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Effect of different recipes on ascorbic acid and organoleptic qualities of custard apple nectar prepared from different cultivars

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Abstract
The study evaluated the suitability of custard apple cultivars-NMK-1 (Golden), Mammoth and Chand Sili for nectar production, sourced from the Centre of Excellence for Custard apple, Chittorgarh. Nectar was formulated at pulp concentrations of 16%, 18%, 20%, and 22%, and assessed for Ascorbic Acid and Organoleptically for Taste, Colour, Flavour and Overall Acceptability on the initial day and every 30 days for three months under refrigerated storage. Results indicated a decrease in ascorbic acid and sensory qualities during storage. Observations showed that the Mammoth cultivar at 22% pulp concentration achieved the highest sensory score and maximum ascorbic acid content, demonstrating its optimal suitability for nectar production.

Keywords: Custard apple cultivars, nectar, organoleptic qualities, pulp, ascorbic acid, value addition

Introduction
Custard apple also known as sugar apple is regarded as the 'New Super Fruit of the 21st Century' owing to its nutritional and medicinal properties (Goutam *et al.*, 2021) [4]. It is the indigenous fruits, which are locally available in a particular season, plays a vital role in the nutrition of rural mass (Shrivastava *et al.*, 2013) [14]. In Rajasthan it is naturally grown in the forests and on the marginal lands. Custard apple is the main source of income for the tribal people of south Rajasthan, especially, Udaipur, Dungarpur, Banswara, Chittorgarh and Sirohi districts (Pilania *et al.*, 2010) [10].

The pulp of fruit is often pressed through a sieve and added to milk shakes, custards or ice cream. Nutrient value of 100 g ripe pulp estimated as: carbohydrates 20.0-25.2 g, calcium 17.6 27 mg, phosphorus 14.7-32.1 mg, iron 0.42-1.14 mg, carotene 0.007-0.018 mg, thiamine 0.075-0.119 mg, riboflavin 0.086-0.175 mg, niacin 0.53-1.19 mg, ascorbic acid 15.0-44.4 mg and nicotinic acid 0.5 mg (Rymbai *et al.*, 2019) [12]. The pulp may be consumed raw or transformed into various food products. The taste of pulp is aromatic sweet, with custard like flavour. It has great potential for value addition through processing (Kotecha *et al.*, 2000) [6].

Being a highly perishable nature of fruits, it is most difficult to store and transportation. The excellent nutritive and therapeutic attempts are needed to standardize (Parihar *et al.*, 2019) [9]. The custard apple is a seasonal fruit with limited annual availability and undergoes substantial post-harvest losses of about 13-25 percent (Shailaja *et al.*, 2015) [13]. Processing of custard apple into quality beverages such as nectar, RTS would be more nutritious than many of the synthetic drinks (Kumar *et al.*, 2015) [7]. Therefore, the present study is done to find out suitable variety for Custard apple nectar preparation based on the ascorbic acid content and organoleptic attributes.

Materials & Methods
The study was conducted at the Post-Harvest and Value Addition Laboratory, Department of Horticulture, Mewar University, Chittorgarh, Rajasthan. This study evaluated three custard apple cultivars—Mammoth, NMK-1 (Golden), and Chand Sili. Uniformly mature fruits were procured from the Centre of Excellence for Custard Apple, Chittorgarh.

Mature fruits were ripened at ambient temperature for 4-5 days, washed, and manually pulped by scooping and sieving to remove seeds. The pulp was homogenized in a grinder for uniform consistency.

Nectar was formulated at varying pulp concentrations as mentioned in the table 1, maintaining Total Soluble Solids (TSS) above 15 °Brix and acidity at 0.3%. Sugar syrup was prepared by heating, with citric acid added to achieve the desired acidity.

After cooling, custard apple pulp was incorporated through a muslin cloth, and the mixture was homogenized. Sodium benzoate was used as a preservative in a concentration of 300 ppm per litre of the product. The nectar was filled into pre-sterilized bottles, labelled, and refrigerated for analysis.

Ascorbic acid content and organoleptic assessments were conducted initially and at 30-day intervals for 90 days. Ascorbic acid was analysed by following standard method (visual titration method) (Ranganna, 1986) [11]. Sensory evaluation employed a 9-point hedonic scale, assessing taste, colour, flavour, and overall acceptability as the average of these attributes. Data were statistically analysed using Factorial Completely Randomized Design with three replications per treatment.

