Effect of hot water treatment and irradiation on chemical composition of graded mango (*Mangifera indica*) fruits cv Alphonso under ambient and in cold storage conditions

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ABSTRACT

The uniform and healthy mango variety Alphonso fruits were taken from the orchard of Central Experiment Station, Wakwalli, Dapoli, Maharashtra. Maximum moisture (82.37%) was noticed in 75 per cent mature (control) fruits. Highest TSS (17.82°B) and β-carotene (15228 mg/100 g) were found in 100 per cent mature (control) fruits and acidity was higher in hot water-treated and irradiated 75 per cent mature fruits.

Keywords: Grading; hot water treatment; irradiation; β-carotene; corrugated fiberboard boxes

INTRODUCTION

Mango (*Mangifera indica*), the tropical fruit is commercially grown in Maharashtra. The postharvest losses are more in mango in tropical country like India. These losses are on account of various reasons such as lack of simple pretreatments, proper storage facilities, improper handling during long distance transportation, rapid ripening and microbial spoilage (Waskar and Gaikwad 2005). Mango being perishable fruit suffers from huge postharvest losses to the extent of 30-40 per cent (Salunkhe and Desai 1984). Many fruits tolerate exposure to water temperature of 50-60°C up to 10 minutes but shorter exposure to these temperatures can control many postharvest pathogens (Barkai-Golan and Phillips 1991). There is a paucity of information on hot water treatment and irradiation on graded Alphonso mango fruits and their effect on changes in moisture, total soluble solids, acidity and β-carotene during ripening under ambient and cold storage conditions.

MATERIAL and METHODS

The mature fruits were harvested and graded as per maturity into three groups viz 75, 85 and 100 per cent of specific gravity by float and sink method (Mukherjee 1959). The fruits were washed in water separately as per grades, dried, packed in corrugated fiber board (CFB) boxes, labeled and immediately carried to hot water unit of Agriculture Produce Market Committee, Nachane, Maharashtra. Graded fruits were given a hot water treatment (HWT) for 5 minutes for which they were separately passed towards hot water unit fitted with thermostat control sensors to maintain the desired temperature of 55°C and were dried with the blow of air. Further these fruits were packed in labeled CFB boxes. Adequate ventilation was provided in the boxes and such ventilators in the boxes were covered with insect proof screen of 30 mesh (Mandatory for USA and Japan). The packaging material used was of food grade quality. The boxes were immediately loaded in van and carried for irradiation treatment at 400 Grays at KRUSHAK (Krishi Utpadhan Sanskaran Kendra), Lasalgoan, district Nashik. As per grades the CFB boxes were loaded in pallets and conveyed towards irradiation chamber. The control fruits were carried in van but not irradiated. After irradiation the fruits were returned immediately to Dapoli and kept for ripening under ambient temperature (AT) and cold storage (CS) conditions. After ripening fruits were analyzed for

chemical properties viz moisture, titratable acidity, total soluble sugars and β-carotene. The experiment was conducted using factorial completely randomized block design with six main treatments, two sub-treatments and six replications with twenty fruits per treatment. The treatments used were T_1N (75% mature fruits, control), T_1HI (75% mature hot water-treated and irradiated fruits), T_2N (85% mature fruits, control), T_2HI (85% mature hot water-treated and irradiated fruits), T_3NI (100% mature fruits, control), T_3I (100% mature hot water-treated and irradiated fruits) and sub-treatments were stored under ambient temperature (28.6°C to 31.8°C, 76% RH) and cold storage (12 ± 2°C, 90% RH). Experiment was replicated six times with 20 fruits in each treatment. The data were subjected to statistical analysis.

RESULTS and DISCUSSION

The changes in chemical composition of graded mango fruits are presented in Table 1.

Moisture content of fruits was found to decrease during storage irrespective of treatments and storage conditions. Maximum moisture was recorded in treatment T_1N (82.37%) and was significantly over rest. CS fruits recorded maximum moisture (82.13%) which was statistically higher over fruits stored under AT. Highest moisture was recorded in 75 per cent mature hot water-treated and irradiated CS fruits which could be due to less maturity of fruits and lower temperature. This decline in moisture from harvest to ripening appears to be due to loss of moisture on account of respiration and transpiration of fruits during storage. Moreno et al (2006) reported no change in control and irradiated fruits of cv Tommy Atkin at ripened stage. Highest TSS at ripened stage was observed in T_3N (17.82°B) that was statistically significant and superior over rest. The increase in the TSS of 100 per cent mature fruits could be due to increase in maturity. Here fruits stored under AT recorded maximum TSS (17.11°B) that was significantly superior over CS fruits. An increase in TSS during ripening could be due to hydrolysis of starch into sugars.

Acidity of fruits declined continuously from harvest to ripened stage. Highest acidity (0.32%) was found in T_1HI that was at par with T_1N (0.30%) and significantly higher over rest. Interaction effects were also found to be significant. Maximum acidity was observed in treatment combination T_1HI (0.33%) that was at par with T_2HI under CS (0.31%) and significantly higher over rest. Highest acidity was found in 75 per cent mature hot water-treated fruits under CS. In general CS fruits exhibited more acidity as compared to control. The decline in the acidity from harvest to ripened stage might be due to utilization of organic acids in the respiration process. Janave and Sharma (2005) observed 0.12. 0.22, 0.28, 0.25 and 0.35 per cent acidity in Alphonso in control, 50, 100, 150 and 200 Gy-irradiated dose after 15 days of storage at 30-32°C.

