



EFFECT OF TEMPERATURE ON RIPENING BEHAVIOUR OF MANGO CV. ALPHONSO

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Abstract

The mango Cv. Alphonso fruits ripened at different temperature conditions *viz.*, 20°C, 25°C, 30°C and ambient temperature (24-33°C) and were analysed for changes in chemical parameters, PLW, ripening behaviour and sensory qualities. It could be revealed that the changes in ripening, PLW, spoilage and shriveling were markedly reduced in 20°C temperature storage condition as compared to other storage conditions but, showed considerable delayed ripening. However, the fruits ripened at 25°C or 30°C temperature exhibited uniformity in ripening, better shelf life than those ripened at ambient condition. As regards the organoleptic evaluation, the mango fruits ripened at 25°C or 30°C temperature storage had better sensory score for colour as well as texture of the fruits than those ripened at either 20°C or ambient condition, however were at par with respect to flavor and overall acceptability of the fruit. Thus, it is suggested to ripen the mango Cv. Alphonso fruits either at 20°C or 30°C temperature for optimum ripening, quality and shelf life of the fruit.

Key words: *Mango, ripening, temperature*

Intorduction

Mango (*Mangifera indica* L.) belongs to family Anacardiaceae is universally accepted as the finest tropical fruit of the world and has been called, in the orient, “King of the fruits”. It is the 5th widely produced fruit crops of the tropics after banana and citrus. It is originated from South East Asia, the Indo-Burma region, in the foothills of the Himalayans. Ripening is a complex physiological process resulting in softening, colouring, sweetening and increases in aroma compounds so that ripening fruits are ready to eat or process. The associated physiological or biochemical changes are increased rate of respiration and ethylene production, loss of chlorophyll and continued expansion of cells and conversion of complex metabolities into simple molecules. Temperature plays an important role while ripening. High and low temperatures during ripening of mangoes affect quality. An increase in the temperature significantly increased the rate of respiration and total carotenoids in pulp. Increased ripening temperature up to 30°C also increased ethylene production in fruit (Lalel, 2004). Temperature affects the changes that occur during ripening, the quality of ripe fruit and the marketable life of mango fruit. Apart

from this, Alphonso mangoes have demand in the international market due to it's flavor and taste. However, the export of these fruits to different countries is done by air, which is costly affair. To reduce the costs, sea-transportation is the only alternative, but movement by sea takes longer time and fruits are to be maintained in good quality and glossy appearance for long time. Keeping in view the requirements of export trade presently no perfect data on temperature required for ripening of Alphonso mango is available. Therefore it is important to study the effect of temperature on ripening behaviour of mango.

Material and Methods

The present investigation was carried out in the, Department of Post harvest management of fruit, vegetable and flower crops, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli (M.S.) to study the effect of temperature on ripening behaviour of mango Cv. Alphonso fruits. The experiment was conducted in Factorial Completely Randomized Design with 4 treatments with different storage conditions *viz.*, T₁: 20°C, T₂: 25°C, T₃: 30°C, and T₄: 24-33°C, (control) with 85 per cent relative humidity. Each treatment had six replications.

The mango fruits Cv. Alphonso were washed with 0.4 percent biosafe, and the fruits were kept at different temperature conditions for ripening. Ripening behaviour and physiological loss in weight (%) of mango fruits was recorded at every four days interval. The fruits were weighed at every four days interval and the loss in weight was expressed as percentage over the initial weight. To record the ripening pattern, the fruits were categorized into five groups *viz*; Green (harvesting stage), Turning (when a slight tinge of yellow colour appeared on the peel), Half ripe (when 50 per cent of fruit peel turned yellow), Ripe (when fruit peel fully turned yellow) and spoilage (when fruit shriveled and diseased). This ripening pattern under each treatment was studied at 4 days interval. The organoleptic evaluation for assessing the flavour, taste, colour of peel, colour of pulp, texture and overall acceptability of ripe mango fruits was carried out by the panels of five judges by using 9 points Hedonic scale.

Results and Discussion

The data on the effect temperature on ripening behaviour of mango Cv. Alphonso for the year of 2011-2012 are presented in the table No. 1 to 6.

