Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.5466

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (6):** 307-311 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Studies on the Influence of Packaging Materials on Biochemical Changes of Mango c. v. Amrapali (*Mangifera indica* L.)

Mounika Taduri[1*], N. N. Reddy[2], N. Jyothi Lakshmi[2] and Veena Joshi[1]

[1]SKLTS Horticulture University, Rajendra nagar-500030, Hyderabad, Telangana

[2]CRIDA, Principal Scientist, Department of Horticulture, Santhosh Nagar-500059(TS)

*Corresponding Author E-mail: tadurimounika@gmail.com

Received: 18.08.2017 | Revised: 28.09.2017 | Accepted: 4.10.2017

ABSTRACT

An investigation was conducted to study the effect of different packaging materials to maintain shelf life and quality of mango cv. Amrapali at ambient storage conditions. Fruits of mango were harvested at firm mature stage, packed in different packaging materials, viz. LDPE + 5% perforation, LDPE +Blotting paper, LDPE + Blotting paper + 5% perforation, Gunny bag, cotton cloth bag, plastic fertilizer bag, mesh bag, control (without packaging).Among the treatments the maximum total soluble solids recorded during 12th day of storage (21.92 Brix°) in fruits of LDPE Bags with 5% perforation whereas Minimum T.S.S. (16.19° Brix) was recorded in control.The fruits packed in LDPE +5 % ventilation recorded higher TSS: ***:*** *Acid ratio 107.44 whereas lower TSS:* *Acid ratio recorded in control.The total sugar, reducing non reducing sugars were also more recorded in LDPE +5 % ventilation lowest sugars was observed in control.After two weeks of storage, fruits packed in perforated LDPE retained high percentage of TSS,desirable firmness, minimum spoilage and better quality as compared to other treatments. The study revealed that mango fruits of Cv. Amrapali packed in 5% perforated LDPE polythene films can be stored for 16 days, as compared to unpacked control fruits which had storage life of 9 days.*

Key words: *Amrapali, Cotton cloth bag, LDPE, Gunny bag, Mango.*

INTRODUCTION

Mango (*Mangifera indica* L.) is one of the most important commercial fruit crops, being referred to as the 'King of fruits'. India accounts for 41% of world's mango production. Mango is cultivated in an area of 2.2million hectares with a production of 18.7 million tonnes and a productivity of 8.5 MT/ha. As per[6] data base mango occupies 34.9% of total fruit area, 20.7% of total fruit production. The area and production of mango has been increased by 45-50% during the last one decade.

Mango has rich diversity with many cultivated varieties and hybrids among them, Amrapali is a well known as a regular bearing dwarf hybrid.

Cite this article: Taduri, M., Reddy, N.N., Lakshmi, N.J. and Joshi, V., Studies on the Influence of Packaging Materials on Biochemical Changes of Mango c. v. Amrapali (*Mangifera indica* L.), *Int. J. Pure App. Biosci.* **5(6):** 307-311 (2017). doi: http://dx.doi.org/10.18782/2320-7051.5466

The fruit is oblong in shape. It is excellent in taste and is regarded as a good table variety. The fruit quality of Amrapali is favorably superior over its parent, Dashehari. The flesh is deep orange red and has about 2.5 to 3.0 times more ß carotene content indicating higher vitamin A content. This variety is more suitable for export and processing industry for preparing coloured mango nectar and juice. Due to dwarf nature the cultivar is recommended and for high density planting & kitchen gardens[10].

Post harvest management of fruits comprises of different steps and packagings are one of them. Because packaging is the most fundamental tool for the post harvest management of highly perishable commodities. Packaging is an essential and indispensable component at different steps of post harvest handling and adopted especially to reduce transportation losses.

