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Characterization and Quality Assessment of Potential Indigenous Mango (*Mangifera indica* L.) Cultivars of Coastal Districts in Andhra Pradesh, India by Bio-Chemical Markers

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A B S T R A C T

Characterization of cultivars using bio-chemical markers has been successfully used for selection of improved cultivars in mango for breeding programs. The study was conducted at Horticultural research station, Venkataramannagudem for evaluating the variability of mango cultivars to conserve the elite ones and to identify the superior genotypes based on fruit bio-chemical markers for future crop improvement. Thirty four cultivars were characterized using bio-chemical fruit markers in subsequent years to know the genetic diversity in mango. The cultivar, Cherukurasam recorded highest TSS, total sugars and non-reducing sugars and the cultivar Banganapalli-1 recorded maximum TSS: acid ratio and reducing sugars indicating that these cultivars could be used as a source for quality improvement. The cultivars Chinnarasam and Banganapalli-1 recorded maximum β-carotene content which can be used as a source of carotenoid content. These identified cultivars may be good donors in future hybridization programme to evolve superior varieties.

Introduction

Mango (*Mangifera indica* L.) is an important member of the family Anacardiaceae in order Sapindales and is the most important fruit crop in India having a great cultural, socio-economic and religious significance since ancient times. It is said to be originated in the Indo-Burma (Myanmar) region (De Candolle, 1904). By virtue of its excellent flavor, delicious taste, attractive color, fruit quality with richness in vitamins and minerals, accessibility to common man, liking by the masses, mango has been assigned the status of the 'King of the fruits' in the tropical world and it is the 'National Fruit of India'. In India mango ranks first in terms of area with 2.50 million ha, second in respect of production with 18.00 million tonnes and with a productivity of 7.2 million tonnes/ha, while Andhra Pradesh ranks second in terms of area with 0.30 million ha, second in respect to production of 2.70 million tonnes and with a productivity of 9.0 million tonnes/ha (NHB, 2013). Andhra Pradesh is considered as a centre of diversity for mango with a rich

diversity of named local cultivars and unnamed local land races. Mango is considered to be an allopolyploid, most probably amphidiploid and outbreeding species having chromosome number 2n=40 (Mukherjee, 1950). It is highly heterozygous as performance varies with the climate which resulted in a high level of genetic diversity. Further, confusion exists in the nomenclature of mangoes due to different local names for the same variety. Knowledge of the magnitude of genetic variation among the land races of fruit characteristics is important for development of new varieties of mango with improved quality is the engine of market demand. The assessment of diversity based on morphological parameters has been often constrained by lack of adequate data on distinguishable morphological characters and confusion due to the wide variations for a particular trait in a given population. Though, morphological markers have been in use to assess the genetic diversity, they had limited application in breeding as they are few in number and phenotype is influenced by environment so, bio-chemical markers offer greater diversity as compared to the morphological markers. The objective of the study was to evaluate fruit bio-chemical markers of 34 indigenous mango cultivars and to isolate and identify the superior genotypes for future breeding programmes.

Materials and Methods

The present study was conducted to study the performance of mango cultivars of coastal districts in Andhra Pradesh at Horticultural Research Station, Venkataramannagudem during the subsequent years of 2013 and 2014. A well- planned germplasm collection survey based on diversity richness was conducted in coastal districts of Andhra Pradesh which includes Horticultural Research Station and private owned mango orchards. Random sampling strategy was followed for collection of samples. Three plants in each cultivar were taken as sample size. The experimental material consists of 34 indigenous mango cultivars and variants within them obtained from the coastal districts of Andhra Pradesh. The indigenous mango cultivars used are:

Banganapalli – 1
Banganapalli – 2
Banganapalli - 3
Banglora - 1
Banglora - 2
Baramasi
Cherukurasam
Chinnarasam
Chinna Suvarnarekha
Elamandala
Hyder
Imampasand
Jalal
Jehangir
Kolanka Goa
Kottapalli Kobbari
Kowsuri Pasand
Nalla Andrews
Nalla Rasalu
Navaneetam
Nuzividu Tiyya Mamidi
Nuzividu Rasalu
Panchadara Kalasa
Pandurivari Mamidi
Paparao Goa
Peddarasam
Panukula Mamidi
Royal Special
Rajamanu
Sora Mamidi
Suvarnarekha
Tella Gulabi
Tella Rasalu
Rajamamidi

Five fruits of each cultivar were taken per replication for evaluating fruit bio-chemical characters. Longitudinal slices of fruit pulp were used to extract juice with the help of

standard commercial juicer. The juice was extracted from each sample and homogenized to study the bio-chemical parameters.