Physiological loss in weight: - It is evaluated from the data that the treatment T_4 *i.e.* ripening at ambient temperature recorded maximum (14.15%) mean PLW, followed by the treatment T_3 and T_2 11.09 and 7.01 percent mean physiological loss in weight, respectively. The treatment T_1 recorded lowest (5.54%) mean physiological loss in weight of mango Cv. Alphonso. Thus it is clear from the data that the physiological loss in weight increased with increase in the ripening temperature. It could be observed from the data presented in Table 1 that the mango fruits Cv. Alphonso stored at different storage conditions shows variations in physiological loss weight. The statistically significant difference was observed among the treatments. As regards to storage, there was increase in physiological loss in weight as the storage period was increased. At 4th day of storage, the mean PLW was 2.36 percent however, at 20th day it was increased to 16.20 percent irrespective the treatments. The lowest moisture loss was observed after 20 days in T_1 (9.58%) which was significantly lower than all other treatments while treatment T_4 recorded higher moisture loss at 20 days *i.e.* 24.71 percent. The treatments T_2 and T_3 were also significantly superior to control and recorded considerable lower PLW on 20th day of storage than the control and had better shelf life than those ripened at ambient condition. The interaction effects between the treatments and storage period were found to be

Table 1: Physiological loss in weight (PLW) in per cent of mango Cv. Alphonso fruits during different storage conditions

Treatments	Storage period (days)					
	4	8	12	16	20	Mean
T_1	1.41	4.30	5.15	7.25	9.58	5.54d
T_2	2.04	4.94	6.55	8.99	12.57	7.01c
T_3	2.69	7.3	12.00	15.50	18.00	11.09b
T_4	3.23	9.51	14.00	19.25	24.71	14.15a
Mean	2.36e	6.50d	9.42c	12.74b	16.20a	
			S.Em.±		C.D. at 5 %	
Different temperatures (T)			0.183		0.514	
Storage (S)			0.205		0.575	
Interaction (T × S)			0.409		1.149	

Table 2: Ripening, shriveling and spoilage of Alphonso mango fruits during storage at 20°C temperature and 85 per cent RH (T_1)

Parameters	Days of storage					
	0	4	8	12	16	20
Ripening						
Green	90 (100)	85 (94.44)	81 (90)	66 (73.33)	29 (32.22)	21 (23.33)
Turning	0	5 (5.55)	7 (7.77)	22 (24.44)	41 (45.55)	37 (41.11)
Half ripe	0	0	2 (2.22)	1 (1.11)	12 (13.33)	17 (18.88)
Ripe	0	0	0	1 (1.11)	7 (7.77)	11 (12.22)
Spoilage						
Diseased	0	0	0	0	1 (1.11)	4 (4.44)
Shrivelled	0	0	0	0	0	0
Total	90 (100)	90 (100)	90 (100)	90 (100)	90 (100)	90 (100)

(Figures in parenthesis indicate percent values)

statistically significant. The fastest and maximum increase in PLW was observed at ambient temperature storage. The continuous increase in PLW values at all storage condition could be as a result of loss of moisture from the fruit peel through respiration and transpiration. Observations in accordance with this finding were also reported by Kapse *et al.* (1979), Karla and Tondon (1984), Gole (1986), Sethi (1987) and Patil (1990) in mango.

Ripening behaviour of fruits: - The data on ripening shriveling and spoilage of mango Cv. Alphonso fruits

Table 3: Ripening, shriveling and spoilage of Alphonso mango fruits during storage at 25°C temperature and 85 per cent RH (T_2)

Parameters	Days of storage					
	0	4	8	12	16	20
Ripening						
Green	90 (100)	69 (76.66)	43 (47.77)	30 (33.33)	7 (7.77)	4 (4.44)
Turning	0	21 (23.33)	26 (28.88)	35 (38.88)	18 (20)	11 (12.22)
Half ripe	0	0	20 (22.22)	15 (16.66)	36 (40)	16 (17.77)
Ripe	0	0	0	10 (11.11)	25 (27.77)	52 (57.77)
Spoilage						
Diseased	0	0	1 (1.11)	0	4 (4.44)	7 (7.77)
Shrivelled	0	0	0	0	0	0
Total	90 (100)	90 (100)	90 (100)	90 (100)	90 (100)	90 (100)

(Figures in parenthesis indicate percent values)

Table 4: Ripening, shriveling and spoilage of Alphonso mango fruits during storage at 30°C temperature and 85 per cent RH (T_3)

Parameters	Days of storage					
	0	4	8	12	16	20
Ripening						
Green	90 (100)	55 (61.11)	28 (31.11)	5 (5.55)	0	0
Turning	0	35 (38.88)	34 (37.77)	15 (16.66)	8 (8.88)	0
Half ripe	0	0	20 (22.22)	39 (43.33)	16 (17.77)	7 (7.77)
Ripe	0	0	8 (8.88)	30 (33.33)	57 (63.33)	61 (67.77)
Spoilage						
Diseased	0	0	0	1 (1.11)	7 (7.77)	10 (11.11)
Shrivelled	0	0	0	0	2 (2.22)	12 (13.33)
Total	90 (100)	90 (100)	90 (100)	90 (100)	90 (100)	90 (100)

