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Quantitative assessment of biochemical traits in cashew (*Anacardium occidentale* L.) genotypes

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Abstract
A two-year study (2024-25) was conducted at the Cashew Research Station, Bapatla, to assess biochemical traits in 65 cashew genotypes (45 F1 hybrids, 17 parents and 3 checks) evaluated in an augmented block design. These genotypes were planted during 2009-2012 and are now in the bearing phase. Marked variability was observed for total soluble solids (TSS), ascorbic acid, titratable acidity and tannins. TSS ranged from 8.63 to 12.91 °Brix, with H-491 recording the highest value (12.91 °Brix). Ascorbic acid content varied widely from 114.29 to 192.10 mg 100 g^{-1}, with genotypes H-719 (192.10 mg 100 g^{-1}) and H-722 (170.64 mg 100 g^{-1}) emerging as rich sources of vitamin C. Titratable acidity ranged from 0.20 to 0.84 per cent, with H-491, H-496 and H-474 expressing the lowest acidity, which is desirable for fresh consumption. Tannin content varied from 2.39 to 3.88 per cent, while T.No.10/19 and H-491 recorded the minimum levels. Genotype H-491 combined high TSS, low acidity, low tannins and favourable ascorbic acid content, identifying it as the most promising type for fresh consumption. Genotypes such as H-719 and H-722 are promising for processing owing to their superior ascorbic acid content. The observed variability among genotypes indicates good potential for selecting cashew types suited for both table and processing purposes.

Keywords: Total soluble solids, ascorbic acid, titratable acidity, tannins, genotypic diversity, hybrid evaluation, value addition, fruit quality, functional foods, antioxidant potential

Introduction
Cashew (*Anacardium occidentale* L.) is a tropical evergreen tree in the family Anacardiaceae. It is cultivated for its edible kernel and the juicy pseudo fruit called the cashew apple. In 2023-24 the crop covered 11.99 lakh hectares and produced 7.95 lakh tonnes of raw nuts (DCCD, 2023) [4]. The nut dominates commercial value but the cashew apple, which is 8-10 times heavier than the nut remains underutilized and is often wasted at the farm level despite its biochemical richness.

The cashew apple is highly perishable but nutritionally valuable. It contains large amounts of ascorbic acid, Total Soluble Solids (TSS) and organic acids. Ascorbic acid levels range from 100 to 314 mg/100 g, far higher than in orange or guava (Assunção and Mercadante, 2003) [11]. TSS, which reflects sweetness and suitability for processing, usually falls between 10.2 and 14.0 °Brix depending on genotype and environment (Assunção and Mercadante, 2003) [11]. Titratable acidity corresponds to a pH of 3.5-4.6 and provides tartness while improving microbial stability.

Besides these nutrients, the fruit contains tannins and phenolic compounds. These are not essential nutrients but they influence astringency, colour stability and antioxidant activity. Their high levels often require clarification or other processing methods to improve consumer acceptability. Tannins generally range from 0.4% to 1.0% and cause the characteristic astringency that limits consumer preference in spite of the nutritional richness of the fruit.

Traits such as TSS, ascorbic acid, acidity and tannins vary with genotype, maturity, environment and storage conditions. They need systematic evaluation to identify promising material. Research on cashew has largely focused on nut yield and kernel traits, with relatively few studies on the biochemical properties of the cashew apple under uniform agronomic conditions.

Evaluating variation in these parameters is essential for better utilization of cashew apple and for expanding its potential in functional foods and beverages. The present study was therefore carried out to assess TSS, ascorbic acid, titratable acidity and tannins in cashew genotypes to identify varieties with superior nutritional and processing potential.

Materials and Methods

A perennial genetic evaluation trial of cashew genotypes was established at this station during 2009-2012 by planting 65 genotypes consisting of 45 F_1 hybrids, 17 parents and 3 standard checks. The present investigation was carried out at the Cashew Research Station, Bapatla, Andhra Pradesh, India, during the 2024-25 season. By the time of the present study, the trees were in the regular bearing stage under uniform management. Fully bearing trees of all 65 genotypes in this trial served as the source material for the biochemical evaluation of cashew apples.

