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COMPARATIVE STORAGE STUDY OF CUSTARD APPLE PULP SEPARATED BY MACHINE AND MANUAL

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Abstract- A research was carried out to study storage of custard apple pulp. The custard apple fruits were split into two halves and pulp with seed were scooped out manually. The seed from the pulp was separated by machine and compared with pulp separated by manual. The pulp was treated with ascorbic acid (0.25 %) and potassium metabisulphite (0.1 %)to check the browning of pulp during storage. Treated pulp (50 gm) was packed in HDPE bags and stored in deep freeze at -20° C for 6 month. The stored pulp wereanalyzed every month for physiochemical qualities and microbial load. The pH, TSS, Total sugar, water activity, acidity and colour(L-Value)of the stored custard apple pulp was found to be in the range of 5.52 to 5.28, 23° to 27°brix, 13.28 to 20.61,0.857 to 0.940,0.44 to 0.20 and 69.98 to59.03, respectively.The microbial load and fungal count of stored custard apple pulp was found to be less than 1000 cfu/g and 100 cfu/g, respectively. The microbial load was less in potassium metabisulphite and ascorbic acid treated sample than that of control sample. Pulp separated by any method scould be stored at -20°C with 0.1%KMS for 180 days without spoilage.

Keywords- Custard apple, pulp, physiochemical properties and Microbial count

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Introduction

The custard apple fruit is mostly used as a dessert fruit for its delicious taste and nutritive values. The pulp is used in preparation of ice-cream and beverages[1]. Custard apple fruit is excellent source of carbohydrates (23.5%), minerals (0.9%), and protein (1.6%). A total soluble solid in the pulp is 22.3° brix. It is also a good source of vitamin A and C. The pulp due to its richness in free sugar, minerals and vitamins is known to serve as blood tonic [2]. The pulp has a pleasant texture and flavor. It is sweet with moderate acidity [3].

It is a climacteric fruit, ripening starts soon afterit detached from the tree. It is highly perishable fruit with short shelf life of 1-2 days after ripening.

Storage of the fresh fruits of (A. squamosa), has limitations, since it is perishable, and cold storage is not promising because of the development of unattractive brown colour on the skin which decrease market value [4]. The shelf life of pulp is very short only few hours at ambient condition but is can be stored under frozen condition for more six months. The pulp in frozen condition is available in the market. The main problem in custard apple processing is to separate the seed from the pulp. Presently, seeds from the pulp are separated by manually which is tedious and time consuming job. Therefore, thede-seeding machine for custard apple pulp was developed at Department of Agricultural Process Engineering Dr. PDKV, Akola which separates the seed from the pulp. The chemical preservatives are used to prevent the food spoilage due to microbial attack[5].The antioxidants canbe used to control enzymatic browning[6].Ascorbic acid is probably the most widely used anti browning agent[7].Potassium metabisulphite (KMS) are also used as preservatives for long term storage of fruit pulp because of their better antimicrobial activity [8-10].The present investigation was undertaken to compare the quality of stored pulp separated by machine and manual.

Materials and methods

Raw Material

Custard apple fruit of Balanagar variety were obtained from farmer's field.These fruits were graded and ripening was carried out at ambient condition.

Pulp and Seed Separation

Fully ripened fruit with firm texture, uniform in size and without blemishes were used for the experiment. The custard apple fruits were split into two halves, pulp along with seeds was scooped out by using spoon. The seeds from the pulp were separated by manual and machine under hygienic condition.

Method of Pulp and Seed Separation

M1= Machine
M2= Manual

Antioxidant Treatment

T1= De-seeded pulp with 0.25% Ascorbic acid
T2= De-seeded pulp with 0.1% Potassium metabisulphite
T3= De-seeded pulp with without addition ofantioxidant (control)

Treatment Combination

M1T1= pulp separated by machine + 0.25 % ascorbic acid
M1T2 = pulp separated by machine + 0.1 % potassium metabisulphite (KMS)
M1T3 = pulp separated by machine + without antioxidant
M2T1 = pulp separated d by manual + 0.25 % ascorbic acid
M2T2 = pulp separated by manual + 0.1 % potassium metabisulphite
M2T3 = pulp separated by manual + without antioxidant.