Carotene content of mango increased from harvest to ripened stage in all treatments irrespective of storage. Maximum β-carotene content was found in T_3N (15228 mg/100 g) that was significantly superior over rest. Highest β-carotene was registered under CS (15417 mg/100 g) that was significantly superior to AT. Interaction effects were found to be significant. Maximum β-carotene was observed in treatment combination T_3N (15639 mg/100 g) that was at par with T_2N (15636 mg/100 g) and T_1N (15572 mg/100 g) under CS and significantlyhigher over rest. Maximum β-carotene was noticed at 100 per cent maturity in control stored under CS which could be due to more maturity of fruits and low temperature. The abrupt increase in carotene during ripening could be attributed to their accelerated biosynthesis during ripening process. Similar results were reported by Gonzalez-Aguilar et al (2007) in Tommy Atkin mango fruits.

CONCLUSION

Maximum moisture (82.37%) was noticed in 75 per cent mature fruits in control. Highest TSS (17.82°B) and β-carotene (15228 mg/100 g) were found in 100 per cent mature fruits in control and acidity was more in 75 per cent mature, hot water-treated, irradiated and graded fruits. The highest moisture, acidity and β-carotene were noticed under cold storage whereas maximum total soluble solids under ambient temperature.

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Table 1. Effect of hot water treatment and irradiation on moisture content, total soluble solids, acidity and *B*-carotene of mango fruits under ambient and cold storage conditions

Treatment	2008				2009				Pooled		
	Initial value	AT	CS	Mean	Initial value	AT	CS	Mean	AT	CS	Mean
Moisture content (%)											
T_1N	83.11	82.32	82.39	82.35	83.42	82.35	82.42	82.38	82.33	82.40	82.37
T_1HI		82.24	82.29	82.26		82.26	82.32	82.29	82.25	82.30	82.28
T_2 N	83.08	82.02	82.14	82.08	83.30	82.05	82.17	82.11	82.04	82.14	82.11
T_2 HI		81.95	82.04	82.00		81.98	82.07	82.03	81.97	82.01	82.00
T_3N	83.00	81.82	81.91	81.87	83.00	81.85	81.94	81.90	81.83	81.92	81.88
T_3 HI		81.86	81.95	81.90		81.89	81.98	81.94	81.87	81.96	81.93
Mean		82.04	82.12			82.06	82.15		82.05	82.13	
Total soluble solids (°B)											
T_1N	10.28	16.72	16.67	16.70	10.32	16.79	16.72	16.75	16.75	16.69	16.69
T_1HI		16.05	15.94	15.99		16.13	16.00	16.06	16.09	15.97	15.98
T_2 N	10.52	17.37	17.30	17.33	10.54	17.44	17.37	17.41	17.27	17.33	17.33
T_2 HI		17.11	17.02	17.07		17.17	17.03	17.10	17.14	17.02	17.04
T_3N	10.80	17.85	17.79	17.82	10.81	17.90	17.84	17.87	17.87	17.82	17.82
T_3 HI		17.37	17.15	17.26		17.42	17.20	17.31	17.39	17.18	17.22
Mean		17.08	16.98			17.14	17.03		17.11	17.04	
Acidity (%)											
T_1N	3.45	0.28	0.27	0.29	3.47	0.24	0.29	0.31	0.26	0.28	0.30
T_1HI		0.30	0.32	0.31		0.30	0.34	0.32	0.30	0.33	0.32
T_2 N	3.48	0.22	0.24	0.23	3.49	0.26	0.31	0.29	0.24	0.28	0.26
T_2 HI		0.21	0.30	0.26		0.23	0.32	0.28	0.22	0.31	0.27
T_3N	3.58	0.26	0.26	0.26	3.60	0.21	0.30	0.26	0.24	0.29	0.26
T_3 HI		0.27	0.26	0.27		0.28	0.29	0.29	0.28	0.28	0.28
Mean		0.25	0.27			0.25	0.31		0.25	0.29	
***B*-carotene**											
T_1N	445	14678	15553	15115	449	14532	15592	15062	14605	15572	15088
T_1HI		14103	14974	14538		14164	15480	14822	14133	15227	14680
T_2 N	488	14843	15597	15220	490	14569	15675	15122	14706	15636	15171
T_2 HI		14238	15383	14810		14347	15580	14963	14292	15481	14887
T_3N	508	14875	15601	15238	510	14758	15678	15218	14816	15639	15228
T_3 HI		14373	15509	14941		14488	14867	14677	14430	15188	14809
Mean		14568	15387			14532	15448		14550	15417	

T_1N (75% mature fruits, control), T_1HI (75% mature hot water-treated and irradiated fruits), T_2N (85% mature fruits, control), T_2HI (85% mature hot water-treated and irradiated fruits), T_3NI (100% mature fruits, control), T_3I (100% mature hot water-treated and irradiated fruits), AT (28.6°C to 31.8°C, 76% RH), CS (12 ± 2°C, 90% RH)

	Moisture content			Total soluble solids			Acidity			*B*-carotene		
	2008	2009	Pooled	2008	2009	Pooled	2008	2009	Pooled	2008	2009	Pooled
Treatment												
SE	0.007	0.007	0.005	0.019	0.018	0.014	0.005	0.005	0.004	23.080	23.278	22.980
$CD_{0.01}$	0.028	0.028	0.020	0.073	0.068	0.054	0.020	0.020	0.016	86.831	87.577	90.10
Sub-treatment												
SE	0.004	0.004	0.003	0.011	0.010	0.008	0.003	0.003	0.002	13.325	13.440	12.980
$CD_{0.01}$	0.016	0.016	0.011	0.042	0.039	0.030	NS	NS	NS	50.132	50.562	49.882
Treatment x sub-treatment												
SE	0.010	0.010	0.008	0.027	0.025	0.019	0.007	0.007	0.004	32.640	32.920	30.280
$CD_{0.01}$	NS	NS	NS	NS	NS	NS	0.028	0.028	0.014	122.80	123.85	120.60

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