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Effect of spermine on the shelf-life of mango cv. 'Dashehari' under low temperature

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ABSTRACT

The mango cv. 'Dashehari' is highly perishable in nature and cannot be stored for more than 8-10 days. There are various means to maintain the quality of fruits and prolong their availability. Spermine was used as post harvest dip-treatment to maintain the shelf life and quality of fruits. Mature and green fruits of mango cv. 'Dashehari' were harvested from the Institute orchard. The fruits were washed and dried at room temperature and divided in to four lots and subjected to treatments as control, modified atmospheric packaging (MAP) (100 gauge LDPE 2% vent.), 0.01% spermine and 0.01% spermine + MAP (100 gauge LDPE 2% vent.) stored under low temperature (12 ±2 ºC and 90±5 % R.H.). The stored fruits were withdrawn from storage at weekly interval, plus 4 days under ambient condition and assessed for physico-chemical parameters. Maximum firmness was noted in fruits treated with 0.01% spermine + MAP on the 15th day of storage while other treatments it decreased at increasing rate. Pulp colour of the fruits increased gradually up to 21 days in fruits treated with 0.01% spermine + MAP and was minimum as compared to other treatments. The yellowness index (YI) value of fruits was low indicating slow carotenoid development. The total carotene content of fruits showed similar pattern thereby a positive correlation between total carotene and YI value. It can be inferred that 0.01% spermine + MAP delay ripening of fruits up to 28 days.

Keywords: Spermine, Modified atmospheric packaging, yelloness index, mango

Introduction

Delaying the ripening process in fruits is the major criteria for enhancing the shelf life of fruits. It is widely accepted that the application of chemical to delay ripening prolong the shelf life of fruits. Mango (*Mangifera indica*) is the choicest fruit known as the 'king of fruits' is highly perishable in nature. The shelf life of mango is correlated to various attributes such as the time of harvest, stage of maturity and the storage conditions which in turns depends on the temperature and relative humidity. In mango and many other climacteric fruits, dramatic changes such as fruit softening, production of colour compounds and increase in soluble solid and decrease in acid levels with concomitant development of aroma and flavour occur in fruits during ripening and storage. Cold storage is one of the storage aspects to extend the storability and maintenance of quality for longer period. This also helps in reducing spoilage, facilitate for sending consignment, and maintain the quality. There is antagonistic effect of polyamines and ethylene on fruit development and sensations (Pandey et al., 2000) [7]. The role of polyamines in development and storage of peach fruit (Jihong et al., 2006) [3]. The objective was to study the effect of spermine and MAP modified atmospheric packaging on the storage and physic-chemical changes of mango cv 'Dashehari'.

Materials and methods

Commercially important cultivar 'Dashehari' was harvested, sorted and graded for the purpose of study. Green mature fruits of mangoes were harvested with stalk of 8-10 mm and dip-treated with water served as control, control+ MAP (100 gauge LDPE 2% vent.), 0.01% spermine and 0.01% spermine + MAP (100 gauge LDPE 2% vent.) stored under low temperature (12 ±2 ºC and 90±5 % R.H.).

The fruits were withdrawn from cold storage at 7 days intervals and assessed for quality parameters. These fruits were also kept for 4 days under ambient conditions to stimulate shelf-life. To record the cumulative physiological loss in weight (CPLW), the fruit weight was

recorded at the time of packaging, and subsequently at each withdrawal. The difference weight was expressed as per cent weight loss. Firmness of the fruit was measured with the help of penetrometre (8 mm probe, USA) and expressed as $kgcm^{-2}$. The colour of the fruits were measured with the help of Colour Guard (Hunters Lab) and expressed as 'a', 'b' and YI. A total soluble solid (TSS) was estimated with the help of a hand held refractometer (Erma, Japan). Titratable acidity (TA) was estimated by taking five gram of sample diluted to 50 ml of distilled water and titrated with 0.1 mol/L NaOH solution and the results were expressed as per cent citric acid (Ranganna, 2000) [10].

Total carotenoids was estimated by weighing 2 g sample in triplicate, extracted in 15 ml acetone thrice and filtered through cotton wool in a conical flask. Samples were extracted till colourless. Petroleum ether (15 ml) was added to the extract and diluted with 2% (15 ml) sodium chloride solution. All the extracts were transferred in a separating funnel and washed with 10 ml of 2 % sodium chloride. The non-aqueous layer was extracted and collected in a 50 ml volumetric flask and volume was made up with 3 % acetone in petroleum ether and the optical density measured at 452 nm and expressed in $mg100g^{-1}$ (Ranganna, 2000) [10].

