The Bioscan 10(3): 1031-1035, 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

STANDARDIZATION OF PACKAGING CONTAINERS FOR STORAGE OF MANGO (*MANGIFERA INDICA* L.) CANDY

PRAVEEN KUMAR MISHRA[1]*, VIKASH KUMAR MISHRA[3], GULAB SINGH[4], VINOD SINGH[2], SANJAY SAHAY[1], PIYUSH SHRIVASTAVA[1] AND V. K. MAURYA[1]

[1]Department of Horticulture (Fruit and Fruit Technology)
Bihar agricultural University, Sabour, Bhagalpur - 813210, Bihar INDIA
[2]KVK, Masaudha, NDUA&T, Kumarganj, Faizabad - 224 137, U.P. INDIA
[3]Department of Genetics and Plant Breeding, NDUA&T, Kumarganj, Faizabad - 224 229, U.P. INDIA
[4]Departments of Agricultural Meteorology and Physics, BCKV, Mohanpur Nadia - 741 252, West Bengal INDIA
e-mail: praveen.bau@gmail.com

KEYWORDS
Mango
Organoleptic test
Candy and Packaging Containers

Received on :
05.05.2015

Accepted on :
20.08.2015

***Corresponding author**

ABSTRACT

The present research was carried out during the year 2012-13 at the Department of Horticulture, N. D. U. A. & T., Kumarganj, Faizabad (U.P.) India to standardized the packaging container for storage stability of mango (*Mangifera indica* L.) candy (osmo-dehydrated product). The prepared candy of Mallika variety was stored in different packaging containers like glass jars, plastic jar and LDPE packet at ambient condition. The qualitative attributes of prepared candy were observed at monthly interval up to 10 months of storage period and observed the LDPE packet was superior over other containers because least changes were observed in biochemical constituents, viz. ascorbic acid (6.2 mg/100g), total sugars (71.0 %), β-carotene (1.9 mg/100g), total phenols (14.4 mg/100g) and also prevent from physiological losses in weight by retaining maximum weight (192.0 g) with maintained higher organoleptic score (7.8) at the end of storage period. This experiment will be very helpful for commercialization of mango candy among processors, industrialist as well as consumers in perspective of stability, price and round the year availability.

INTRODUCTION

Mango (*Mangifera indica* L.) is popular as a king of fruits in India. It belongs to family Anacardiaceae and the origin of Indo-Burma regions (Mukherjee, 1958). India is the leading mango growing countries and produces 45.10% total production of the world. The total area under cultivation, production and productivity in our country reported as 2.516 million hectare, 18.431 million tonnes and 7.3 metric tonnes per hectare respectively (Anonymous, 2014). It is most likable fresh fruit among Indians due to its delicious taste, appealing flavour and high nutritional quality. It is wealthy source of several nutritive values like vitamin A, ascorbic acid and vitamin B complex (Manthey *et al.,* 2009 and Sogi *et al.,* 2012). Young and unripe mango fruits are acidic in nature and consumed for culinary purposes in addition to preparing pickles, chutney, and amchoor while the ripe fruits are utilized in preparing of squash nectar, jam, cereal flakes, custard powder, baby food, mango leather (Aam Papar) toffee and candy. Fresh mango fruits have very less shelf-life and the maximum post harvest losses occur during harvesting season because of several problems which significantly affect their freshness and storability. Therefore, osmotic dehydration is one the technology which can be minimising the post harvest losses up to great extent.

Mango candy is an osmo-dehydrated product and prepared through osmotic dehydration process. Osmotic dehydration is an advance practice for partial water removal from fruit tissues by immersed in a concentrated sugar solution without change of phase (Moraga *et al.,* 2009). The concentrated sugar solutions are an act as osmotic director to the obstruction of microbial activities and sustain the product for extend period (Giralado *et al.,* 2003). Sucrose is the chief sugar of mango (Gil 2000), consequently concentrated solution of this sugar may be slightest alteration in the organoleptic quality of primed product. This technology can be favourable for variety of fruits, to overcome the glut situation during the season. It is an essential to stabilize the product, achieving high quality alternative products, with an increasing shelf-life and less monetary load during storage and transportation. Presently mango candies are attaining additional credit in the global market just because of the product has original flavour and taste by means of all bio constituents. So maintaining the original flavour and taste of candy suitable packaging is prior need.