MATERIALS AND METHODS

The study was conducted at Department of Horticulture, CRIDA during the year 2015-16.The fruits of mango cv. Amrapali were harvested at physiological mature stage. The bruised and diseased fruits were sorted out, and only healthy and uniform sized fruits were selected for the study. The fruits were packed in different packaging materials. The experiment consisted of 8 packaging treatments v*iz*; T_1–LDPE + 5% Perforation, T_2–LDPE + Blotting paper inside, T_3 – LDPE +5% perforation+ blotting paper, T_4 – Jute Gunny Bag, T_5 – Cloth Bag, T_6 – Plastic fertilizer bag, T_7 –Mesh bag, T_8-Control. Thereafter, the packed fruits as well as control (non-packed) fruits were stored at 20-21°C and 85-90% RH. The fruits were subjected to physic-chemical analysis at 4 days interval, viz., 0^{th}, 4^{th}, 6^{th}, 8^{th}, 12^{th} and 16^{th} days of storage and analyzed statistically following the complete randomized design as out lined by Panse and Sukhatme[7].

The physiological loss in weight (PLW) after each interval of storage was calculated by subtracting final weight from the initial weight of the fruits and expressed in per cent. The fruit firmness was measured with the help of a penetrometer (Model FT- 327, USA) using 8 mm stain less steel probe. The ripening percentage was calculated as the number of ripe fruit/total number of fruit x 100 and expressed as a percentage. The spoilage percentage was calculated as the number of spoiled fruit/total number of fruit x 100 and expressed as a percentage.

TSS was determined by Hand Refractrometer and expressed in ºbrix, acidity of fruits by AOAC method[1] total sugars, reducing and non reducing sugar and acidity of fruits were recorded by a method as suggested by Ranganna[9].

RESULTS & DISCUSSION

TOTAL SOLUBLE SOLIDS (TSS)

Total soluble solids (TSS) content increased slowly and steadily in all the packed fruits, after which decline in the TSS was recorded at the end of storage (Fig 1). After 12^{th} days of storage interval the highest TSS (21.92%) was recorded in mango fruits packed in 5% perforated LDPE film, closely followed 21.19 % TSS in fruits packed in 5% perforated LDPE film with blotting paper. It was observed that in 5% perforated LDPE film packed fruits the TSS con tent in creased slowly and steadily up to 12 days (21.92%) and there after grad ally declined after 16 days storage (19.70%). The lowest average TSS (12.66%) was observed in fruits kept as unpacked (control). On the other hand, unpacked control fruits recorded increase in TSS up to 8^{th} days and then declined sharply afterwards. Likewise, Goutam *et al*[4] observed in guava that TSS of fruits was found increasing for few days in storage and later on decline in TSS was occurred. Mango fruits packed in polythene films retained high percentage of TSS as compared to unpacked control fruits. These results are in agreement with findings of Parihar and Kumar[8] on guava.

ACIDITY

The titratable acidity of mango fruits packed in polythene films showed a linear declining trend with the advancement of storage periods (Fig 1). The packaging films helped in better retention of acidity as compared to control. After 8^{th} day of storage interval the highest titratable acidity (0.39%) was recorded in the fruits packed in 5% perforated LDPE, followed by 0.37% acidity in 5% perforated LDPE film +blotting paper. The lowest mean titratable acidity (0.32%) was recorded in control fruits, followed by fruits packed in mesh bag (0.33%). The progressive reduction in the acidity with advancement of storage periods may be attributed to utilization of organic acid in pyruvate decarboxylation reaction occurring during the ripening process of fruits. A declining trend in acidity in mango fruits was noticed during storage and it was observed in all the treatments. The present study results are in agreement with the results of Goutam *et al.*[4] in guava, who also reported decrease in acidity with advancement of storage periods. The maintenance of higher acidity in the packed fruits may be due to the decreased hydrolysis of organic acids and subsequent accumulation of organic acids, which oxidized at a slow rate because of decreased respiration in these films.

The treated fruits could maintain a higher level of acidity up to last day of storage. It might be due to reduced respiration rate in the later stage of storage as affected by different packing containers. Decline in acidity at faster rate under control could be associated with the higher rate of respiration, as acid forms the necessary substrate for this catabolic process in the fruits[2].