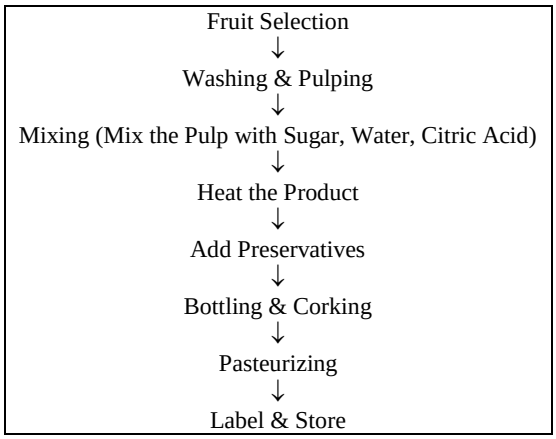

Fig 1: Flow chart for Custard apple Nectar preparation

Results

Ascorbic acid and Sensory qualities of Custard apple nectar was significantly influenced with different pulp concentration and varied cultivars.

Ascorbic acid content decreased over time under storage, it is evident from the data (Table 2) V_2 having the highest levels (6.36 mg/100 g initially, 6.05 mg/100 g at 90 days). Pulp P_4 showed the highest ascorbic acid (6.46 mg/100 g initially, 6.12 mg/100 g at 90 days), with V_2P_4 interaction maximum (6.59 mg/100 g initially, 6.26 mg/100 g at 90 days) and V_3P_1 minimum (6.07 mg/100 g initially, 5.68 mg/100 g at 90 days) (Table 3).

Sensory qualities for Taste, Colour, Flavour and Overall acceptability based on the Hedonic scale. The Evaluation was done with the pannel of five judges. The Sensory qualities of Custard apple Nectar showed a decreasing trend. Taste scores were highest for V_2 (7.41 initially) and P_4 (7.14 initially) (Table 4), with V_2P_4 interaction maximum (7.61 initially), followed by V_3P_4 (6.93) and V_1P_4 (6.88) (Table 6). Flavour and colour both decreased, with V_2 maximum in both parameters. Overall acceptability, averaged from sensory parameters, was highest initially for V_2 (6.01), P_4 (6.86) (Table 5) and V_2P_4 interaction (6.10), indicating superior sensory quality (Table 7).

Table 1: Treatment details

Treatments	Treatment details
V_1P_1	NMK-1 (Golden) 16% Pulp concentration
V_1P_2	NMK-1 (Golden) 18% Pulp concentration
V_1P_3	NMK-1 (Golden) 20% Pulp concentration
V_1P_4	NMK-1 (Golden) 22% Pulp concentration
V_2P_1	Mammoth 16% Pulp concentration
V_2P_2	Mammoth 18% Pulp concentration
V_2P_3	Mammoth 20% Pulp concentration
V_2P_4	Mammoth 22% Pulp concentration
V_3P_1	Chand Sili 16% Pulp concentration
V_3P_2	Chand Sili 18% Pulp concentration
V_3P_3	Chand Sili 20% Pulp concentration
V_3P_4	Chand Sili 22% Pulp concentration

Table 2: Ascorbic acid content of Custard apple nectar prepared from different cultivars

Treatment	Ascorbic acid (mg/100 g)			
	Initial	30	60	90
Factor-Variety				
V_1 (NMK-1 Golden)	6.28	6.16	6.07	5.95
V_2 (Mammoth)	6.36	6.26	6.16	6.05
V_3 (Chand Sili)	6.21	6.05	5.98	5.84
CD (5%)	0.030	0.030	0.022	0.030
SE(d)	0.030	0.015	0.010	0.014
SE(m)	0.010	0.010	0.007	0.010
Factor-Pulp Concentration				
P_1 (16% pulp)	6.10	5.98	5.89	5.77
P_2 (18% pulp)	6.24	6.11	6.04	5.90
P_3 (20 pulp %)	6.35	6.20	6.13	6.00
P_4 (22% pulp)	6.46	6.34	6.24	6.12
CD (5%)	0.034	0.035	0.025	0.034
SE(d)	0.016	0.017	0.012	0.017
SE(m)	0.012	0.012	0.008	0.012

Table 3: Interaction effect of different combinations of Custard apple Nectar on Acsorbic acid