Experimental design

The genotypes were laid out in an augmented block design at the time of establishment, with the standard checks replicated in each block and the hybrids and parents treated as unreplicated test entries. Recommended agronomic and management practices for cashew in the region have been followed uniformly since planting .Biochemical characterization of the cashew apples was undertaken during the 2024-25 season using fruits harvested from these bearing trees.

Collection of Samples for Analysis

Fully matured and physiologically ripe cashew apples were harvested during the peak harvesting season. Uniformly sized, healthy and undamaged fruits were randomly collected from each genotype. The samples were immediately transported to the laboratory in clean, food-grade containers and processed fresh on the same day to avoid biochemical deterioration and enzymatic changes. For the biochemical analysis, the cashew apples were washed thoroughly with distilled water and juice was extracted by gently pressing the apples under hygienic conditions. The extracted juice was filtered through muslin cloth to remove coarse particles and then subjected to analysis.

Analysis of Samples

The Total Soluble Solids (TSS) of the juice were measured using a hand refractometer and expressed in °Brix following the method of Ranganna (1986) [10]. Titratable acidity was determined by titrating a 10 ml aliquot of diluted juice against 0.1 N sodium hydroxide using phenolphthalein as the indicator until a faint pink endpoint was obtained and expressed as percent malic acid equivalent on a fresh weight basis (Ranganna, 1986) [10]. Ascorbic acid content was estimated by the 2,6-dichlorophenol indophenol (DCPIP) dye titration method employing 3% metaphosphoric acid as the extraction medium and expressed as mg 100 ml^{-1} of juice (Ranganna, 1986) [10]. Tannin concentration was determined using the Folin-Denis colorimetric method (AOAC, 1975) [2] in which clarified juice was reacted with Folin-Denis's reagent and sodium carbonate incubated for 30 minutes and the absorbance was read at 760 nm. Tannin content was calculated against a standard tannic acid curve and expressed as mg 100 ml^{-1}.

Results and Discussions

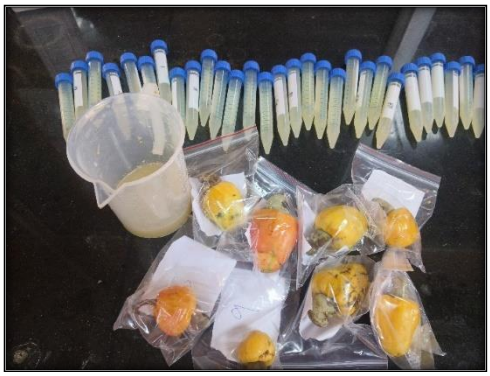
The biochemical characterization of cashew apple juice across 65 genotypes revealed appreciable diversity in Total Soluble Solids, ascorbic acid, titratable acidity and tannin content. Detailed results and their discussions are provided in the subsequent sections.

Total soluble solids (TSS)

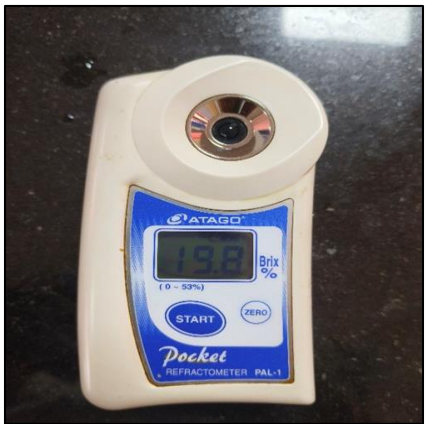
Total soluble solids (TSS) are a key index of fruit quality, indicating suitability for fresh consumption and for the preparation of juices, beverages and other processed products. As presented in Table 1, TSS in 2024 ranged from 8.91 to 13.20 °Brix with a mean of 10.92 °Brix. The best check was Vengurla 4 (11.54 °Brix) and 14 test entries exceeded this value. The maximum TSS was recorded in H-491 (13.20 °Brix) which was statistically on par with H-706 (12.68 °Brix), H-705 (12.54 °Brix), H-710 (12.54 °Brix) and H-715 (12.46 °Brix). The lowest value was observed in H-698 (8.91 °Brix).

As shown in Table 1, TSS in 2025 ranged from 8.34 to 12.62 °Brix with a mean of 10.22 °Brix. The best check was again Vengurla 4 (11.47 °Brix) with five test entries surpassing this standard. The highest TSS was observed in H-491 (12.62 °Brix), which was statistically on par with H-715 (11.85 °Brix), H-710 (11.83 °Brix), H-705 (11.62 °Brix) and H-467 (11.53 °Brix). The lowest value was recorded in H-698 (8.34 °Brix).