Storage of Pulp

The treated pulp (50 gm) were packaged in HDPE bags immediately and subjected to storage condition at-20°C. The quality of pulp separated by machine was compared with pulp separated by manual (Plate 1). The stored pulp was analyzed at an interval of 30 days.

Analysis of Pulp

Stored pulp was analyzed for acidity, pH, Total soluble solid (TSS), Water activity and Total sugar. Total soluble solid (TSS) was measured by using Erma Hand Refractometer. Titrable acidity was determined by titration method given by [11] while total sugar content of pulp was measured by Anthron method [12].Water activity of stored pulp was determined by Aqua lab water activity meter and colour of pulp in terms of L-value was determined by Konica Minolta chromameter (CR-400).

Custard apple fruits

Splitting Custard apple

Scooping of pulp

De-seeding of custard apple pulp by machine

Manual de-seeding of custard apple pulp at commercial processing plant

Plate 1: Pulp separated by machine and manual

Microbiological Evaluation of the Product

For microbial analysis, 1 gm of sample was serially diluted to 10^{-2} dilution and the aliquots of all the dilutions (10^{-0}, 10^{-1} and 10^{-2}) were plated on nutrient agar for total bacterial count and on potato dextrose agar for fungus. The experiment was carried out in triplicates for each sample. All plates were incubated at 37°C for 24 hours.

Sensory Evaluation

The sensory evaluation of stored custard apple pulp was carried out by panel 10 members. The judgment were made to rating product on a 9 point Hedonic scale with corresponding descriptive terms ranging from 9 'like extremely' to 1 'dislike extremely'

Result and Discussion

The results obtained from the present investigation are discussed in following heads.

Physico-chemical changes

The data of pH of custard apple pulp during storage is presented in [Table-1]. The rate of change in pH during storage was found to be negligible.

Change in TSS of custard apple pulp during storage at different treatments and separation methods are presented in [Table-2]. It has been observed that there was gradual increase in TSS of custard apple pulp with increasing storage period. TSS of control sample of custard apple pulp was found to be more compared to treated sample. The TSS of sugar apple fruits increased during

storage at different temperatures. The increase in TSS might be due to the increase in soluble solid content and total sugars caused by hydrolysis of polysaccharides into simple sugar during storage. Similar results were reported by [13-15].

Data of total sugar of custard apple pulp during storage is given in [Table-3]. There was gradual increase in total sugar with increase in storage period. There was not found any effect of treatment and separation method on total sugar of stored custard apple pulp. The increase in total sugars might be due to the hydrolysis of polysaccharide like pectin, Cellulose, starch, etc. and its conversion into simple sugar [16].

Water activity of stored custard apple pulp was found to be in the range of 0.8 to 0.9. There was not found any effect of treatment and separation method on water activity of stored custard apple pulp [Table-4].

There was a slight decrease in titrable acidity during storage period of 180 days. This may be due to the utilization of acid in the respiratory process or conversion of acid into sugar. The similar findings have been advocated by [17-18] in custard apple fruits.

Change in colour of custard apple pulp is mainly due to enzymatic browning. Data of change in colour of custard apple pulp during storage are presented in [Table-6]. There was negligible change in colour of pulp with increase in storage period. This may be due to storage temperature was very low (-20°C)[19]. Chang in colour of pulp was observed when the pulp was taken out from the deep freeze for further analysis. Among the treatment of stored pulp KMS (T2) treated sample shows the highest L- value followed by ascorbic acid treated (T1) and lowest of control sample. This shows that KMS treated sample was whiter in colour than that of other sample.