Packaging is an essential exercise not only storage of fresh fruit and its by-products but also for transportations. Because it played master role during storage, transportation and marketing with enhanced shelf life of fruits by-product by reduction of wastages. It has significantly manipulated the shelf life of stored produces by retarding the unnecessary physiological actions and other microbial deterioration. Packaging materials are also facilitate to maintaining several bio constituent as per as qualities concern like PLW, TSS, total

sugars, ascorbic acid and such other antioxidants for longer storage duration (Bhatia *et al.,* 2013 and Mishra *et al.,* 2013). The appropriate packaging containers offers pleasant environment by the decrement of undesirable bio-chemical changes and pathological deterioration of stored products (Singh *et al.,* 2007, Singh *et al.,* 2008 and Patel *et al.,* 2009). The quality candy is greatly dependent on the packaging containers during storage because all packaging containers are not fitting to retention edible quality and lengthen storage life for mango candy. Therefore, here three packaging containers LDPE packet, glass jar and plastic jar were selected to assess the appropriate packaging container for storage of mango candy in light of candy industries benefits as well as consumer safety.

MATERIALS AND METHODS

The present investigation was carried out in the Department of Horticulture, Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) during the year 2012-13 on packaging containers standardization for mango candy storage. The mango cultivar Mallika was taken in the 1st week of July, 2012 from university farm, which was grown under uniform management conditions. Here, three packaging containers LDPE packet, glass jar and plastic jar were taken under C.R.D. factorial design (Panse and Sukhatme, 1978) with three replications to study suitable packaging container for mango candy storage.

Preparation of mango candy

The completely matured mango cultivar Mallika was selected for preparation of candy. Firstly, the fruits were peeled, pricked and soaked with $CaCO_3$ (2%) for 24 hour. The slices were washed meticulously and blanched for 5 minutes. The sugar syrup solutions (40%, 50%, and 60% TSS) were prepared with the adding of citric acid (2%) and steeped the slices for 24 hours in each concentration whereas, in 70% TSS for 3 days. Slices were dried in to hot air oven at 50ºC for 12 hours (Mishra *et al.,* 2014). The dried products (candy) were packed in 200 g of each of following three types of containers (LDPE packet, glass jar and plastic jar) to find out suitable container for storage.

Biochemical estimations

The biochemical attributes of prepared Mallika candy among all packaging containers were analysed at monthly interval from beginning to completion of this work. These biochemical observations viz. ascorbic acid by (2, 6dichlorophenol indophenols- Dye) titration method, â-carotene analyzed with the help of spectrophotometer at 452 nm, browning (Rangana, 2010), total sugars (Lane and Eynon 1923) and total phenols (Singleton and Rossi, 1965) were recorded as par as method of several workers. The physiological loss in weight (PLW) was recorded in each container at initial stage to completion of the investigation. The physiological loss in weight of the fruits in percent was calculated at monthly interval on initial weight basis using the following formula

$$PLW\ (\%) = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

Organoleptic evaluation

Organoleptic evaluation was made for evaluating the taste, colour, flavour and texture of mango candy at monthly gap by the team of 10 judges on a 9 point hedonic scale (Amrine *et al.* 1965). Professors and Ph. D. scholars were including as a judge for organoleptic evaluation of mango candy at monthly interval. The candies of all containers were rated on description of their physical appearance, colour, taste and aroma etc. Overall acceptability was considered by adding of the each member scores.