When the results of both years were combined, pooled data (Table 1) showed TSS ranging from 8.63 to 12.91 °Brix with a mean of 10.57 °Brix. The best check remained Vengurla 4 (11.51 °Brix) and seven genotypes exceeded this benchmark. The highest pooled value was noted in H-491 (12.91 °Brix), which was statistically on par with H-706 (10.67 °Brix), H-705 (12.08 °Brix), H-710 (12.18 °Brix) and H-715 (12.15 °Brix). The lowest pooled value was found in H-698 (8.63 °Brix).



Samples for Analysis

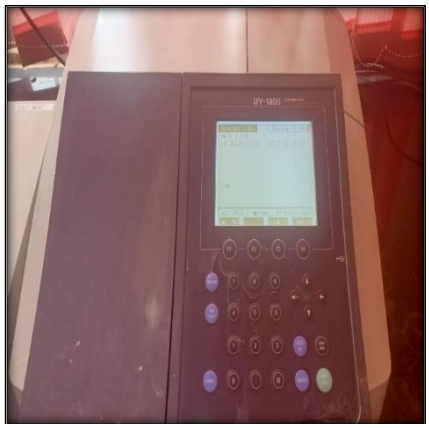


Digital Refractometer

Analysis for Titratable Acidity

Using Digital Refractrometer

Analysis for Ascorbic Acid



Spectrophotometer for Tannins Analysis

The present study revealed significant variability in TSS among cashew hybrids, ranging from 8.63 to 12.91 °Brix. Such variation is consistent with earlier reports, where values between 10-15 °Brix have been observed across genotypes (Mridha *et al.*, 2019) [6]. Naidu *et al.* (2016) [7] also reported varietal differences in TSS, with Priyanka and BPP-8 recording higher levels, supporting the role of genetic background in influencing sweetness. Similarly, Chandrasekhar *et al.* (2018) [3] noted that Bhubaneswar-1 had the highest TSS among released varieties. These results are also in accordance with Kabita Sethi *et al.* (2015) [13] and M. Sreenivas *et al.* (2014) [15] who emphasized the potential of hybrids combining high sweetness and yield attributes. The present findings are in line with these studies, confirming the potential of certain genotypes for both fresh consumption and processing.

Titratable acidity

As presented in Table 1, titratable acidity in 2024 ranged from 0.23 to 0.87% with a mean of 0.53%. Because lower acidity is preferred for consumers, the best check was Vengurla 4 (0.57%) and 36 test entries recorded lower values. The minimum was in H-491 (0.23%), statistically on par with H-496 (0.23%), H-474 (0.24%), H-461 (0.25%) and H-656 (0.31%). The highest value in H464 (0.87%) is undesirable for fresh consumption.

As shown in Table 1, titratable acidity in 2025 ranged from 0.17 to 0.82% with a mean of 0.48%. The best check was Vengurla 4 (0.53%) with 37 test entries below this benchmark. The lowest value was in H-491 (0.17%), on par with H-496 (0.18%), H-474 (0.19%), H-461 (0.20%) and H-656 (0.27%). The upper extreme in H-685 (0.82%) is less desirable for fresh use.

When both years were combined, pooled data (Table 1) showed titratable acidity ranging from 0.20 to 0.84% with a mean of 0.50%. The best check remained Vengurla 4 (0.55%) and 36 genotypes recorded lower values. The minimum pooled value was in H-491 (0.20%) on par with H-496 (0.20%), H-474 (0.21%), H-461 (0.22%) and H-656 (0.29%). The highest pooled value in H-685 (0.84%) is not preferred.

Titratable acidity among hybrids ranged from 0.20% to 0.84%, with lower values being desirable for fresh consumption. Comparable variation was reported by Kabita Sethi *et al.* (2015) [13] and Mridha *et al.* (2019) [6], who recorded acidity ranging from 0.23-0.86% among diverse cashew genotypes. Naidu *et al.* (2016) [7] observed varietal differences where acidity values varied between 0.60-1.20% depending on the cultivar. Abdullah *et al.* (2021) [1] also demonstrated that enzymatic treatments such as tannase can reduce acidity, thereby improving juice acceptability. The present investigation also identified hybrids with low acidity, supporting earlier observations (Sreenivas *et al.* 2014 and Paikra *et al.* 2016) [15, 8] that acidity is negatively associated with TSS and consumer preference. Thus, our results corroborate previous work and indicate scope for selecting genotypes suitable for beverage development.