. **Table-1** *Change in pH of custard apple pulp during storage*

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	5.45	5.49	5.38	5.52	5.42	5.42
30	5.48	5.51	5.46	5.47	5.50	5.52
60	5.50	5.43	5.47	5.42	5.36	5.37
90	5.30	5.41	5.38	5.32	5.39	5.32
120	5.34	5.23	5.38	5.21	5.24	5.30
150	5.30	5.28	5.32	5.31	5.25	5.23
180	5.32	5.26	5.30	5.30	5.23	5.28

Table-2 *Change in TSS (Deg.Brix) of custard apple pulp during storage*

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	24.2	24.5	25.1	24.3	23.1	24.1
30	24.1	25	26	24.1	23	24.1
60	25	24.1	25.2	24	24.1	26
90	26	24.6	25	24.8	24.3	24.4
120	26	24.6	25.8	24	24.4	24.8
150	27	26	28	25	26	26
180	26	26.8	27	26	26	27

Table-3 *Change in Total Sugar %of custard apple pulp during storage*

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	13.45	13.68	15.54	15.45	13.98	16.71
30	13.43	13.92	16.18	16.28	14.04	17.43
60	16.77	17.08	20.09	15.26	16.41	16.89
90	15.08	13.64	18.15	15.85	16.25	16.77
120	15.43	15.92	16.98	13.28	17.04	18.43
150	16.89	19.57	20.61	17.38	18.77	16.94
180	20.07	19.72	18.76	19.87	20.26	17.79

Table-4 *Change in water activity (fraction) of custard apple pulp during storage*

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	0.913	0.921	0.911	0.913	0.901	0.923
30	0.885	0.882	0.892	0.857	0.904	0.881
60	0.910	0.890	0.896	0.876	0.859	0.892
90	0.905	0.921	0.896	0.894	0.907	0.906
120	0.917	0.917	0.910	0.923	0.940	0.940
150	0.928	0.900	0.933	0.901	0.902	0.900
180	0.915	0.912	0.927	0.922	0.905	0.910

Table-5 *Change in % acidity of custard apple pulp during storage*

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	0.31	0.32	0.32	0.33	0.35	0.37
30	0.32	0.36	0.40	0.42	0.39	0.38
60	0.40	0.30	0.34	0.44	0.30	0.41
90	0.42	0.24	0.40	0.36	0.42	0.34
120	0.27	0.28	0.32	0.20	0.29	0.32
150	0.29	0.27	0.29	0.30	0.20	0.29
180	0.22	0.21	0.22	0.24	0.20	0.23

Table- 6 *Change in Colour (L-value) of custard apple pulp during storage*

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	69.32	70.14	64.24	68.67	69.98	62.12
30	60.75	65.75	59.03	60.97	62.56	59.98
60	64.37	68.37	59.81	63.08	66.16	61.41
90	62.41	62.94	56.84	68.06	67.32	61.26
120	58.03	65.05	58.77	63.29	63.39	59.56
150	64.43	64.54	59.03	63.73	64.26	61.89
180	65.88	66.52	57.91	64.83	63.59	60.83

Microbial Analysis

The data present in [Table-7] show the bacterial and fungal load (cfu/g) of stored custard apple pulp. Bacterial load of custard apple pulp during storage was found to be in the range of 1 x 103 to 7 x 103cfu/g. The microbial load of stored custard apple pulp was below 1000 cfu/g. The microbial load was less in potassium metabisulphite and ascorbic acid treated sample than that of control sample. This may be due to the antimicrobial properties of KMS and ascorbic acid. There was not found any difference between the microbial load of custard apple pulp separated by machine and manual. This may be due to that size of sample was small and it was packed immediately after separating the pulp by both the methods. There was not found any change in microbial load with increasing storage period. This may be due to that storage temperature was very low (-20° C). The fungal count in the entire sample was found to be less 100 cfu/g.

Sensorial Quality of Custard Apple Pulp During Storage

The data representing the change in sensorial quality of custard apple pulp with respect to different treatments and stored at -20°C is given in [Table-8]. It has been observed that custard apple treated with 0.1 per cent potassium metabisulphite and stored at -20°C temperature had the more sensory score that of the other samples. The maximum score of all parameters of sensory was obtained for the treatment M1T2 and M2T2 which is in the range of 7-8. This shows that there was not found any difference between the sensory score of custard apple pulp separated by machine and manual.

