gel matrix was separated from the outer cortex of leaves and this colourless hydroparenchyma was grind in blender. The resulting mixture was filtered to remove the fibres. Then, 75ml of *Aloe vera* gel was added in 25ml of water and mixed it with blender. To prepare 5% *Acacia* gum, 5g of laboratory grade *Acacia* gum powder was dissolved in 95 ml distilled water. The solution was heated at 40^{0}C and stirred until it became clear[5]. To prepare 5% tapioca starch solution, 5g 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 obtain required concentration. The following observation were taken viz, physiological loss in weight (%), firmness (kg/cm^2), total soluble solids (%), acidity (%), TSS: acidity ratio, total sugar (%), reducing sugar (%), non reducing sugar (%), Ascorbic acid content (mg/100g) and shelf life (days).

RESULT AND DISCUSSION

Physiological loss in weight (%)

The data presented in table 1 revealed that the minimum PLW (19.74% and 19.00%) was noted with the application of 80% N through Neem cake + *Azotobacter* + PSB (50 gm each /tree) and fruits coated with 5% *Acacia* gum which was statistically at par with O_3 and O_1 treatment, while maximum PLW (22.62% and 23.04%) was observed in O_4 treatments and uncoated fruits respectively. This can be attributed to the phenomenon that the altered physiology and biochemistry of the fruits as influenced by organic sources of nutrients might have led to the reduced respiration which in turn resulted in low PLW and highest shelf life[10]. Similar results were obtained by Vanilarasu[17] in banana and Shivakumar[13] in papaya. The basic mechanism of weight loss from fresh fruits is by vapour pressure at different locations[14]. Reduction in weight loss is probably due to effect of the coating as semi permeable barrier against O_2, CO_2, moisture and solute movement thereby reducing respiration, water loss and oxidation reduction rates[7]. Similar result were also obtained by Baldwin in 1999.

Table 1: Effect of organic coating on PLW, firmness, TSS, acidity and TSS: acidity ratio of organically grown mango cv. Kesar

Treatments	PLW (%)	Firmness (kg/cm^2)	TSS (%)	Acidity (%)	TSS: Acidity Ratio
Organic (O)					
O_1- 80% N through Castor cake + *Azotobacter*+ PSB (50 gm each/tree)	21.05	4.26	20.92	0.252	84.53
O_2- 80% N through Neem cake + *Azotobacter*+ PSB (50 gm each/tree)	19.74	4.33	21.78	0.248	85.81
O_3- 80% N through Vermi-compost + *Azotobacter* + PSB (50 gm each /tree)	20.95	4.30	20.94	0.245	86.98
O_4- 80% N through Biocompost + *Azotobacter* + PSB (50 gm each /tree)	22.62	4.14	20.69	0.252	81.48
S.Em. ±	0.58	0.06	0.39	0.01	3.35
C.D. at 5%	1.66	NS	1.13	NS	NS
Coating (C)					
C_1- 75% *Aloe vera* gel	20.35	4.38	20.62	0.245	83.83
C_2- 5% *Acacia* gum	19.00	4.75	20.65	0.281	93.01
C_3- 5% *Tapioca* starch	21.97	4.10	21.30	0.240	87.97
C_4- Control (No coating)	23.04	3.78	21.75	0.231	73.99
S.Em. ±	0.58	0.06	0.39	0.01	3.35
C.D. at 5%	1.66	0.16	1.13	0.03	9.67
Interaction Effect (O×C)					
S.Em. ±	1.15	0.11	0.26	0.006	2.23
C.D. at 5%	NS	NS	NS	NS	NS
C.V.%	9.45	4.49	2.14	4.83	4.57

Fruit Firmness (kg/cm^2)

The examination of data regarding firmness as influenced by different organic application are presented in table 1 clearly revealed non-significant different. While the maximum firmness (4.75kg/cm^2) was noticed in fruit coated with 5% *Acacia* gum and minimum firmness (3.78kg/cm^2) was recorded in fruits without coating. This is a biochemical process involving pectin and starch hydrolysis due to enzymes including wall hydrolyses. De-polymerization (shortening of chain length of pectin substances) occurs with an increase in pectinesterase and polygalacturonase activities during fruit ripening[1]. In agreement with this findings, Maqboo[11] reported that banana fruits treated with gum arabic delayed fruit ripening and resulted in firmer fruits.

Total soluble solid (%)

The data presented in table 1 revealed that maximum TSS (21.78% and 21.75%) was noted with the application of 80% N through Neem cake + *Azotobacter* + PSB (50 gm each /tree) and uncoated fruits respectively. Increase TSS at higher levels of nitrogen may have extered regulatory role as an important constituent of endogenous factors in affecting the quality of fruit in which carbohydrate is important and during ripening of fruits the carbohydrate reserves of the roots and stem are drawn upon heavily by fruits which might have resulted into higher TSS and sugar content of fruits[4]. Such results were also noted by Gohil[8]. The uncoated fruits had interrupted gaseous exchange and normal ripening processes which might be reflected as higher TSS in fruits as compared to coated fruits.