RESULTS AND DISCUSSION

The results of this research have been showed and discussed about mango candy among all packaging containers. The biochemical estimations as well as organoleptic scores of candies were taken up to 10 month of storage period.

Biochemical estimations

The biochemical attributes are play important role for commercialization of packed fruit by-products. The chemical constituents of mango candy such as total sugars increased during ten months of storage period at ambient temperature in each packaging container (LDPE packet, glass jar and plastic jar) and significantly increased from third month till the end of storage (Fig.1). LDPE packet was found superior over other container because least changes in total sugars (71%) were

Table 1: Response of different packaging containers on ascorbic acid (mg/100g) of mango candy during storage

Storage period(in month)	Packaging containers			Average
	LDPE packet	Glass jar	Plastic jar	
0	10.2	10.2	10.2	10.2
1	10.2	10.0	10.2	10.1
2	9.8	9.5	10.0	9.7
3	9.4	8.8	9.2	9.1
4	9.0	8.3	8.8	8.7
5	8.2	7.9	8.3	8.1
6	7.8	7.3	7.9	7.6
7	7.2	6.5	7.4	7.0
8	7.0	6.0	6.7	6.5
9	6.8	5.7	6.1	6.2
10	6.2	5.3	5.9	5.8
Average	8.3	7.7	8.2	-

C.D. at 5%; Packaging container (P) 0.20; Storage period (S); 0.38; Interaction of P X S NS

Table 2: Response of different packaging containers on total phenols (mg/100g) of mango candy during storage

Storage period (in month)	Packaging containers LDPE packet	Glass jar	Plastic jar	Average
0	18.0	18.0	18.0	18.0
1	17.6	17.6	17.6	17.6
2	17.2	17.1	17.2	17.1
3	16.9	16.7	16.7	16.7
4	16.5	16.4	16.1	16.3
5	16.1	16.0	15.6	15.9
6	15.6	15.5	15.2	15.4
7	15.1	15.0	14.7	14.9
8	14.8	14.6	14.3	14.5
9	14.4	14.0	13.9	14.1
10	14.4	13.4	13.2	13.6
Average	16.7	15.8	15.6	-

C.D. at 5%; Packaging container (P) 0.25; Storage period (S) 0.49; Interaction of P X S NS

Table 3: Response of different packaging containers on organoleptic quality of mango candy during storage

Storage period (in month)	Packaging containers LDPE packet Organoleptic score	Rating	Glass jar Organoleptic score	Rating	Plastic jar Organoleptic score	Rating
0	9.0	LE	9.0	LE	9.0	LE
1	9.0	LE	9.0	LE	9.0	LE
2	9.0	LE	8.9	LVM	8.8	LVM
3	8.9	LVM	8.8	LVM	8.7	LVM
4	8.7	LVM	8.5	LVM	8.6	LVM
5	8.6	LVM	8.2	LVM	8.5	LVM
6	8.5	LVM	8.0	LVM	8.3	LVM
7	8.5	LVM	7.7	LS	8.2	LVM
8	8.2	LVM	7.6	LS	8.0	LVM
9	8.0	LVM	7.4	LS	7.8	LS
10	7.8	LS	7.2	LS	7.6	LS

LE- Like Extremely, LVM- Like Very Much, LS- Like Satisfactory

observed. Similarly, several scientist Pathak, (2011) bael candy, Singh (2012) ber candy and Mishra *et al.* (2013) bael candy were also reported LDPE packet was found superior over other containers. An increase in total sugars during storage in mango candy might be due to the inversion of non-reducing to reducing sugars and hydrolysis of polysaccharides in to monosaccharide (Singh, 2012).