Table- 7 *Bacterial and Fungal load of custard apple pulp during storage Bacterial load (CFU/g*

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	2 x 103	3 x 103	2 x 103	1 x 103	3 x 103	2 x103
30	3 x 103	2 x 103	7 x 103	3 x 103	2 x103	5 x 103
60	1 x 103	1 x 103	5 x 103	1 x 103	1 x 103	3 x 103
90	2 x 103	2x 103	4 x 103	2 x 103	2 x 103	5x 103
120	1 x 103	1 x 103	3 x 103	1 x 103	2 x 103	3 x 103
150	3 x 103	2 x 103	5 x 103	2 x 103	1 x 103	7 x 103
180	1 x 103	2 x 103	7 x 103	2 x 103	1x 103	3 x 103

Fungal load (CFU/g.)

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	2×10^2	1×10^2	2×10^2	1×10^2	1×10^2	2×10^2
30	1×10^2	1×10^2	2×10^2	3×10^2	2×10^2	5×10^2
60	3×10^2	1×10^2	3×10^2	2×10^2	1×10^2	1×10^2
90	2×10^2	2×10^2	6×10^2	1×10^2	1×10^2	4×10^2
120	1×10^2	2×10^2	5×10^2	1×10^2	2×10^2	3×10^2
150	1×10^2	1×10^2	4×10^2	3×10^2	2×10^2	5×10^2
180	2×10^2	2×10^2	5×10^2	1×10^2	1×10^2	4×10^2

Table- 8 *Sensory evaluation of custard apple pulp during storage Changes in Flavour*

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	7.25	7.09	6.10	6	7.89	6.00
30	5.35	8.00	4.01	5.08	7.81	4.00
60	5.26	7.99	4.00	5.06	7.80	4.40
90	5.45	7.95	4.08	5.32	7.88	4.03
120	5.41	7.91	4.05	5.10	7.00	4.10
150	5.37	7.78	4.01	5	7.56	4.02
180	5.00	8.00	4.00	5.22	7.62	4.04

Changes in Taste

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	7.35	8	5.00	6.00	8.00	5.25
30	5.00	7.90	4.01	5.00	7.98	4.85
60	5.01	7.97	4.05	5.01	7.91	4.65
90	5.00	7.95	3.99	5.00	7.98	4.25
120	4.99	7.91	3.98	4.99	7.96	4.21
150	4.98	7.89	4.00	4.22	7.95	4.13
180	4.90	8.00	4.01	4.38	8.00	4.00

Changes in Texture

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	5.90	7.99	4.58	5.65	7.78	4.90
30	5.99	7.97	4.66	5.62	7.79	4.98
60	5.92	7.91	4.52	5.57	7.89	4.86
90	5.89	7.94	4.63	5.73	7.80	4.80
120	5.86	7.90	4.67	5.71	7.83	4.00
150	5.91	7.92	4.00	5.70	7.65	4.52
180	5.90	7.99	4.58	5.65	7.78	4.90

Changes in Overall Acceptability

Storage period (Days)	Treatments					
	M1			M_2		
	T_1	T_2	T_3	T_1	T_2	T_3
0	5.98	8	4.95	6	8	5
30	5.75	7.85	4.90	5.90	7.90	5
60	5.63	7.76	4.87	5.88	7.97	4.13
90	5.45	7.72	4.00	5.00	7.95	4.35
120	5.42	7.66	4.86	5.69	7.91	4.28
150	5.00	7.80	4.82	5.78	7.89	4.25
180	4.96	7.85	4.00	5.73	8.00	4.01

Conclusions

From the present investigation it could be concluded that quality of pulp separated by machine was same as that of pulp separated by manual. Therefore, for faster separation of pulp, machine can be recommended. Separated pulp could be stored at -20°C with 0.1% potassium metabisulphite (KMS)as anti browning agent for 180 days.

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