Treatment	Ascorbic acid (mg/100 g)			
	Initial	30	60	90
V1P1	6.10	6.00	5.89	5.80
V1P2	6.24	6.08	6.02	5.91
V1P3	6.37	6.21	6.14	5.97
V1P4	6.43	6.32	6.22	6.09
V2P1	6.12	6.03	5.94	5.81
V2P2	6.34	6.25	6.15	6.00
V2P3	6.41	6.30	6.22	6.12
V2P4	6.59	6.45	6.32	6.26
V3P1	6.07	5.89	5.82	5.68
V3P2	6.15	5.97	5.93	5.77
V3P3	6.26	6.06	6.01	5.91
V3P4	6.35	6.23	6.16	6.00
CD (5%)	0.059	0.060	0.043	0.060
SE(d)	0.028	0.029	0.021	0.029
SE(m)	0.020	0.021	0.015	0.020

Table 4: Taste and Flavour of Custard apple Nectar

Treatment	Taste				Flavour			
	Initial	30	60	90	Initial	30	60	90
Factor-Variety								
V_1 (NMK-1 Golden)	6.83	6.81	6.76	6.73	7.90	7.78	7.34	7.07
V_2(Mammoth)	7.41	7.37	7.30	7.25	8.20	8.14	8.01	7.70
V_3 (Chand Sili)	6.86	6.82	6.78	6.74	7.85	7.72	7.27	7.02
CD (5%)	0.040	0.036	0.028	0.035	0.027	0.027	0.030	0.037
SE(d)	0.019	0.017	0.014	0.017	0.013	0.013	0.014	0.018
SE(m)	0.014	0.012	0.010	0.012	0.009	0.009	0.010	0.013
Factor-Pulp Concentration								
P_1 (16% pulp)	6.91	6.89	6.82	6.77	7.93	7.78	7.41	7.16
P_2 (18% pulp)	7.00	6.96	6.93	6.89	7.97	7.87	7.51	7.25
P_3 (20 pulp%)	7.07	7.04	6.98	6.93	7.99	7.90	7.60	7.31
P_4 (22% pulp)	7.14	7.09	7.06	7.02	8.04	7.96	7.64	7.34
CD (5%)	0.046	0.042	0.033	0.041	0.031	0.031	0.034	0.043
SE(d)	0.022	0.020	0.016	0.020	0.015	0.015	0.016	0.021
SE(m)	0.016	0.014	0.011	0.014	0.010	0.010	0.012	0.015

Table 5: Colour and Overall acceptability of Custard apple Nectar

Treatment	Colour				Overall Acceptability			
	Initial	30	60	90	Initial	30	60	90
Factor-Variety								
V_1 (NMK-1 Golden)	7.15	7.09	7.06	6.50	5.70	5.65	5.49	5.32
V_2(Mammoth)	7.27	7.16	7.00	6.54	6.01	5.97	5.88	5.71
V_3 (Chand Sili)	7.06	7.01	6.94	6.33	5.69	5.62	5.45	5.29
CD (5%)	NS	0.020	NS	0.030	0.016	0.014	0.015	0.016
SE(d)	0.011	0.009	0.055	0.014	0.008	0.007	0.007	0.008
SE(m)	0.008	0.007	0.039	0.010	0.006	0.005	0.005	0.005
Factor-Pulp Concentration								
P_1 (16% pulp)	7.16	7.07	6.95	6.43	5.74	5.68	5.52	5.36
P_2 (18% pulp)	7.16	7.08	6.97	6.44	5.79	5.73	5.59	5.43
P_3 (20 pulp%)	7.16	7.09	7.06	6.47	5.82	5.77	5.65	5.46
P_4 (22% pulp)	7.15	7.11	7.01	6.49	5.86	5.81	5.68	5.51
CD (5%)	NS	0.020	NS	0.030	0.016	0.014	0.015	0.016
SE(d)	0.011	0.009	0.055	0.014	0.008	0.007	0.007	0.008
SE(m)	0.008	0.007	0.039	0.010	0.006	0.005	0.005	0.005

Table 6: Interaction effect of different combinations of Custard apple Nectar on Taste and Flavour

