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Effect of putrescine and packaging on storage of mango (*Mangifera indica*)

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Mango is a perishable fruit and its ripening period coincides with the summer months under north Indian conditions. It has very short life at ambient temperature and high post-harvest losses. Keeping it in view, an experiment was planned to study the effect of putrescine and LDPE packaging on storage life and quality of mango fruits cv. Langra. Physiologically mature and uniform fruits of mango were treated with putrescine @0.0, 1.0, 2.0 and 3.0 mmolL^{-1}. Treated fruits were air dried in shade and packed individually in perforated LDPE bags before storage at 13^0 C and 85-90 per cent RH for 4 weeks. Results revealed that fruits treated with putrescine @2.0 mmolL^{-1} alongwith LDPE packaging retained best quality in terms of high palatability rating, good blend of TSS and acidity and low physiological loss in weight and spoilage percentage

Key words : Polyamine, *Mangifera indica*, Palatability rating, Spoilage, Quality

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INTRODUCTION

Mango (*Mangifera indica*), the king of fruits is grown in tropical and sub-tropical regions of the India. It occupies the prime position due to its rich bio-diversity, wider adaptability, higher returns and excellent taste. However, heavy post-harvest losses in sub-tropical conditions is a major constraint in its export. Rapid ripening process is responsible for short life of mango fruit and it represents a serious constraint for efficient handling and transportation. Therefore, techniques for storage of mango fruit have to be standardized and employed to enhance the storage life. Polyamines, packaging and low temperature are known to improve shelf-life of fruits by delaying ripening process. Reduction in physiological loss in weight (PLW), better fruit quality and low occurrence of fruit decay was observed in fruits packed in perforated film than non wrapped and fruits packed in non-perforated film (Ben-Yehoshua *et al.,* 1996). Polyamines and ethylene has opposite effects on fruit ripening and senescence. Balance between the two is important to enhance and retard the ripening process of fruits. Usually the concentration of polyamines decreases during tissue senescence with accelerated ethylene production (Valero *et al.,* 2002*).* Pre and post harvest application of putrescine increased fruit firmness and also retarded colour development (Malik *et al.,* 2003). Treatment with exogenous putrescine (PUT) inhibited ethylene production, thus retarding the increase of MDA (malondialdehyde) content and membrane permeability and delaying the occurrence of chilling injury (Zhang *et al.,* 2000). In Hayward kiwi fruit, 1mM putrescine treatment resulted in inhibition of ethylene production, low respiration rate and higher flesh firmness (Wen *et al.,* 2003). Exogenous application of polyamines was also found effective in many other fruits to reduce the ripening processes. But, no such information is available on effect of polyamines on mango cv. Langra. So the present studies were aimed to extend the storage life of 'Langra' mango fruit with putrescine and LDPE packaging under low temperature storage conditions.

RESEARCH METHODOLOGY

Physiologically mature and uniform fruits of mango cv. Langra were harvested from Fruit Research Station Gangian, Punjab Agricultural University, Ludhiana in July, 2010. Selected fruits were treated with an aqueous solution containing different concentrations of putrescine @1.0 (T_1), 2.0 (T_2), 3.0 (T_3) and 0.0 (T_4) mmolL^{-1}. Each treatment was replicated thrice and comprised of 2.0 kg fruit/ replication.

Treated fruits were air dried in shade and packed individually in perforated LDPE bags before placing in corrugated fibre board (CFB) boxes . Packed fruits were kept at 13^0C and 90-95 per cent RH for 4 weeks. For various physico-chemical characters the fruits were analysed after one week interval. The per cent loss in weight after each interval of cold storage was calculated by subtracting final weight from the initial weight of the fruits and then converted into percentage value. The cumulative loss in weight was calculated on fresh weight basis. The palatability rating of the fruit was conducted by a panel of judges following the Hedonic scale (0-9). The appearance of fruits, taste, texture and eating quality were the characters taken into consideration by the panel for its evaluation. Spoilage percentage of fruits was calculated by counting the rotten fruits and total fruits in each treatment replication on each storage interval. Total soluble solids (TSS) were determined with the help of hand refractrometer at room temperature and expressed in per cent. These reading were corrected with the help of temperature correction chart at 20^0 C temperature. Whereas, titratable acidity was estimated as per standard procedure of AOAC (2000). The data obtained were subjected to statistical analysis by following CRD method.

