



Research Article

STUDY ON RIPENING OF CUSTARD APPLE FRUIT (*Annona squamosa* L.)

BAKANE P.H.¹, GAJABE M.H.^{1*}, KHAKARE M. M.¹, KHEDKAR M.B.², DANGE M.M.² AND PREM MANJEET¹

¹Department of Agricultural Process Engineering, CAET, Dr. Panjabrao Deshmukh Krishi Vidyapeeth P.O. Krishi Nagar Akola, 444104, MS, India

²AICRP on Seed Tech Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth P.O. Krishi Nagar Akola, 444104, MS, India

*Corresponding Author: Email-madhurigajabe@gmail.com

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Abstract- Custard apples have been part of human diet for ages due to its nutritional and medicinal values. General practice of farmer for ripening of custard apple is keeping the fruit in crates or on floor covered with custard apple leaves or gunny bags. In this method all fruits cannot ripened and some of fruits becomes black and hard which becomes postharvest losses. Therefore, present study was undertaken to study the ripening of custard apple. Ripening of custard apple was carried out in crates covered with leaves, cartoon boxes and modified household refrigerator. Household refrigerator was modified to maintain uniform temperature and relative humidity by fitting air circulation tank and hanging wet cloth. Average weight of the fruit was found to be in the range of 105.67–164 g. Maximum physiological weight loss of custard apple fruit during ripening was found to be 19.90 % in cartoon and minimum 15.49 % in refrigerator. Custard apple fruits were ripened in 3 to 4 days in crates as compare to 6 to 7 days in refrigerator. Ripening percentage of custard apple fruit was found to maximum in Crates followed by cartoon and lowest in refrigerator. Ripening of custard apple fruit at low temperature can delay the ripening of custard apple fruit though ripening percentage of fruit in modified refrigerator was less, it delay the ripening of fruit. Therefore, further study is needed for development of farm level ripening chamber for custard apple fruit which can ripen the fruit with good quality of pulp and also delay the ripening period.

Keywords- *Annona squamosa* L, Ripening, Refrigerator, crates, Cartoon.

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Introduction

Custard apple (*Annona squamosa* L.) is a climacteric fruit and highly perishable in nature. Hence, it is mostly utilized or preferred for fresh market. Due to its climacteric nature, it ripens fast and spoiled easily [1]. In India area and production of custard apple was 21,7700 Ha, and 165,150 MT, respectively in 2013-14 [2].

Custard apple is one of the most delicious and highly perishable fruit. It has its delightful taste, flavour, moderate price in markets and a high nutritional status. Overall the importance of fruits in domestic and export market as fresh fruits and processed products. Custard apple is the rich source of nutrients but it has short storage life and having a great demand in the market. Custard apple ripens within four days after harvest. Fruit can safely be ripened in straw and fruit leaves and stores at room temperature with a shelf life of four days [3, 4]. The ripe fruits being soft require careful handling in marketing [5]. Like many other tropical fruits, the mature custard apple fruit get chilling injury if stored below 15°C, for six week [6]. Out of the ripening temperature of 15, 20 and 25°C, 20°C gave the most acceptable fruit for fresh consumption [7]. The addition or removal of ethylene had no effect on the ripening of custard apple [8].

The mature fruits after harvest ripen quickly and become excessively soft within 2 to 3 days at ambient condition and become unfit for consumption. Therefore, development of technique for extending the shelf life of fruits is the only answer for getting the remunerative profit from it. Ripening of custard apple fruits occurred earliest at high temperature and delayed at low temperature. The increase in shelf life of custard apple fruit would, therefore, be an advantage to the growers [9]. Therefore, present study was undertaken to study the ripening of custard apple fruits at different conditions.

Materials and Methods

Custard apple cv. Balanagar fruits were harvested when fruit is in light green colour, yellowish white colour between the carpel's and initiation of cracking of the skin between the carpels. Matured fruits of uniform size, firm, free from disease and injuries were directly picked from orchard and brought to the laboratory. The fruits were cleaned with running tap water to remove the adherent dirt material and then allowed to dry in shade. Ten sound fruits were numbered, weight and ripened in different condition like crates, cartoons and refrigerator. The dimensions, weight, true density and colour of custard apple fruit were measured.