Treatment	Taste				Flavour			
	Initial	30	60	90	Initial	30	60	90
V1P1	6.75	6.72	6.67	6.63	7.86	7.64	7.20	6.98
V1P2	6.84	6.78	6.75	6.71	7.88	7.79	7.30	7.05
V1P3	6.83	6.86	6.78	6.74	7.89	7.83	7.41	7.10
V1P4	6.89	6.86	6.85	6.82	7.94	7.85	7.45	7.14
V2P1	7.18	7.18	7.08	7.03	8.13	8.09	7.90	7.58
V2P2	7.35	7.33	7.28	7.24	8.19	8.13	8.03	7.70
V2P3	7.49	7.42	7.37	7.31	8.22	8.15	8.05	7.75
V2P4	7.61	7.53	7.47	7.42	8.26	8.20	8.08	7.77
V3P1	6.81	6.77	6.71	6.67	7.79	7.61	7.13	6.91
V3P2	6.82	6.79	6.75	6.71	7.83	7.70	7.21	7.00
V3P3	6.89	6.85	6.80	6.74	7.86	7.72	7.34	7.07
V3P4	6.93	6.88	6.87	6.82	7.92	7.83	7.38	7.11
CD (5%)	0.080	0.073	0.057	0.070	NS	0.053	NS	NS
SE(d)	0.039	0.035	0.027	0.034	0.026	0.026	0.028	0.036
SE(m)	0.027	0.025	0.019	0.024	0.018	0.018	0.020	0.025

Table 7: Interaction effect of different combinations of Custard apple Nectar on Colour and Overall acceptability

Treatment	Colour				Overall Acceptability			
	Initial	30	60	90	Initial	30	60	90
V1P1	7.15	7.05	6.98	6.46	5.66	5.57	5.40	5.25
V1P2	7.15	7.08	6.99	6.48	5.70	5.64	5.46	5.31
V1P3	7.15	7.11	7.24	6.52	5.70	5.69	5.54	5.34
V1P4	7.14	7.13	7.02	6.54	5.74	5.70	5.55	5.38
V2P1	7.27	7.15	6.97	6.52	5.91	5.88	5.77	5.60
V2P2	7.26	7.16	7.00	6.53	5.99	5.95	5.88	5.70
V2P3	7.28	7.16	7.00	6.54	6.05	5.99	5.92	5.75
V2P4	7.26	7.18	7.04	6.55	6.10	6.04	5.96	5.79
V3P1	7.06	7.00	6.90	6.30	5.65	5.57	5.38	5.23
V3P2	7.06	7.00	6.93	6.32	5.67	5.60	5.42	5.27
V3P3	7.06	7.01	6.95	6.34	5.70	5.63	5.49	5.31
V3P4	7.05	7.02	6.97	6.37	5.73	5.68	5.52	5.35
CD (5%)	NS	NS	NS	NS	0.028	0.024	0.026	0.027
SE(d)	0.019	0.016	0.096	0.025	0.014	0.012	0.012	0.013
SE(m)	0.013	0.012	0.068	0.018	0.01	0.008	0.009	0.009

Discussion

The Custard apple Nectar was stored under refrigerated storage. Sensory qualities and ascorbic acid were observed at Initial days and every 30 days interval.

The decrease in ascorbic acid content in nectar may be due to oxidation or irreversible conversion of L-ascorbic acid into dehydro ascorbic acid in the presence of enzyme ascorbic acid oxidase (ascorbinase) (Kalra and Tondon, 1998) [5]. Similar results were reported by Pilania *et al.* (2010) [10] in RTS beverage of Custard apple and Bal *et al.* (2014) [2] in storage of guava nectar. The reduction in ascorbic acid may be attributed to its destruction by oxidation or heat during processing (Sravanthi, 2014). Gautam *et al.* (2021) [4] also reported decrease in ascorbic acid content of blended custard apple nectar.

The sensory quality of Custar apple Nectar decreased during storage period. Similar findings were reported by Pilania *et al.*, (2010) [10] in colour of custard apple RTS. Ali *et al.* (2022) [1] also recorded a gradual decrease in organoleptic score of nectar prepared from guava and papaya. A decrease in sensory qualities (taste, flavour, colour, overall acceptability) during storage was also recorded by Parihar *et al.*, (2019) [9], in custard apple squash. Meghwal *et al.* (2017) [8] also reported that the guava nectar prepared from 18% pulp concentration showed minimum changes in ascorbic acid and organoleptic properties viz. colour, taste, flavour and overall acceptability under both refrigerated and ambient storage condition. A decline in flavour acceptability score had been observed with storage period in Pomegranate nectar by Bhatt *et al.* (2022) [3] might be due to loss of typical aroma owing to the reactions of acids with other constituents especially the polyphenols and the acid

deteriorates the volatile compounds like flavonoids by oxidation and polymerization.

Conclusion

The present study concludes that the Mammoth cultivar (V_2) at 22% pulp concentration (P_4) is the most suitable for Custard apple Nectar production, exhibiting the highest ascorbic acid and sensory acceptability (taste, flavour, colour and overall score) initially as well as after 90 days of refrigerated storage, despite a general decrease over storage period.

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