RESEARCH FINDINGS AND ANALYSIS

Maximum physiological loss in weight (PLW) was recorded in untreated fruits, whereas minimum PLW was found in putrescine @ 2.0 mmolL^{-1} treated + LDPE packed fruits during the entire storage period. All the treatments showed significantly less PLW as compared to control (Table 1). Pre-storage dip of polyamines retarded reduced weight loss during storage in mango cv. Kensington Pride (Malik and Singh, 2005). Malik *et al.* (2006) reported that polyamine application retarded colour development and reduced physiological weight loss during storage in mango cv. Kensington Pride. The control pomegranate fruits had significantly higher weight loss during storage whereas polyamine treatment retarded the maturation process by reducing softening as well as the loss of weight (Mirdehghan *et al.*, 2007). Polyamine treatments led to reduced weight loss of fruits during storage, which might be due to comparatively lower rates of respiration in treated fruit as compared to control. Putrescine treated lemon fruit showed lower weight loss than non treated fruit during storage (Valero *et al.*, 1998). Putrescine effects on weight loss could possibly due to changes in the biophysical properties of the fruit. Putrescine might have modified the properties of cell wall and the permeability of tissues to water (Martinez *et al.*, 2002). The lower weight loss in polyamine treated fruit could be attributed to stabilisation or consolidation of both cell integrity and the permeability of the tissues, ameliorating chilling injury, the latter induces tissue disruption and connection between the skin and the external atmosphere allowing the transference of water vapour (Woods, 1990). Reduction in weight loss with LDPE packaging was also reported by Ben-Yehoshua *et al.* (1996) and Tsuda *et al.* (1999).

Palatability of stored fruits was improved up to two weeks of storage in all the treatments, afterwards a decline was noted in T_1 and T_4. After one week of storage highest

Table 1: Effect of post harvest treatments on physiological loss in weight of cold stored mango fruits cv. Langra

Treatments	Physiological loss in weight (%) Weeks after storage				
	1	2	3	4	Mean
T_1 Putrescine 1.0 mmol/l + LDPE packaging	0.15	0.35	0.97	1.20	0.67
T_2 Putrescine 2.0 mmol/l + LDPE packaging	0.10	0.26	0.78	1.02	0.54
T_3 Putrescine 3.0 mmol/l + LDPE packaging	0.12	0.30	0.86	1.13	0.60
T_4 Control	2.27	4.78	6.39	7.16	5.15
Mean	0.66	1.42	2.25	2.63	
C.D. (P=0.05)	Treatment (A): 0.58		Storage interval (B): 0.21		Ax B= 0.48

Table 2: Effect of post harvest treatments on spoilage of cold stored mango fruits cv. Langra

Treatments	Spoilage (%) Weeks after storage				
	1	2	3	4	Mean
T_1 Putrescine 1.0 mmol/l + LDPE packaging	0	0	0	8.63	2.16
T_2 Putrescine 2.0 mmol/l + LDPE packaging	0	0	0	0	0.00
T_3 Putrescine 3.0 mmol/l + LDPE packaging	0	0	0	0	0.00
T_4 Control	0	4.45	17.21	26.71	12.09
Mean	0	1.11	4.30	8.83	
C.D. (P=0.05)	Treatment (A): 1.2		Storage interval (B): 1.12		Ax B= 2.25

Table 3: Effect of post harvest treatments on palatability of cold stored mango fruits cv. Langra

Treatments	Palatability rating (1-9) Weeks after storage				
	1	2	3	4	Mean
T_1 Putrescine 1.0 mmol/l + LDPE packaging	5.75	7.53	7.10	5.51	6.47
T_2 Putrescine 2.0 mmol/l + LDPE packaging	5.0	7.03	8.53	7.57	7.03
T_3 Putrescine 3.0 mmol/l + LDPE packaging	5.13	7.25	8.50	7.13	7.00
T_4 Control	7.13	7.33	6.10	4.25	6.20
Mean	5.75	7.29	7.56	6.12	
C.D. (P=0.05)	Treatment (A): 0.17		Storage interval (B): 0.24		Ax B= 0.45