All the analysis was carried out in triplicates and the data recorded during the course of investigation were subjected to statistical analysis by Microsoft Excel and the results were interpreted by ± standard error of mean.

Result and Discussion

The treatments of MAP versus spermine +MAP were studied for physical characteristics at harvest and at weekly interval and 4days after storage under ambient condition (Table no.1.). The cumulative physiological loss in weight was minimum in fruits treated with spermine plus MAP (5.95 %) while it was maximum in control (10.47 %) on the 21st day of storage. Firmness of the fruits was maximum on the day of harvest which decreased with increase in storage period. On the 21 day firmness was highest (0.53 Kg/cm^2) in fruits treated with spermine plus MAP. The yellowness index of the peel was highest (92.94) in spermine plus MAP and lowest (86.03) in spermine treated fruits on the 21st day of storage. Pulp yellowness index in spermine plus MAP was maximum (117.39) and (131.57) on the 21st day and 21+4 days under ambient conditions. The CPLW percent increased with increase in storage period may be due to evapo-transpiration of the fruit surface. There is antagonistic effect of polyamines and ethylene on fruit development and sensations (Pandey et al., 2000) [7]. Polyamines increased fruit shelf life, probably by reducing post-harvest senescence and decay (Nambeesan et al., 2010) in tomato and storage of peach fruit (Jihong et al., 2006) [3]. Fruit softening was delayed by all the poly amine (PA) treatments, as previously observed in peaches (Bregoli et al., 2002) [1]. Putrescine infiltrated in ripe peaches increased flesh firmness (FF), thus reflecting a delay in the ripening process (Martinez-Romero et al., 2000) [8]. Application of putrescine in damaged plum fruit increased fruit firmness, (Perez-Vicente et al., 2002) [8].

From data of quality parameters (Table. No. 2.), there was decrease in tritatable acidity and increase in TSS and total carotenoids during the storage for 21 days. There was a significant difference among the treatments and period of storage. TSS was maximum (17.20 ^{0}B) in control fruits, while it was minimum (14.93 ^{0}B) in spermine plus MAP on 14+4 days of storage. After 21plus 4 days of storage the TSS was maximum (15.73 ^{0}B) in spermine plus MAP and minimum in MAP (14.53^{0}B). The titratable acidity exhibited a reverse trend of TSS during the course of fruit storage. Total carotenoids in mango cv 'Dashehari' was maximum (4.27 mg per cent) in fruits treated with spermine plus MAP, it was minimum (4.13 mg per cent) in fruits of only MAP on the 21+4 days of storage under ambient condition. Our findings are similar with the findings of (Langerkämper et al., 1998; Pua et al., 2000) [4, 9] information on the role of ethylene in controlling sugar and organic acid metabolism during fruit ripening. Etienne et al., 2002 reported about the role of expression of UDP-glucose pyrophosphorylase and sucrose phosphatase, during banana and kiwifruit ripening and expression of cDNA encoding for key proteins in organic acid metabolism and solute accumulation during ripening.

Table 1: Effect of spermine on the physical attributes of mango cv 'Dashehari' during storage.

Parameters	**Storage period (days)**						
CPLW (%)	0d	7d	7+4d	14 d	14+4d	21d	21+4d
Control	0	1.84	8.60	4.52	7.15	6.92	10.47
	0	±0.02	±0.11	±0.04	±0.01	±0.02	±0.01
MAP	0	1.93	2.97	4.36	7.25	6.03	9.52
	0	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01
Spermine	0	1.06	2.86	2.50	2.75	4.52	6.56
	0	±0.01	±0.01	±0.01	±0.02	±0.03	±0.01
Spermine+MAP	0	1.30	2.75	2.76	3.24	5.95	6.45
	0	±0.03	±0.01	±0.01	±0.26	±0.01	±0.01
Firmness(Kg/Cm^2)							
Control	11.28	10.02	0.58	2.45	0.58	0.63	0.39
	±0.03	±0.10	±0.12	±0.69	±0.05	±0.10	±0.01
MAP	11.28	9.38	0.68	2.48	0.48	0.46	0.41
	±0.03	±0.19	±0.06	±0.38	±0.03	±0.02	±0.03
Spermine	11.28	10.07	0.84	7.18	0.54	0.54	0.37
	±0.03	±0.17	±0.19	±0.33	±0.00	±0.02	±0.02
Spermine+MAP	11.28	10.11	0.71	1.37	0.56	0.58	0.45
	±0.03	±0.06	±0.15	±0.18	±0.02	±0.04	±0.01
YI Peel							
Control	64.23	50.39	61.98	59.04	72.43	86.52	84.42
	±0.91	±3.32	±2.99	±2.30	±4.31	±2.41	±5.51
MAP	64.23	59.91	63.36	61.27	73.17	90.50	96.89