Ascorbic acid

Cashew apple juice is recognized as an excellent source of ascorbic acid (vitamin C). The elevated vitamin C levels justify expanded utilization in ready-to-drink formulations and value-added processing. As presented in Table 1, ascorbic acid in 2024 ranged from 88.55 to 247.48 mg 100 g^{-1} with a mean of 141.39 mg 100 g^{-1}. The best check was Vengurla 4 (136.12 mg 100 g^{-1}) and 41 test entries exceeded this value. The maximum was recorded in H-719 (247.48 mg 100 g^{-1}), which was statistically on par with H-722 (206.87 mg 100 g^{-1}) and Kankady (191.80 mg 100 g^{-1}). The lowest value was observed in H-684 (88.55 mg 100 g^{-1}).

As shown in Table 1, ascorbic acid in 2025 ranged from 129.40 to 172.00 mg 100 g^{-1} with a mean of 150.81 mg 100 g^{-1}. The best check was BPP-6 (152.84 mg 100 g^{-1}) with 29 test entries surpassing this standard. The highest value was observed in H-491 (172.00 mg 100 g^{-1}), which was statistically on par with H-474 (171.16 mg 100 g^{-1}), H-656 (169.15 mg 100 g^{-1}), BPP-3 (169.03 mg 100 g^{-1}) and H-694 (168.86 mg 100 g^{-1}). The lowest value was recorded in H-710 (129.40 mg 100 g^{-1}).

When the results of both years were combined, pooled data (Table 1) showed ascorbic acid ranging from 114.29 to 192.10 mg 100 g^{-1} with a mean of 146.10 mg 100 g^{-1}. The best check remained Vengurla 4 (142.75 mg 100 g^{-1}) and 42 genotypes exceeded this benchmark. The highest pooled value was found in H-719 (192.10 mg 100 g^{-1}), which was statistically on par with H-722 (170.64 mg 100 g^{-1}), H-491 (168.16 mg 100 g^{-1}), H-474 (167.89 mg 100 g^{-1}) and Kankady (164.94 mg 100 g^{-1}). The lowest pooled value occurred in T.No.228 (114.29 mg 100 g^{-1}).

Cashew apple is exceptionally rich in vitamin C. In the present study, values ranged from 114.29 to 192.10 mg 100 g^{-1}, comparable to earlier findings. Assunção and Mercadante (2003) [11] reported varietal and geographical effects on vitamin C, with yellow cashew apples generally containing higher ascorbic acid (up to 260 mg 100 g^{-1}). Mridha *et al.* (2019) [6] also recorded genotypic variation from 180-254 mg 100 g^{-1}, while Abdullah *et al.* (2021) [1] reported values up to 269 mg 100 mL^{-1} under optimized juice processing. Naidu *et al.* (2016) [7] documented high ascorbic acid in Priyanka and BPP-8, while Kabita Sethi *et al.* (2015) [13] and Sreenivas *et al.* (2014) [15] observed rich vitamin C content in selected hybrids. The present results are in line with these reports, reaffirming the nutritional superiority of certain genotypes and their potential use in functional food development.

Tannins

As presented in Table 1, tannins in 2024 ranged from 2.50 to 4.05% with a mean of 3.22%. Since lower tannins improve palatability, the best check was BPP-6 (2.95%) and 19 test entries were lower than this value. The minimum was in T.No.10/19 (2.50%), statistically on par with H-491 (2.52%), H-483 (2.54%), H-694 (2.55%) and H-706 (2.57%). The upper extreme in T.No.40/1 (4.05%) is undesirable for consumers.

As shown in Table 1, tannins in 2025 ranged from 2.27 to 3.70% with a mean of 2.96%. The best check was BPP-6 (2.70%) and 17 test entries recorded lower values. The lowest value occurred in H-491 (2.27%), on par with T.No.10/19 (2.30%), H-483 (2.34%), H-694 (2.38%) and H-706 (2.38%). The highest value in H-686 (3.70%) is less desirable.

