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Studies on the Effect of Hot Water Treatment on Shelf Life of Custard Apple Stored at Low Temperature (13ºC±1) on cv. Balanagar

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A B S T R A C T

A laboratory experimental study was conducted on studies on the effect of hot water treatment on shelf life of custard apple stored at low temperature (13ºC±1) on cv. balanagar" at Department of Horticulture, Fruit Research Station Sangareddy and framed in Factorial Completely Randomized design. Unblemished, mature fruits of custard apple cv. Balanagar of uniform size were directly picked from custard apple orchard and washed thoroughly in running tap water to remove the adherent dirt material. The hot water treatments were done with the help of hot water chamber. The machine washed with tap water and filled with water, in the middle of the chamber the iron mesh was placed. The washed fruits were placed on the mesh, the water level should be maintain up to the above the fruit. The fruits are placed in the plastic trays. The temperature levels should be maintained with thermostat. After the treatment the moisture on the surface of the fruits were dried and the fruits were stored at low temperature. Indicating the delayed ripening and hence increasing the storage /shelf life of the fruits.

Introduction

Annona squamosa L., also called sugar apple, sweetsop or custard apple, is listed as one of the world's five most famous tropical fruits. Custard apple is native to the tropical America, which is commercially cultivated in tropical and sub-tropical regions of Australia.

Custard apple is one of the important fruit crops of Andhra Pradesh. Nearly 75000 tons of this fruit is available from the state 2, 3. Custard apple, popularly known as Sitaphal is grown in about 40000 ha in India mainly in the states of Andhra Pradesh, Assam, Tamilnadu. Custard apple is one of the important hardy fruit crop growing wild on Deccan Plateau and some parts of Central India (Kumar et al., 2011) and different tropical areas around the world (Jagtap and Bapat, 2014).

Custard apple is a climacteric fruit and starts ripening soon after detachment from the tree (Wills *et al.*, 2001). In India, custard apple is grown on marginal lands and hilly rocks with

minimum inputs (Rajput, 1985). The steady increase in area under custard apple has enhanced the fruit flow into the markets which most of the time leads to glut in the markets (Jalikop, 2006). The practices reported by (Salunkhe and Kadam, 1995) and Reddy (2000) suggest that the fruits of custard apple after harvesting are either loaded directly or packed in bamboo baskets with paddy straw or leaves of custard apple as cushioning material and transported to markets. Modified atmosphere packaging (MAP) is intended to create an appropriate gaseous atmosphere around a commodity packed in film packages to enhance shelf life and conserve the quality of packed produce (Deepak Raj Rai *et al.,* 2002).

Custard apple, one of the delicious and nutritionally valuable fruit meant for table purpose has a soft granular, juicy and sugary pulp with mild flavour and slight acidity (Kumar *et al.,* 2011). The shelf life of the custard apple is very short (Chadha, 2006) due to the climacteric nature of the fruit. Therefore, it is sold in local markets only. To utilize the large quantity of fruit produced during glut period, different researchers had reported the use of custard apple in preparation of juice, ice creams, milk shakes, soft drink and alcoholic beverages, i.e. wine (Jagtap and Bapat, 2014; Kumar *et al.,* 2011; Luciana *et al.,* 2010).

Materials and Methods

In the present investigation, tried the hot water treatment for cv. Balanagar and. Lab Experiment was laid in Factorial Completely Randomized Design. In each treatment 6 units containing 4 fruits were tested and observations were recorded at 4 days interval for Physiological loss in weight, Firmness (kg cm^{-2}), Ripening (%) Statistical analysis was carried out in Windostat 8.5

Factor -1

Temperature

F_1- Dipping of fruits in hot water at 45^0 C
F_2- Dipping of fruits in hot water at 50^0 C
F_3- Dipping of fruits in hot water at 55^0C

Factor -2

Time

D_1- Dipping of fruits in hot water for 5 minutes

D_2- Dipping of fruits in hot water for 10 minutes

D_3- Dipping of fruits in hot water for 15 minutes

D_4- Dipping of fruits in hot water for 20 minutes

Treatment combinations

F_1D_1	F_2D_1	F_3D_1
F_1D_2	F_2D_2	F_3D_2
F_1D_3	F_2D_3	F_3D_3
F_1D_4	F_2D_4	F_3D_4

Results and Discussion

Physiological loss in weight (%)

The data pertaining to physiological loss in weight (PLW) of custard apple fruits cv. Balanagar treated with different hot water and stored at low temperature are presented in Table 1.