	±0.91	±1.98	±2.67	±3.73	±6.08	±2.83	±1.29
Spermine	64.23	62.95	64.14	61.89	65.63	86.03	100.96
	±0.91	±0.78	±5.01	±0.49	±2.39	±7.50	±1.61
Spermine+MAP	64.23	60.56	57.34	67.17	65.10	92.94	105.33
	±0.91	±1.81	±0.60	±1.80	±6.11	±4.94	±3.29
YI Pulp							
Control	64.29	77.88	125.10	88.15	123.51	124.20	133.49
	±0.06	±3.25	±3.08	±6.49	±2.55	±7.61	±0.72
MAP	64.29	65.07	139.29	114.78	123.60	124.28	131.90
	±0.06	±6.88	±1.32	±1.98	±2.54	±2.28	±1.18
Spermine	64.29	54.07	111.86	109.82	128.14	119.48	132.73
	±0.06	±2.77	±20.79	±4.81	±2.62	±2.02	±3.26
Spermine+MAP	64.29	62.38	124.49	108.89	126.46	117.39	131.57
	±0.06	±10.81	±2.59	±9.71	±1.42	±2.57	±1.41

Table 2: Effect of spermine on the quality attributes of mango cv 'Dashehari' during storage.

Parameters	**Storage period (days)**						
TSS (^{0}Brix)	0d	7d	7+4d	14 d	14+4d	21d	21+4d
Control	7.80	11.73	17.47	15.67	17.20	16.33	15.27
	±0.11	±0.07	±0.18	±0.07	±0.11	±0.07	±0.07
MAP	7.80	11.07	16.90	14.73	15.40	16.07	14.53
	±0.11	±0.07	±0.06	±0.07	±0.11	±0.13	±0.07
Spermine	7.80	11.33	16.27	14.67	15.67	15.33	15.47
	±0.11	±0.07	±0.07	±0.07	±0.07	±0.07	±0.13
Spermine+MAP	7.80	10.60	14.93	12.73	14.97	14.60	15.73
	±0.11	±0.11	±0.07	±0.07	±0.12	±0.11	±0.07
Acidity (%)							
Control	1.72	1.48	0.61	0.93	0.13	0.77	0.64
	±0.02	±0.01	±0.01	±0.01	0.00	±0.01	±0.01
MAP	1.72	1.53	0.63	1.10	0.17	0.75	0.63
	±0.02	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01
Spermine	1.72	1.60	0.67	0.96	0.25	0.89	0.77
	±0.02	±0.00	±0.01	±0.01	±0.01	±0.02	±0.01
Spermine+MAP	1.72	1.64	0.87	1.31	0.33	0.92	0.72
	±0.02	±0.02	±0.01	±0.01	±0.01	±0.01	0.00
Total Carotenoids (mg%)							
Control	0.23	0.38	2.45	1.07	2.94	2.68	4.14
	0.00	0.00	±0.01	±0.02	±0.01	±0.02	±0.01
MAP	0.23	0.27	2.12	0.97	2.80	2.46	4.13
	0.00	0.00	±0.01	±0.01	±0.02	±0.01	±0.02
Spermine	0.23	0.29	2.06	0.68	3.42	2.65	4.18
	0.00	0.00	±0.01	0.00	±0.02	±0.01	0.00
Spermine+MAP	0.23	0.25	1.68	0.50	3.36	2.57	4.27
	0.00	0.00	±0.01	±0.01	±0.01	±0.01	±0.01

Conclusion

It can be inferred from the above findings that mango fruits treated with spermine + MAP can enhance the storage period of 21+4 days under ambient conditions. The CPLW per cent was minimum in fruits treated with spermine + MAP. These fruits were firm and developed good colour upon stimulating storage under ambient condition. There was an increase in TSS and total carotenoids of fruits during storage for 21+4 days.

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