For ripening of custard apple household refrigerator was modified by fitted with air circulating fan to maintain an even temperature distribution. The relative humidity was maintained by hanging wet cloths in the refrigerator. Fruits were weighed when ripe to assess weight loss during storage [10]. In modified refrigerator temperature was maintained up to 15°C. Ripeness was determined by finger pressure to determine the stage of eating softness. The stage wherein more than 50 % of the stored fruit became ripen was considered as end of the days taken for ripening [11]. The physiological loss of weight (PLW) was recorded on weight basis. The total soluble solids (°Brix) were determined by using ERMA hand refractometer. The pH value was determined by using a digital pH meter (Systronics pH analyzer 371, Ahmedabad, India). The colour of custard apple fruit was measured in terms of L, a, b value during ripening with Minolta Chromameter (CR-400). Weight and axial dimension was measured with Weighing balance and Vernier caliper, respectively. Size, Sphericity and Volume of custard apple fruit was calculated as method describe by [12].



Plate-1 Ripening of custard apple fruits in crates



Plate-2 Modified household refrigerator for ripening

Results and Discussion

Physical characteristics

Data present in [Table-1] shows the physical properties of custard apple fruit used in the experiment. Average weight of custard apple fruits kept in crates; cartoon

and refrigerator were found to be 132.87 g, 169.5 g and 176.66 g, respectively. Average volume of custard apple fruit was found to be in the range of 131.85 to 177.5 mm³ kept for ripening at different condition. Size and Sphericity of unripe custard apple fruit was found to be in the range of 53.48 to 56.77mm and 0.88 to 0.92, respectively. Average true density of unripe custard apple fruit was found to be in the range of 0.95 to 1.15 g/cm³.

Physicochemical changes

pH

Data present in [Table-2] shows that the custard apple ripened in crates had maximum pH value (5.27) followed by ripened in cartoon (5.19) and lowest ripened in refrigerator (5.14).

Total soluble solid

Data present in [Table-2] shows that the Custard apple ripened in the cartoon had maximum TSS value (27.75°Brix) followed by ripened in crates (24°Brix) and lowest in ripened in refrigerator (22.1°Brix). This may due to that, TSS, which are mostly made of sugars, and sugar might be more in custard apple ripened in cartoons. TSS increased with the increase in storage duration and the rate of increases is higher at higher temperature [13].

Physiological weight loss

Minimum physiological weight loss of custard apple (15.49 per cent) was recorded ripened in refrigerator followed by ripened in crates (17.46 per cent) and maximum (19.90per cent) ripened in cartoon up to 5 days of ripening. The physiological loss in weight of custard apple fruit increases with the increases in storage period. These results are in conformity with the findings of [14]. In refrigerator, relative humidity was more, this might be reason that moisture removal from fruit was less as compared to crates and cartoon.

Days taken for ripening

Data present in [Table-3] shows that ripening period of custard apple fruits was observed highest in refrigerator (6-7 days) followed cartoon (4-5) days and least in crates (3-4 days). This may be due to that temperature of refrigerator was lower than the crates and cartoon which delay the ripening process of fruit. Similar result was also reported by [11].

In modified refrigerator temperature was maintained up to 15°C resulted in extending the days taken for ripening of custard apple fruits [15]. The rate of ripening of Balanagar custard apple fruits was found to be decreased with decrease in ripening temperature. The ripening of fruit as observed on days 4, 6 and 9 of storage at 25, 20 and 15°C, respectively [16].

Table-1 Physical properties of custard apple fruit before ripening

Ripening condition	Wt (gm)	Dimensions (mm)			Size(mm)	Sphericity(Φ)	Volume (mm ³)	True density (g/cm ³)
		L	b	t				
Crate	132.87	51.8	61.2	57.8	56.77	0.92	131.85	1.01
Refrigerator	169.5	48.7	60.6	51.9	53.48	0.88	177.5	0.95
Cartoon	176.66	50.23	62.0	55.0	55.51	0.89	154	1.15

Table-2 Chemical properties of custard apple after ripening

Ripening Condition	Wt. of Fruit (gm)	P _H	TSS (°Brix)
Crates	105.67	5.27	24.07
Refrigerator	164.00	5.14	22.1
Cartoon	136.50	5.1975	27.75

Ripening percentage of custard apple fruits was found to be maximum in crates (100 %) followed by cartoon (97 %) and lower in refrigerator (50 %). This was because the temperature of refrigerator was low which caused blackening and hardening of custard apple fruits as shown in [Plate-3]. Similar results were also reported by [17].



Plate-3 Hard and blacken custard apple fruit ripened in modified household refrigerator.