(Figures in parenthesis indicate percent values)

during storage under temperatures are presented in table 2 to 5 respectively. It could be revealed from the data that ripening was fastest at ambient temperature (24-34°C) (T_4) followed by 30°C (T_3), 25°C (T_2), and 20°C

Table 5: Ripening, Shrivelling and spoilage of Alphonso mango fruits during storage at ambient temperature (24-33°C) (T_4)

Parameters	Days of storage					
	0	4	8	12	16	20
Ripening						
Green	90 (100)	48 (53.33)	11 (12.22)	0	0	0
Turning	0	39 (43.33)	19 (21.11)	11 (12.22)	0	0
Half ripe	0	0	37 (41.11)	16 (17.77)	8 (8.88)	3 (3.33)
Ripe	0	0	18 (20)	53 (58.88)	44 (48.88)	32 (35.55)
Spoilage						
Diseased	0	3 (3.33)	5 (5.55)	8 (8.88)	18 (20)	20 (22.22)
Shrivelled	0	0	0	2 (2.22)	20 (22.22)	35 (38.88)
Total	90 (100)	90 (100)	90 (100)	90 (100)	90 (100)	90 (100)

(Figures in parenthesis indicate percent values)

Table 6: Organoleptic evaluation of Alphonso mango fruits during different storage conditions

Treatments	Organoleptic score for			Overall acceptability
	Colour	Flavour	Texture	
T_1	6.50	6.42	6.35	6.426
T_2	7.78	7.00	6.92	7.163
T_3	8.00	7.64	7.71	7.783
T_4	7.21	7.14	7.00	7.117
S. Em. ±	0.186	0.344	0.298	0.248
C.D.(5%)	0.545	N.S	0.872	0.725

(T_1) temperatures. At ambient temperature the ripening peak was noticed on 8 day while at 30°C temperature it was observed on 12 day. At 25°C temperature it was on 16 day and at 20°C the maximum ripening was on 20 day. This could be due to low temperature and high humidity prevalent in the treatments T_1 (20°C temperature) and T_2 (25°C temperature) hindered or slowed down the ripening process. Ripening process commenced earliest in fruits at ambient temperature (8 day) while at 30°C and 25°C ripening began also on 8 day with 22.22 percent fruits were at half ripe stage but little as compared to ambient temperature (only percent). At 20°C temperature ripening was started on 16 day which was too late compared to ambient temperature, 25°C and 30°C temperatures. As far as spoilage was concerned

maximum spoilage occurred in T_4 *i.e.* ambient temperature both in terms of shriveled and diseased fruits. The shriveling per cent was found maximum during ambient temperature. At 20°C storage condition fruits remained firm which resulted in minimum shrivellage, where as fruits stored at the 25°C for ripening exhibited a substantially reduced and delayed the shriveling of fruits substantially as compared to ambient temperature. Such a significant reduction in shriveling at 20°C storage as well as 25°C storage condition might be due to low temperature and high humidity conditions prevalent under these storages which reduced moisture loss and hence shriveling of mango fruits was minimum at 20°C storage condition, followed by 25°C storage condition. The observations analogous to this finding were also reported by Mann and Singh (1975^{ab}), Ramana *et al.* (1984), Gole (1986) with respect to cold storage and Naik (1985), Gole (1986), Badar (1990) regarding cool chamber storage of mango fruits.

Organoleptic evaluation at ripening

The data (scores) on organoleptic evaluation of Alphonso mango fruits are presented in table 6. It could be revealed from the data that fruits ripened at 30°C temperature recorded maximum (8.00) sensory score in colour, but were at par with those stored at 25°C (T_2). The lowest (6.50) score for was recorded by the fruits ripened at 20°C (T_1), followed by those ripened at ambient temperature. It is clear from the data the ripening temperature had no significant effect on the flavor of the fruit Cv. Alphonso. The mango fruits ripened at 20°C temperature (T_1) also recorded lowest (6.35 and 6.426 respectively) sensory score for texture as well as overall acceptability and all other treatments were at par with each other, but significantly superior to the treatment T_1 .

Conclusion

From the present investigation, it could be concluded that the changes in ripening, PLW, spoilage and shriveling were markedly reduced in 20°C temperature storage condition as compared to other storage conditions but, showed considerable delayed ripening. However the fruits ripened at 25°C or 30°C temperature exhibited uniformity in ripening, better shelf life than those ripened at ambient condition. As regards the organoleptic evaluation, the mango fruits ripened at 25°C or 30°C temperature storage had better sensory score for colour as well as texture of the fruits than those ripened at either 20°C or ambient condition, however were at par with

respect to flavor and overall acceptability of the fruit. Thus, it is suggested to ripen the mango Cv. Alphonso fruits either at 20°C or 30°C temperature for optimum ripening, quality and shelf life of the fruits.

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