TSS-ACID RATIO

There was a continuous increase in the mango fruit TSS-Acid ratio with the advancement of storage periods irrespective of different packaging material (Fig 1). The fruit packed in LDPE+5%perforation recorded highest TSS-Acid ratio (109.44) followed by treatments in which the fruits were packed in LDPE+5%perforationwith blotting inside (107.27). The control fruits recorded the minimum average TSS-Acid ratio (39.77). Among the different treatments, mango fruits packed in LDPE+5%perforation retained highest average TSS-Acid ratio (51.72) of fruits rather than fruits packed in other packing material. TSS: acid ratio of mango fruit increased continuously throughout the storage period though TSS had slow initial increase followed by decrease. The increase in ratio might be due to the fact that magnitude of decrease in acidity is more compared to decrease in TSS in the later stage of storage which is faceable with the results obtained by Goud[11] in sapota.

TOTAL SUGAR

The fruits packed in LDPE+5%perforation (Fig 2) recorded maximum total sugar con tent (8.36%). The control fruits recorded the lowest average total sugar content (11.68%). It was further observed that in LDPE+5%perforation packed fruits the total sugar content in creased slowly and steadily up to 12 days (16.75%) and there after gradually declined after 16 days storage (16.26%). On the other hand, control fruits recorded a faster rise in total sugar con tent up to 8 days and there after declined at a faster rate at the end of storage. The delayed increase in TSS and total sugars over a longer period of time in LDPE+5%perforation mango fruits might be attributed to delay in ethylene production and respiration rate of fruits. The increase in TSS/sugars during storage may possibly be due to break down of starch into sugars, as on complete hydrolysis of starch no further increase in sugars occurs and subsequently a decline in these parameters is predict able as they along with other organic acids are primary substrate for respiration Wills *et al.*[12]. Similar findings of increase in TSS and sugars of plum fruits during storage have been reported Mahajan.

REDUCING SUGARS

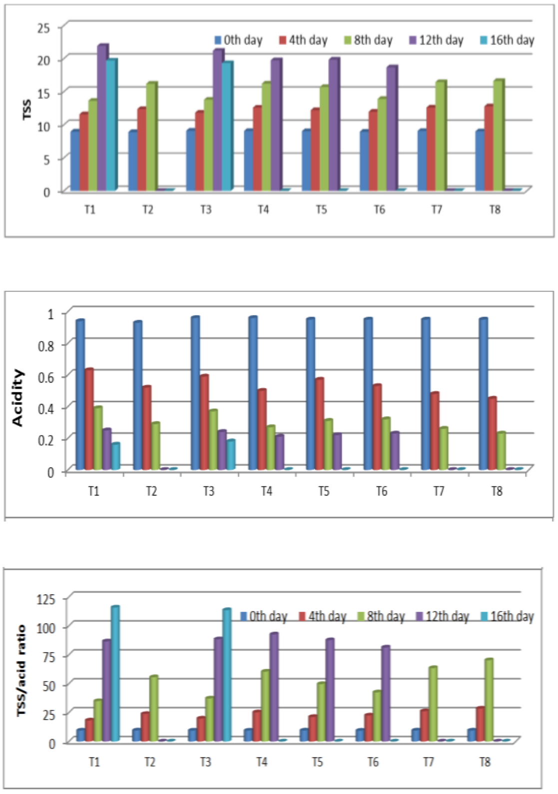
Reducing sugars was gradually increased in fruits with a slight decline at the end of storage periods, being significantly highest with LDPE+5%perforation packed fruits (9.23%) as compared to rest of the treatments (Fig 2). The initial increase in reducing sugars might be due to the conversion of starch into reducing sugar and later on reduction could possibly might be due to utilization of sugar in the process of respiration. The percentage of reducing sugar increased slowly during storage period up to 12^{th} day and declined thereafter.