Ascorbic acid content was decreased significantly from first month till the end of storage in all packaging containers but the maximum retention (6.2 mg/100g) was noticed in LDPE packet (Table 1). The difference in loss of ascorbic acid of mango candy in different containers may be due to oxidation with trapped oxygen in the containers, moisture proof containers and transparency against light of the container which resulted in formation of dehydroascorbic acid content (Mishra *et al.,* 2013). The candy becomes tough and hard after 10 month storage in glass jar due to loss of moisture from the product and leakages of air from the container. The β-carotene content of stored mango candy was decreased significantly from first month till the end of storage in all containers while the maximum β-carotene content (1.9 mg/100g) was observed in LDPE packet up to 10 month of storage period. The decline of β-carotene content in stored mango candy was probably due to the temperature, light and presence of residual oxygen that had marked effect on the pigment (Fig.2). Similar observations were made by Sahni and Khurdiya (1989) and Patil (1990).

The phenolic compounds play an important role to determining the colour and flavours of a product. Total phenol contents were decreased significantly from second month till the end of storage in all packaging containers. The least changes in total phenol values (14.4 mg/100g) were found in LDPE packet stored mango candy over other containers (Table 2). The losses of total phenol might be due to highly volatile and easily oxidizable nature and finally condensed in to brown pigments. This may probably be due to greater movement of oxygen, water vapour and oxidation of ascorbic acid, organic acid and polyphenols during storage. Such type results were also found in ber candy (Singh, 2012), fresh cut mango (Sogi *et al.,* 2012) and bael candy (Mishra *et al.,* 2013). The physiological loss in weight increased continuously in all containers with increasing storage period. LDPE packet stored mango candy was found significantly superior and retained maximum weight (192.0 g) against other containers up to 10 month of storage period (Fig. 3). It may possibly be due to moisture loss in product during storage. Similar works have been done in aonla candy (Singh *et al.*, 1993), ber candy (Singh, 2012) and bael candy (Mishra *et al.,* 2013).

Organoleptic evaluation

Organoleptic scoring is a simplest process of judging the suitability of any new processed product by the group of

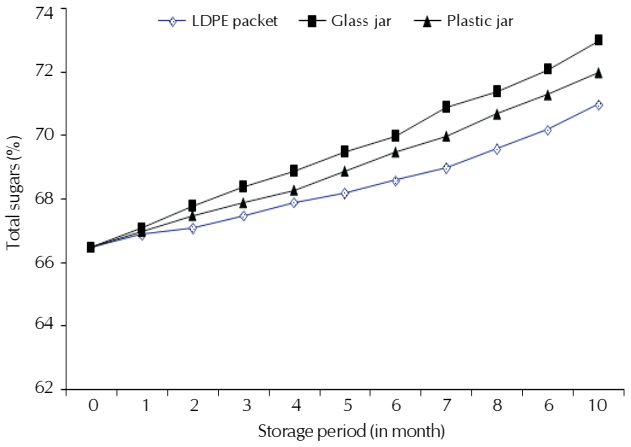

Figure1: Response of different packaging containers on total sugars (%) of mango candy during storage

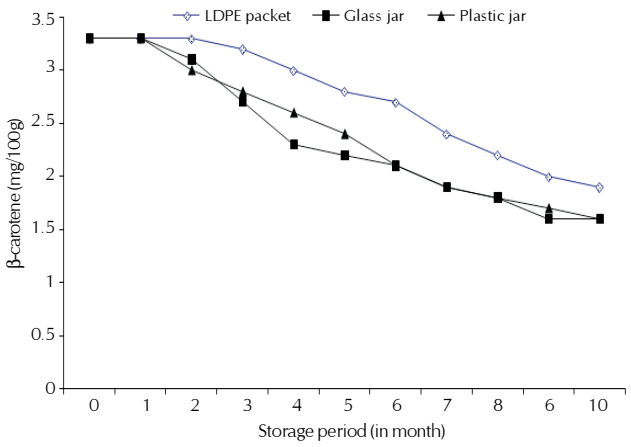

Figure 2: Response of different packaging containers on β-carotene (mg/100g) of mango candy during storage