Table 4: Effect of post harvest treatments on total soluble solids in weight of cold stored mango fruits cv. Langra

Treatments	Total soluble solids (%) Weeks after storage				
	1	2	3	4	Mean
T_1 Putrescine 1.0 mmol/l + LDPE packaging	12.26	13.21	14.73	16.07	14.07
T_2 Putrescine 2.0 mmol/l + LDPE packaging	11.87	12.46	14.20	15.17	13.43
T_3 Putrescine 3.0 mmol/l + LDPE packaging	12.03	12.63	14.13	15.30	13.52
T_4 Control	13.57	14.67	16.53	17.21	15.50
Mean	12.43	13.24	14.90	15.94	
C.D. (P=0.05)	Treatment (A): 0.26		Storage interval (B): 0.42		Ax B= 0.79

Table 5: Effect of post harvest treatments on acidity of cold stored mango fruits cv. Langra

Treatments	Acidity (%) Weeks after storage				
	1	2	3	4	Mean
T_1 Putrescine 1.0 mmol/l + LDPE packaging	1.21	0.72	0.51	0.28	0.68
T_2 Putrescine 2.0 mmol/l + LDPE packaging	1.62	1.08	0.72	0.54	0.99
T_3 Putrescine 3.0 mmol/l + LDPE packaging	1.56	1.02	0.66	0.42	0.92
T_4 Control	1.12	0.61	0.42	0.31	0.62
Mean	1.38	0.86	0.58	0.39	
C.D. (P=0.05)	Treatment (A): 0.04		Storage interval (B): 0.13		Ax B= 0.29

palatability rating (PR) was recorded in untreated fruits, whereas after 4 weeks of storage highest PR was recorded in putrescine @ 2.0 mmolL^{-1} treated +LDPE packed fruits. Highest PR in all the treatments was recorded after 2 weeks of storage (Table 3). Fruits kept under control showed a decline in fruit appearance and wrinkles on the fruits. Tsuda *et al.* (1999) also recorded that 'Carabao' mangoes packed in perforated polythene bags did not shrivel and maintained attractive appearance. Exogenous application of polyamines has revealed their potential to retard fruit ripening process and extend the shelf-life of fruit with better fruit quality (Malik *et al.*, 2005).

No fruit rotting was recorded in treated and packed fruits up to three weeks of cold storage. Whereas, 17.21per cent rotting was noted in untreated fruits. At the end of storage, 8.63 per cent rotting was also recorded in putrescine @1.0 mmolL^{-1} + LDPE packed fruits, but in untreated fruits 26.71 per cent rotting was observed (Table 2). It may be due to the delay of senescence in putrescine treated +LDPE packed fruits.

Total soluble solids of fruits were increased with the advancement of storage period in all the treatments (Table 4). During the entire storage period highest TSS contents were recorded in control fruits. Total titratable acidity was decresed in all the treatments during storage, but the decline was rapid in control and putrescine @ 1.0 mmolL^{-1} + LDPE packed fruits (Table 5). At the end of storage highest acidity was retained in putrescine @ 2.0 mmolL^{-1} treatment, a good blend of TSS and acidity was also maintained by this treatment. Similarly, Khan *et al.* (2008) reported that putrescine treated fruit stored at low temperature exhibited lower soluble solids content, delayed respiration rate and higher titratable acidity than untreated fruits in Angelino plum. Khosroshahi and Ashari (2008) also found the low soluble solids content and high acidity in putrescine treated strawberry, apricot and peach fruits during storage than untreated fruits.

Results revealed that fruits treated with putrescine @

2.0 mmolL^{-1} + LDPE packed fruits retained acceptable quality up to four weeks of storage in terms of high palatability rating, good blend of TSS and acidity and low physiological loss in weight and spoilage percentage.

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