There were significant differences in PLW of custard apple fruits treated with hot water. Significantly lowest PLW was recorded in fruits treated with 50^0C on 4^{th} day (2.36) and 8^{th} day of experimentation.

Table.1 Effect of hot water treatments on physiological loss in weight (%) of custard apple fruits cv. Balanagar at low temperature (13ºC±1)

Treatments	Days															
	4th DAY				8th DAY				12th DAY				16th DAY			
	45^{0}C	50^{0}C	55^{0}C	MEAN	45^{0}C	50^{0}C	55^{0}C	MEAN	45^{0}C	50^{0}C	55^{0}C	MEAN	45^{0}C	50^{0}C	55^{0}C	MEAN
5minutes	2.59	2.45	3.16	**2.73**	6.40	5.55	6.31	**6.08**	10.90	10.41	12.62	**11.31**	18.21	16.50	18.41	**17.71**
10 minutes	3.17	2.66	3.80	**3.21**	6.89	5.34	6.83	**6.35**	12.67	10.71	12.65	**12.01**	16.36	16.61	22.08	**18.35**
15 minutes	3.89	1.96	2.80	**2.88**	6.68	4.89	5.62	**5.73**	9.44	9.79	12.15	**10.46**	16.67	15.21	20.49	**17.46**
20 minutes	3.76	2.38	2.61	**2.91**	7.61	4.82	5.74	**6.05**	13.01	9.74	10.39	**11.04**	19.05	15.78	18.26	**17.69**
MEAN	**3.35^B**	**2.36^A**	**3.09^B**		**6.89^B**	**5.15^A**	**6.12^B**		**11.50**	**10.16**	**11.95**		**17.57**	**16.02**	**19.81**	

	4th DAY		8th DAY		12th DAY		16th DAY	
	CD at (0.05)	S.Em ±	CD at (0.05)	S.Em ±	CD at (0.05)	S.Em ±	CD at (0.05)	S.Em ±
Factor A (Temperature)	0.43	0.15	0.83	0.28	N.S	0.85	N.S	1.25
Factor B (Time)	N.S	0.17	N.S	0.33	N.S	0.98	N.S	1.45
For A x B	0.87	0.30	N.S	0.57	N.S	1.71	N.S	2.51

Table.2 Effect of hot water treatments on firmness (kg cm^{-2}) of custard apple fruits cv. Balanagar at low temperature (13ºC±1)

Treatments	Days															
	0 DAY				4th DAY				8th DAY				12th DAY			
	45⁰C	50⁰ C	55⁰C	MEAN	45⁰C	50⁰C	55⁰C	MEAN	45⁰C	50⁰C	55⁰C	MEAN	45⁰C	50⁰C	55⁰C	MEAN
5minutes	10.50	9.50	9.10	**9.70**	8.10	7.20	6.70	**7.33**	5.60	4.96	3.96	**4.84[a]**	2.20	2.00	2.20	**2.13**
10 minutes	8.30	11.30	10.60	**10.06**	6.20	8.13	7.60	**7.31**	3.76	4.83	4.83	**4.47[b]**	2.00	2.00	2.00	**2.00**
15 minutes	8.50	10.60	10.20	**9.76**	6.50	7.90	7.60	**7.33**	4.26	5.06	4.86	**4.73[a]**	2.00	2.40	2.13	**2.17**
20 minutes	11.30	8.50	10.90	**10.23**	7.60	6.60	7.70	**7.30**	4.76	4.96	4.96	**4.90[a]**	2.10	2.50	1.80	**2.13**
MEAN	**9.65**	**9.97**	**10.20**		**7.10**	**7.45**	**7.40**		**4.60[A]**	**4.95[B]**	**4.65[A]**		**2.07**	**2.22**	**2.03**	

	0 DAY		4th DAY		8th DAY		12th DAY	
	CD at (0.05)	S.Em ±	CD at (0.05)	S.Em ±	CD at (0.05)	S.Em ±	CD at (0.05)	S.Em ±
Factor A (Temperature)	N.S	0.21	N.S	0.16	0.18	0.06	N.S	0.05
Factor B (Time)	N.S	0.24	N.S	0.18	0.21	0.07	N.S	0.06
For A x B	1.23	0.42	0.66	0.32	0.37	0.12	0.34	0.11

Table.3 Effect of hot water treatments on ripening (%) of custard apple fruits cv. Balanagar at low temperature (13ºC±1)