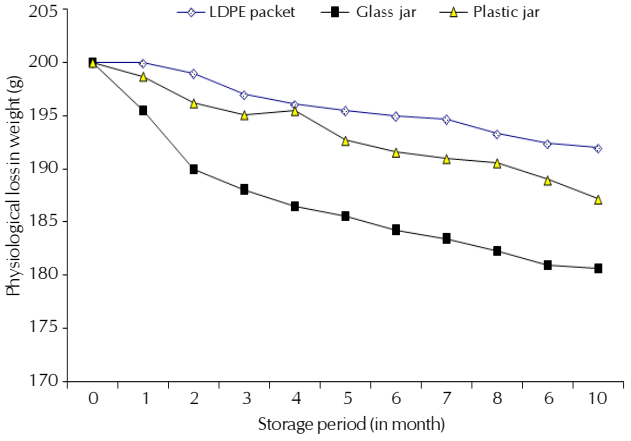

Figure 3: Response of different packaging containers on physiological loss in weight (g) of mango candy during storage

specialist. The organoleptic score of mango candy decreased continuously in each packaging container during the storage (Table 3). The acceptability of product was maintained up to 10 months in each container. LDPE packed candy was found best throughout the storage period and gained maximum score (7.8) as compared to other containers. It may possibly be due to good retention of texture, colour, odour and taste in LDPE packet. The deterioration in the acceptance of plastic jar and glass jar packed candy was not due to odd flavours or taste but it was due to the tough texture of candy. It may be due to the rapid loss of moisture by very tiny air leakage in the both packaging containers resulting tough texture of candy (Singh *et al*. 1993). Some other researcher (Singh *et al.*, 2014 in bael preserve and Sharma, 2014 on jamun mango blended jam) were also evaluate the various processed products on the basis of organoleptic test.

ACKNOWLEDGEMENT

We are highly grateful to Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, U.P. for providing the all amenities to conduct this research. Thanks to respected Dr. Sanjay Pathak for his valuable guidance in this research.

REFERENCES

Amrine, M. A., Pangbron, R. M. and Rossler, E. B. 1965. *Principal of Sensory Evaluation of Foods. Academic Press Inc.*, New York, USA.

Anonymous 2014. Indian Horticulture Database. *National Horticulture Board, Ministry of Agriculture, GOI,* pp. 4-246.

Bhatia, K., Asrey, R., Jha, S. K., Singh, S. and Kannaujia, P. K. 2013. Influence of packaging material on quality characteristics of minimally processed Mridula pomegranate (*Punica granatum*) arils during cold storage. *Indian J. Agricultural Sciences*. **83(8):** 872-876.

Gil, A., Duarte, I., Delgadillo, I., Colquhoun, J., Casuscelli, F. and Humper, E. 2000. Study of the compositional changes of mango during ripening by use of nuclear magnetic resonance spectroscopy. *J. Agricultural and Food Chemistry*. **48:** 1524-1536.

Giraldo, G., Talens, P., Fito, P. and Chiralt, A. 2003. Influence of sucrose solution concentration on kinetics and yield during osmotic dehydration of mango. *J. Food Engineering*. **58:** 33-43.

Lane, J. H. and Eynon, L. 1923. Determination of reducing sugar by Fehling solutions with methylene blue as indicator. *J. Soc. Chem. Ind.* **42:** 32-37.

Manthey, J. A. and Perkins-Veazie, P. 2009. Influences of harvest date and location on the levels of beta-carotene, ascorbic acid, total phenols, the in vitro antioxidant capacity, and phenolic profiles of five commercial varieties of mango (*Mangifera indica* L.). *J. Agril. Food. Chem*. **57(22):** 10825-10830.

Mishra, D. K., Saroj, P. L. and Pathak, S. 2013. Effect of packaging containers on storage stability of bael (*Aegle marmelos* Correa) candy under ambient conditions. *Prog. Hort*. **45(1):** 122-125.