When pooled across years, tannins ranged from 2.39 to 3.88% with a mean of 3.09%. The best check remained BPP-6 (2.83%) and 17 genotypes recorded lower tannin content. The minimum pooled value was T.No.10/19 (2.39%), statistically on par with H-491 (2.40%), H-483 (2.45%), H-706 (2.47%) and H-694 (2.47%). The highest pooled value in T.No.40/1 (3.88%) is not preferred.

Tannin content affects the astringency of cashew apple juice. Sethi *et al.* (2015) [13] reported variation from 2.5-4.0%, with lower tannin genotypes preferred for juice extraction and fresh consumption. According to Sreenivas *et al.* (2014) [15], hybrids with reduced tannin levels not only improve palatability but also widen the scope for industrial utilization. Paikra *et al.* (2016) [8] also highlighted tannin content as a key factor influencing apple acceptability and stressed the importance of breeding programs that reduce astringency without compromising nutritional value. The present findings are in line with these reports, as hybrids with comparatively low tannin levels were also identified in this study, underscoring their potential for processing and table purposes.

Table 1: Biochemical composition of cashew genotypes assessed in 2024, 2025 and pooled analysis

Treatment	TSS			Titrable acidity			Ascorbic acid			Tannins		
	2024	2025	Pooled	2024	2025	Pooled	2024	2025	Pooled	2024	2025	Pooled
H-445	10.57	9.45	10.01	0.45	0.40	0.42	146.83	146.15	146.49	2.85	2.65	2.75
H-448	11.14	10.66	10.90	0.47	0.42	0.44	135.93	161.36	148.64	3.81	3.46	3.64
H-460	11.54	11.26	11.40	0.36	0.31	0.33	147.42	139.88	143.65	2.80	2.58	2.70
H-461	10.31	10.09	10.20	0.25	0.20	0.22	148.49	158.23	153.36	3.51	3.27	3.39
H-464	11.62	11.06	11.34	0.87	0.80	0.83	110.20	140.90	125.55	3.56	3.21	3.39
H-466	11.12	10.64	10.88	0.42	0.37	0.39	135.54	155.27	145.40	3.56	3.23	3.40
H-467	11.81	11.53	11.67	0.36	0.31	0.33	155.35	157.85	156.60	3.18	2.93	3.06
H-472	10.04	9.50	9.77	0.80	0.73	0.76	138.12	158.43	148.28	2.76	2.49	2.63
H-474	11.11	10.63	10.87	0.24	0.19	0.21	164.63	171.16	167.89	2.63	2.39	2.51
H-483	10.54	10.25	10.39	0.62	0.57	0.59	110.28	154.20	132.23	2.54	2.34	2.45
H-484	9.60	8.44	9.02	0.76	0.72	0.74	132.19	139.79	135.99	3.80	3.54	3.67
H-491	13.20	12.62	12.91	0.23	0.17	0.20	164.32	172.00	168.16	2.52	2.27	2.40
H-492	10.43	9.97	10.20	0.44	0.39	0.41	150.52	156.50	153.50	3.46	3.15	3.31
H-493	10.53	9.33	9.93	0.55	0.50	0.52	105.87	146.34	126.10	2.94	2.73	2.84
H-496	11.69	11.11	11.40	0.23	0.18	0.20	120.59	152.57	136.58	3.95	3.65	3.81
H-656	10.35	9.96	10.15	0.31	0.27	0.29	142.19	169.15	155.68	3.22	2.99	3.11
H-657	11.21	10.54	10.87	0.61	0.56	0.58	136.61	149.83	143.23	3.65	3.31	3.49
H-658	11.08	10.49	10.79	0.37	0.32	0.35	161.40	142.64	152.02	3.72	3.40	3.56
H-660	10.34	9.53	9.93	0.33	0.29	0.31	141.90	163.37	152.64	3.29	3.09	3.19
H-661	9.83	9.42	9.63	0.41	0.37	0.39	97.46	155.87	126.67	2.76	2.57	2.67
H-662	11.62	10.35	10.98	0.36	0.31	0.33	112.05	138.48	125.27	2.66	2.42	2.55
H-663	11.44	11.05	11.25	0.73	0.69	0.71	137.73	163.13	150.44	3.70	3.45	3.58
H-684	11.02	10.43	10.73	0.82	0.77	0.79	88.55	160.79	124.68	2.80	2.57	2.69
H-685	10.70	10.31	10.50	0.86	0.82	0.84	97.43	133.83	115.64	3.44	3.20	3.32
H-686	9.02	8.69	8.85	0.84	0.81	0.82	149.45	137.25	143.36	3.95	3.70	3.83
H-693	11.53	10.86	11.19	0.70	0.64	0.67	143.86	148.07	145.97	3.26	2.96	3.11
H-694	9.96	9.57	9.76	0.59	0.55	0.57	144.37	168.86	156.62	2.55	2.38	2.47
H-695	11.35	11.04	11.20	0.33	0.29	0.31	136.94	145.14	141.05	2.93	2.74	2.84