Acidity (%)

The data regarding acidity as influenced by different organic application are presented in table 1 clearly revealed non-significant difference. the minimum acidity (0.231%) was observed in fruits without coating. This results might be due to aerobic respiration and higher evapotranspiration rate[14]. Such results were also noted by Chauhan, Sweta, Ergun[6] and Guillen[9].

Table 2: Effect of organic coating on total sugar, reducing sugar, non reducing sugar, ascorbic acid and shelf life of organically grown mango cv. Kesar

Treatments	Total sugar (%)	Reducing sugar (%)	Non reducing sugar(%)	Ascorbic acid (mg/100g)	Shelf life (days)
Organic (O)					
O_1- 80% N through Castor cake + *Azotobacter*+ PSB (50 gm each/tree)	14.69	5.23	9.46	33.73	18.95
O_2- 80% N through Neem cake + *Azotobacter*+ PSB (50 gm each/tree)	15.08	5.47	9.61	33.99	20.00
O_3- 80% N through Vermi-compost + *Azotobacter* + PSB (50 gm each /tree)	14.97	5.40	9.57	33.93	19.87
O_4- 80% N through Biocompost + *Azotobacter* + PSB (50 gm each /tree)	14.48	5.19	9.29	33.59	18.62
S.Em. ±	0.13	0.16	0.14	0.13	0.25
C.D. at 5%	NS	NS	NS	NS	0.73
Coating (C)					
C_1- 75% *Aloe vera* gel,	14.10	5.09	9.01	38.68	19.66
C_2- 5% *Acacia* gum,	14.97	5.33	9.64	32.76	21.33
C_3- 5% *Tapioca* starch	14.82	5.27	9.55	35.36	18.68
C_4- Control (No coating)	15.34	5.61	9.73	28.45	17.87
S.Em. ±	0.13	0.16	0.14	0.13	0.25
C.D. at 5%	0.40	0.46	0.42	0.37	0.73
Interaction Effect (O×C)					
S.Em. ±	0.27	0.10	0.29	0.26	0.50
C.D. at 5%	NS	NS	NS	NS	NS
C.V.%	3.19	3.49	5.26	1.34	4.53

TSS: Acidity ratio

It is evident from table 1 revealed that maximum TSS: acidity ratio (93.01) was observed in fruits coated with 5% *Acacia* gum. Similar results were also noted in mango fruits coated with *acacia* gum by Ganvit[7].

Total sugar (%)

The data presented in table 2 revealed that highest total sugar (15.34%) was found in fruit without coating whereas, the fruit coated with 75% *Aloe vera* gel had lowest total sugar (14.10%) content. total sugar in mango fruits increased 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 75% aloe vera gel 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[7].

Reducing sugar (%)

It is evident from table 2 revealed that maximum reducing sugar was recorded in uncoated fruits whereas, the minimum reducing sugar was noted in fruits coated with 75% *Aloe vera* gel. Hydrolysis of starch to simple sugar and rate of conversion might be higher in uncoated fruits due to normal respiration and sequences of ripening processes. But in case of 75% *Aloe vera* gel 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[7].

Non reducing sugar (%)

The data presented in table 2 revealed that highest non reducing sugar was found in uncoated fruits whereas, lowest non reducing sugar was measured in 75% *Aloe vera* gel. It is proven that coating reduces respiration rates by modification in exchange of o2 and co2 in fruits. the lower level of non reducing sugar (sucrose) among 75% *Aloe vera* gel coated fruits at ripening might be due to its specific capacity to altered respiration process resulted in slow hydrolysis of starch as well as inadequate biosynthesis of sucrose during ripening. It is also possible that 75% aloe vera gel affected the inversion of non reducing sugar into reducing sugar. The higher quantity of non reducing sugar in uncoated fruits is obvious due to normal ripening processes[7].

Ascorbic acid (mg/100g)

The data presented in table 2 clearly revealed that highest ascorbic acid content was recorded in fruits coated with 5% aloe vera gel solution. this might be due to low oxygen permeability of coating which delayed the deteriorative oxidation reaction of ascorbic acid content[14]. Such results were also noted by Brishti[2] in papaya and Vahdat[15] in strawberry.

Shelf life (days)

The data presented in table 2 clearly revealed that maximum shelf life was noted with the application of 80% N through Neem cake + *Azotobacter* + PSB (50 gm each /tree) and fruits coated with 5% acacia gum respectively. This can be attributed to the phenomenon that the altered physiology and biochemistry of the fruits as influenced by organic sources of nutrients might have led to the reduced respiration which in turn resulted in highest shelf life[10]. This result lend support to the findings of Vanilarasu[17] in banana. The fruits coated with 5% *Acacia* gum solution had reduced water loss which reflected as minimum per cent PLW, delayed ripening processes which resulted in longer shelf life. These findings are also in line with 'Anna' apples coated with arabic gum by El-Anay[5] and Valverde[16]. The uncoated fruits had recorded lowest shelf life at ripening due to higher PLW possibly due to higher respiration rate which then hastened the ripening of fruits and reflected as earlier ripening as compared to all other treatments. As the fruits ripened early, they also crossed the shelf life quality earlier due to climacteric nature[12].

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