Treatments	Days											
	4th DAY				8th DAY				12th DAY			
	45^{0}C	50^0 C	55^{0}C	MEAN	45^{0}C	50^{0}C	55^{0}C	MEAN	45^{0}C	50^{0}C	55^{0}C	MEAN
5minutes	16.66	10.00	10.00	**12.22^a**	36.66	40.00	30.00	**35.55^a**	60.00	56.66	60.00	**58.88^a**
10 minutes	6.70	6.70	6.70	**6.70^b**	36.70	30.00	20.00	**28.90^b**	60.00	60.00	50.00	**56.66^a**
15 minutes	6.70	10.00	0.00	**5.56^b**	30.00	24.43	20.00	**24.81^c**	66.66	50.00	46.66	**54.44^b**
20 minutes	6.70	6.66	6.66	**6.67^b**	33.33	27.76	16.66	**25.92^b**	63.33	53.33	43.33	**53.33^b**
MEAN	**9.19^B**	**8.34^B**	**5.84^A**		**34.17^C**	**30.55^B**	**21.66^A**		**62.50^C**	**55.00^B**	**50.00^A**	

	4th DAY		8th DAY		12th DAY	
	CD at (0.05)	**S.Em ±**	**CD at (0.05)**	**S.Em ±**	**CD at (0.05)**	**S.Em ±**
Factor A (Temperature)	1.81	0.62	2.87	0.98	3.43	1.17
Factor B (Time)	2.09	0.71	3.32	1.13	3.96	1.35
For A x B	3.62	1.24	N.S	1.97	6.87	2.35

Significantly higher PLW was recorded with 45^0C treated fruits on 4th day (3.35) and 8th day (6.89) of storage. The PLW on 12th day and 16th day of storage were not significant. The treatment, dipping time in hot water has no significant effect on PLW of custard apple fruits.

The interaction between temperature and dipping times on PLW of custard apple fruits was significant on 4th day. The rest of the treatment combinations were non-significant. Lowest PLW was recorded on 4th day at 50^0C for 15 minutes of dipping time (1.96). Significantly highest PLW was recorded with the treatment combination on 4th day with 45^0Cfor 15 minutes (3.89).

Firmness (kg cm^{-2})

The results observed on firmness of custard apple fruits cv. Balanagar treated with different hot water and stored at low temperature are presented in Table 2.

There was significant difference in firmness of custard apple fruits treated with hot water on 8th day of storage. The rest of the treatments were non-significant. Significantly higher firmness was recorded with 50^0C treated fruits on 8th day of storage (4.95). Significantly lowest firmness was recorded in fruits treated with 45^0C on 8th day of storage (4.60), which is on par with 55^0C on 8th day of storage (4.65).

The treatment, dipping time in hot water has significant effect on firmness of custard apple fruits on 8th day of storage. The rest of the treatments were non-significant. Significantly higher firmness was recorded with 20 minutes dipped fruits on 8th day of storage (4.84), which is on par with 5 minutes (4.84), and 15 minutes (4.73). Significantly lower firmness was recorded with 10 minutes dipped fruits on 8th day of storage (4.47).

The interaction between temperature and dipping times on firmness of custard apple fruits was significant. Significantly highest firmness was recorded with the treatment combination on '0' day with 50^0C for 10 minutes (11.30). Significantly lowest firmness was recorded on 12th day at 55^0C for 20 minutes of dipping time (1.80).

Ripening (%)

The data pertaining to ripening of custard apple fruits cv. Balanagar treated with different hot water and stored at low temperature are presented in Table 3.

There were significant differences in ripening of custard apple fruits treated with hot water. Significantly lowest ripening was recorded in fruits treated with 55^0C on 16th day of storage (50.00). Significantly higher ripening was recorded with 45^0C treated fruits on 16th day of storage (50.00).

There was significant difference in ripening of custard apple fruits among the dipping times. Significantly lower ripening was recorded with 5 minutes dipped fruits on 16th day of storage (58.88). Significantly lower ripening was recorded with 20 minutes dipped fruits on 16th day of storage (53.33), which is on par with 15 minutes dipped fruits on 16th day of storage (54.44).

The interaction between temperature and dipping times on ripening of custard apple fruits was significant. Significantly lowest ripening was recorded with the treatment combination of 55^0C for 20 minutes of dipping time on 12th day (1.80) and on 16th day of storage.

Significantly highest ripening was recorded with the treatment combination of 45^0C for 20 minutes of dipping time on 16th day of storage (63.33).

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