Mishra, P. K., Pathak, S., Singh, R. K., Sahay, S., Tiwari, D. K., Shrivastava, P. and Rashmi, R. 2014. Evaluation of Mango (*Mangifera Indica* L.) Cultivars for Preparation of Osmo-Dehydrated Product. *The Bioscan*. **9(4):** 1495-1498.

Moraga, M. J., Moraga, G., Fito, P. J. and Martínez-Navarrete, N. 2009. Effect of vacuum impregnation with calcium lactate on the osmotic dehydration kinetics and quality of osmodehydrated grapefruit. *J. Food Engineering*. **90:** 372-379.

Mukerjee, S. K. 1958. The origin of mango. *Indian J. Hort*. **15:** 129-134.

Panse, V. G. and Sukhatme, P. V. 1978. Statistical methods for

agricultural workers. *I.C.A.R.* New Delhi.

Patel, R. K., Singh, A., Yadav, D. S., Bhuyan, M. and Deka, B. C. 2009. Waxing, lining and polyethylene packaging on shelf life and juice quality of passion fruit during storage. *J. Food Sci. Technol.* **46(1):** 70.

Pathak, S. 2011. Post harvest technology of few important fruits & vegetables. *Annual Progress Report*, College of Horticulture & Forestry, Narendra Deva University of Agriculture &Technology, Kumarganj, Faizabad, (U.P.).

Patil, R. 1990. Evaluation of mango (*Mangifera indica* L.) cvs. Alphonso, Ratna, Pairi and Kesar fruits for physico-chemical composition, storage and processing. M.Sc. Thesis, Konkan Krishi Vidyapeeth, Dapo1i, Dist. Ratnagiri, (M.S.).

Rangana, S. 2010. *Analysis and quality control for fruit and vegetable products*. Tata McGraw Hill Ltd. New Delhi.

Sahni, C. K. and Khurdiya, D. S. 1989. Effect of ripening and storage temperature on the quality of mango nectar. *Indian Fd. Packer,* **43** (6): 5-11.

Sharma, D. S. 2014. Quality Evaluation and Storage Stability of Jamun mango Blended Jam. *The Bioscan.* **9(3):** 953-957.

Singh, A., Nath, A., Buragohain, J. and Deka, B.C. 2008. Quality and shelf life of strawberry fruits in different packages during storage**.** *J. Food Sci. Technol.* **45(5):** 439-442.

Singh, B. 2012. Evaluation of ber cultivars for preparation of osmo-dehydrated product. *M.Sc. (Ag.) Thesis, Narendra Deva University of Agriculture and Technology, Faizabad, (U.P.).*

Singh, A. K., Chakraborty, I. and Chaurasiya 2014. Bael Preserve Syrup as Booster of Human Health as a Health Drink. *The Bioscan.* **9(2):** 565-569.

Singh, A., Yadav, D. S., Patel, R. K. and Bhuyan, M. 2007. Effect on Shelf life and quality of passion fruit with polythene packaging under specific temperature. *J. Food Sci. Technol.* **44(2):** 201-204.

Singh, I. S., Pathak, R. K., Dwivedi, R. and Singh, M. K. 1993. Aonla production and postharvest technology. *Tech. Bull,* Department of Horticulture, Narendra Deva University of Agriculture &Technology, Faizabad, (U.P.).

Singleton, V. L. and Rossi, J. A. 1965. Colorimetry of total phenols with phospho molybdic phosphotungstic acid reagents. *American J. Enology and Viticulture.* **16:** 144-158.

Sogi, D. S., Siddiq, M., Roidoung, S. and Dolan, K. D. 2012. Total Phenolics, Carotenoids, Ascorbic Acid, and Antioxidant Properties of Fresh-cut Mango (*Mangifera indica* L., cv. Tommy Atkin) as Affected by Infrared Heat Treatment. *J. Food. Sci.* **77(11):** C1197-C1202.