The increase in reducing sugar might be due to increased rate of starch by amylase activity. The increase in the total reducing sugar content is in line with the findings of Ingle *et al*.[5], who reported an increase in reducing sugar content of sapota fruits during ripening. However, decrease in reducing sugar content (%) was also observed due to over ripening of fruits which was utilized during respiration process.

NON REDUCING SUGAR

It was observed that the accumulation of non reducing sugar (%) showed significant difference with respect to treatments and ripening stages of fruit, with a slight decline at over ripe stage being significantly highest with LDPE+5%perforation packed fruits (7.52%) which was at par with LDPE+5%perforation with blotting paper (7.28%) as compared to rest of the treatments (Fig 2).The increase in the non-reducing sugar might be due to the hydrolysis of starch and conversion in the pectin substances from water insoluble to water soluble fractions. These results are in accordance with the findings of Hiwale and Singh *et al*.[3] in guava.

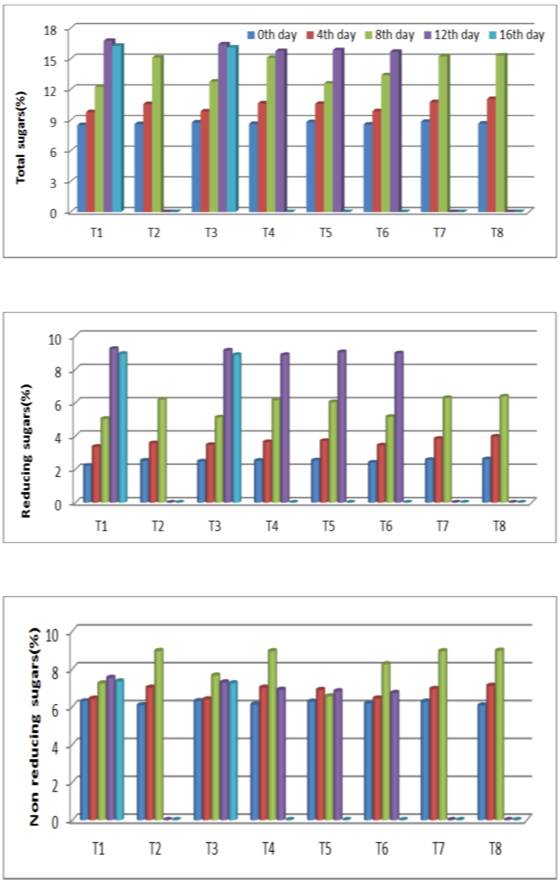
Fig. 1: Effect of packaging materials on TSS, acidity and TSS/acid ratio of Mango cv. Amrapali



0-End of shelf life

T_1-LDPE + 5% Perforations, T_2-LDPE + Blotting paper inside, T_3-LDPE + 5% Perforations + Blotting paper inside, T_4-Jute gunny bag, T_5-Cloth bag, T_6-Plastic fertilizer bag, T_7-Mesh bag, T_8-Control (no packing)

Fig. 2: Effect of packaging materials on total sugars, reducing sugars and non reducing sugars of Mango cv. Amrapali



0-End of shelf life

T_1-LDPE + 5% Perforations, T_2-LDPE + Blotting paper inside, T_3-LDPE + 5% Perforations + Blotting paper inside, T_4-Jute gunny bag, T_5-Cloth bag, T_6-Plastic fertilizer bag, T_7-Mesh bag, T_8-Control (no packing)

CONCLUSION

From the above findings, it can be concluded that LDPE +5% perforation proved to be the best treatment. Hence it can be used for the post harvest storage of mango fruits.

Acknowledgements

We would like to express our deep sense of gratitude to Dr. N. Jyothi lakshmi principal scientist CRIDA & staff for providing necessary facilities for carrying out the research work and feel grateful to the faculty members of the Department of horticulture for their needful help.

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