Color changes during ripening

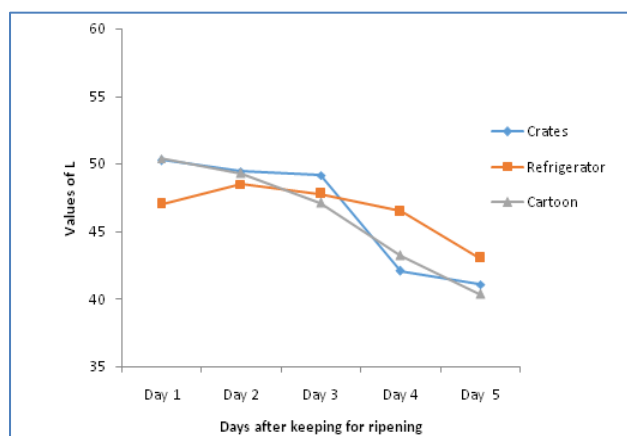
Data of colour of custard apple fruit are presented in [Table-3], it shows the highest L- value of custard apple fruit ripening in crates (47.81) followed by cartoon (46.60) and lowest in refrigerator (46.57).

[Fig-1(a-c)] shows the changes in colour of custard apple fruit during ripening.

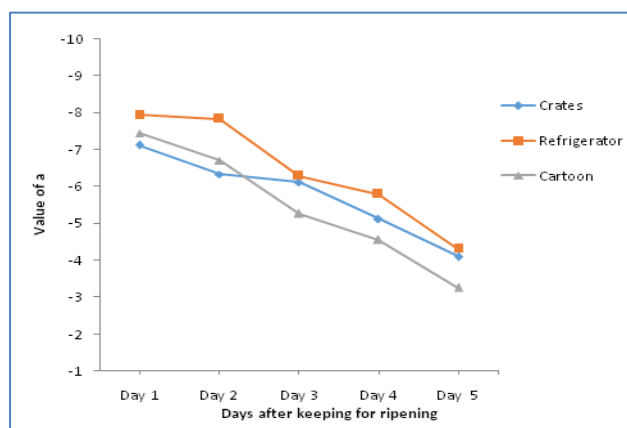
Lightness (L- value) of custard apple fruit was found to be decreased with increase in ripening period at all ripening condition. This shows that custard apple fruit becomes slightly black during ripening. Among the ripening condition blackening of the custard apple fruit was found to be less in modified household refrigerator.

Table-3 Ripening of custard apple fruit at different conditions.

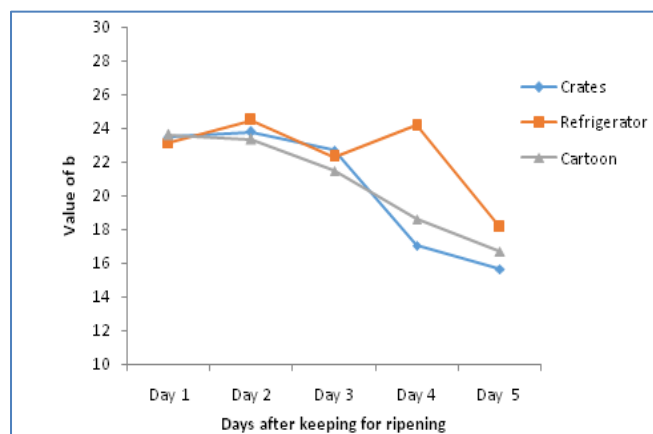
Ripening condition	Temp (°C)	No. of Fruits	Rh (%)	Colour of fruit (L value)	Colour of pulp (L value)	Per cent ripening	No. of days for ripening	Physiological weight loss (%)
Crates	25	10	60-70	47.81	57.83	100	3-4	17.46
Refrigerator	15	10	80-85	46.57	51.45	50	6-7	15.49
Cartoon	25	10	60-70	46.60	48.63	97	4-5	19.90



a



b



c

Fig-1 Changes in colour value of (L,a,b) of custard apple fruit during ripening

[Fig-1(b)] shows effect of ripening period on the greenness colour of custard apple fruit. Greenness was found to be decreased with increase in ripening period. Among the ripening condition greenness was found to be less of custard apple fruit ripen in cartoon as compared to refrigerator.

Yellowness of custard apple fruit was found to be decreased with increased in storage period. Yellowness (b-value) of custard apple fruit was found to be more ripened in refrigerator as compared to crates and cartoon

Conclusion

The result of the study suggested that ripening of custard apple fruit at low temperature can delay the ripening period. Therefore, farm level ripening chamber could be developed for custard apple fruits in which fruits can be ripened and ripening period can be delayed as per the requirement.

Conflict of Interest: None declared

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