H-696	10.19	9.34	9.76	0.76	0.70	0.73	116.41	154.95	135.69	3.21	2.92	3.07
H-698	8.91	8.34	8.63	0.45	0.40	0.42	121.59	152.55	137.08	3.28	3.00	3.15
H-701	10.25	9.60	9.92	0.46	0.42	0.44	177.87	141.41	159.64	3.33	3.09	3.21
H-703	10.11	9.14	9.62	0.45	0.40	0.42	146.93	156.35	151.64	3.94	3.54	3.74
H-705	12.54	11.62	12.08	0.37	0.32	0.34	154.02	148.46	151.24	2.94	2.66	2.80
H-706	12.68	8.67	10.67	0.60	0.56	0.58	163.05	145.07	154.06	2.57	2.38	2.47
H-710	12.54	11.83	12.18	0.66	0.61	0.64	131.41	129.40	130.40	3.60	3.32	3.46
H-712	11.97	10.86	11.41	0.39	0.34	0.36	166.52	161.03	163.77	3.39	3.07	3.23
H-713	10.84	9.56	10.20	0.79	0.73	0.76	136.67	138.39	137.53	3.16	2.83	2.99
H-714	11.39	9.68	10.53	0.57	0.52	0.55	164.23	159.77	161.99	3.69	3.41	3.54
H-715	12.46	11.85	12.15	0.60	0.56	0.58	156.98	165.23	161.10	3.52	3.27	3.39
H-716	10.97	10.25	10.61	0.47	0.42	0.45	174.32	147.29	160.80	3.51	3.24	3.37
H-717	10.61	9.71	10.16	0.40	0.35	0.37	160.29	165.41	162.85	2.71	2.45	2.58
H-718	11.79	10.80	11.29	0.46	0.41	0.43	175.73	153.21	164.47	3.21	2.88	3.04
H-719	11.04	10.13	10.58	0.55	0.50	0.52	247.48	136.73	192.10	3.61	3.27	3.43
H-720	10.95	10.33	10.64	0.64	0.59	0.62	131.59	167.89	149.74	3.09	2.84	2.96
H-722	9.45	8.78	9.11	0.58	0.54	0.56	206.87	134.43	170.64	3.15	2.93	3.03
M15/4	10.71	10.24	10.47	0.42	0.37	0.39	107.23	158.55	132.88	3.30	3.00	3.15
T.No.30/1	11.60	11.04	11.32	0.40	0.34	0.37	150.16	141.40	145.77	2.88	2.60	2.74
VRI-3	11.09	10.11	10.60	0.59	0.54	0.56	151.89	144.90	148.39	3.34	3.08	3.22
BPP-9	11.08	10.88	10.98	0.42	0.37	0.39	103.40	131.34	117.37	3.25	3.03	3.14
BPP-3	11.10	10.82	10.96	0.49	0.44	0.46	145.37	169.03	157.20	2.88	2.66	2.77
Priyanka	12.24	11.36	11.80	0.44	0.39	0.41	154.21	139.37	146.78	3.10	2.82	2.96
BPP-8	10.65	10.11	10.38	0.40	0.34	0.37	150.56	141.30	145.93	3.02	2.72	2.88
T.No.228	9.95	9.62	9.79	0.62	0.59	0.60	98.37	130.21	114.29	3.30	3.10	3.20
VRI-2	9.92	9.35	9.63	0.50	0.45	0.47	146.09	146.45	146.28	3.41	3.12	3.27
BPP-5	9.47	9.06	9.27	0.57	0.53	0.55	97.25	155.92	126.59	3.21	2.98	3.10
T.No.2/22	10.45	10.14	10.29	0.65	0.62	0.63	99.42	145.53	122.48	3.84	3.60	3.72
ABT-3	10.81	10.14	10.48	0.65	0.59	0.62	95.71	166.38	131.05	3.13	2.85	2.99
T.No.40/1	11.22	10.63	10.93	0.49	0.44	0.46	144.55	155.59	150.07	4.05	3.70	3.88
Ullal-3	9.75	9.34	9.55	0.42	0.38	0.40	138.31	159.74	149.03	2.63	2.45	2.54
Kankady	11.89	11.26	11.57	0.59	0.55	0.57	191.80	138.08	164.94	3.17	2.95	3.05
BLA39/4	9.79	8.90	9.34	0.77	0.72	0.74	165.40	148.12	156.76	3.10	2.81	2.95
T.No.10/19	10.83	10.11	10.47	0.50	0.45	0.48	160.82	146.69	153.75	2.50	2.30	2.39
BPP-4	10.92	9.67	10.30	0.61	0.56	0.59	135.18	137.26	136.22	3.33	3.05	3.19
BPP-6	11.33	10.71	11.02	0.75	0.70	0.72	130.37	152.84	141.61	2.95	2.70	2.83
Vengurla 4	11.54	11.47	11.51	0.57	0.53	0.55	136.12	149.38	142.75	3.41	3.17	3.29
Mean	10.92	10.22	10.57	0.53	0.48	0.50	141.39	150.81	146.10	3.22	2.96	3.09
SE(m)	0.11	0.112	0.106	0.02	0.021	0.02	3.485	1.38	1.841	0.05	0.047	0.048
CV (%)	4.453	7.174	5.547	9.384	8.48	8.951	9.193	4.093	5.2	5.146	6.317	5.706
CD for a hybrid and check varieties mean	1.806	2.721	2.177	0.186	0.154	0.170	48.271	22.782	28.126	0.613	0.692	0.653
C.D for two Check Varieties mean	1.106	1.667	1.333	0.114	0.094	0.104	29.560	13.951	17.224	0.376	0.424	0.400
CD for two hybrids in different block	2.212	3.333	2.667	0.228	0.188	0.208	59.120	27.902	34.447	0.751	0.848	0.799
C.D for two hybrids in same block	1.916	2.887	2.310	0.198	0.163	0.180	51.199	24.164	29.832	0.650	0.734	0.692

Conclusion

The two-year evaluation of 65 cashew genotypes at Bapatla revealed wide and consistent variability for cashew apple juice quality traits, including total soluble solids, ascorbic acid, titratable acidity and tannins. Pooled TSS values ranged from 8.63 to 12.91 °Brix, ascorbic acid from 114.29 to 192.10 mg 100 g^{-1}, titratable acidity from 0.20 to 0.84 per cent and tannins from 2.39 to 3.88 per cent, confirming ample scope for selection within the existing material.

Genotype H-491 emerged as the most promising type for fresh consumption. It recorded the highest pooled TSS (12.91 °Brix) in combination with very low titratable acidity (0.20 per cent), low tannins (2.40 per cent) and high ascorbic acid (168.16 mg 100 g^{-1}). This favourable combination of sweetness, reduced acidity and lower astringency along with good vitamin C content, indicates its potential as a superior table type. Other genotypes such as H-705, H-710 and H-715 also exhibited high TSS and may be considered for further evaluation of eating quality.

For processing, genotypes with high ascorbic acid, particularly H-719 (192.10 mg 100 g^{-1}) and H-722 (170.64 mg 100 g^{-1}) are promising candidates for value-added products, provided their acidity and tannin levels are managed through suitable processing. Genotypes with consistently low acidity (H-491, H-496, H-474, H-461) and low tannins (T.No.10/19, H-491, H-483, H-706, H-694) represent useful donors for breeding programmes aimed at improving sweetness, reducing astringency and enhancing overall juice acceptability.

Overall, the study identifies H-491 as a potential cashew apple type for fresh consumption, while H-719, H-722 and other high vitamin C and low tannin genotypes can be exploited for processing and breeding for improved cashew apple quality.

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