Total soluble solids (^{O}Brix)

The percentage of total soluble solids (TSS) was determined by using ERMA hand refractrometer by placing a drop of filtered juice on the prism of the refractrometer and observed the coincidence of shadow of the sample with the reading on the scale and expressed as ^{O}Brix. Before taking the reading, the refractrometer was tested for its error with distilled water, corrected accordingly and TSS content was recorded (Ranganna, 1986).

Titratable acidity (%)

The titratable acidity was determined by taking 10 ml of homogenized sample and volume was made up to 100 ml with distilled water in a volumetric flask. The contents were filtered through Whatman No.1 filter paper.

An aliquot of 10 ml was taken in 250 ml conical flask for titration against 0.1N NaOH by using phenolphthalein as an indicator. The turn of aliquot to light pink colour which persists for 15 seconds was considered as an end point and the titratable acidity was estimated in terms of per cent citric acid (Ranganna, 1986).

Factor for acidity = 1ml of N/10 NaOH = 0.0064g of citric acid

$$\text{Acidity (\%)} = \frac{\text{Titer value} \times \text{Normality of NaOH} \times 0.0064 \times 100}{\text{Volume of aliquot taken (ml)}}$$

TSS: acid ratio

Total soluble solids/Acidity ratio (TSS: acid ratio) was calculated by dividing the value of TSS with that of corresponding titratable acidity.

Reducing sugars (%)

Reducing sugars were determined by Lane and Eyon method (AOAC, 1965). Twenty five ml of fruit juice was taken and transferred to 250 ml volumetric flask. Two ml of lead acetate solution (45%) was added to flask for precipitation of colloidal matter. Potassium oxalate (22%) of 2 ml was added in this solution to precipitate the lead and the volume made up to 250 ml using distilled water.

The contents were then filtered through Whatman No. 1 filter paper after testing a little of filtrate for its freedom from lead by adding a drop of potassium oxalate. Reducing sugars in the lead free solution was taken in burette and titrated against 10 ml of standard Fehling's solution mixture of A and B (1: 1) by using methylene blue as an indicator till the end point was indicated by the formation of brick red precipitate.

The titration was carried out by keeping the Fehling's solution boiling on the heating mantle. The results were expressed as per cent reducing sugar by using the following formula:

$$\text{Reducing sugars (\%)} = \frac{\text{Factor} \times \text{Volume made up} \times 100}{\text{Titer value} \times \text{Weight of the sample}}$$

10 ml of Fehling solution = 0.05 glucose.

Total sugars (%)

Total sugars were determined as procedure described by Lane and Eyon method (AOAC, 1965). A quantity of 50 ml lead free filtrate was taken in a 100 ml volumetric flask and to it 5 ml of concentrated HCl was added, mixed well and then kept for 24 hours at room

temperature. Acid was then neutralized with NaOH by using a drop of phenolphthalein as an indicator till the pink color persisted for at least few seconds. Then volume was made up to 100 ml. Total sugars were then estimated by taking this solution in a burette and titrating it against standard Fehling's solution mixture of A and B (1:1) by using methylene blue as an indicator and taking brick red colour as an end point. The per cent total sugars were calculated by using the following formula:

$$\text{Total sugars (\%)} = \frac{\text{Factor} \times \text{Volume made up} \times 100}{\text{Titer value} \times \text{Weight of the sample}}$$

Non-reducing sugars (%)

Non-reducing sugars in juice was obtained by subtracting reducing sugars from total sugars.

Non-reducing sugars (%) = Total sugars - Reducing sugars

Ascorbic acid (mg/100ml)

10 ml of juice was blended with metaphosphoric acid (3% HPO_3) and volume was made up to 100 ml with HPO_3 (3%).The content after shaking well was filtered through Whatman No.1 filter paper. Ten ml of filtrate was titrated against 2,6 dichlorophenol-indophenol dye until light pink colour was observed (AOAC, 1965).

$$\text{Ascorbic acid (mg/100ml)} = \frac{\text{Titer value} \times \text{Dye factor} \times \text{Volume made up} \times 100}{\text{Volume of the sample} \times \text{Volume of aliquot taken}}$$

β- Carotene (µg/100g)

Five grams of fresh sample was weighed with the help of electronic balance and crushed with 10-15 ml of acetone and a few crystals of anhydrous sodium sulphate, with the help of mortar and pestle. Decant the supernatant into a beaker. Repeat the process twice and transfer the combined supernatant sample into a separatory funnel, 10-15 ml petroleum ether was added and mixed thoroughly.

Two layers were separated out on standing. Discard the lower layer and collect the upper layer into a 100 ml volumetric flask, made up the volume to 100 ml with petroleum ether and record the optical density at 425 nm by using Thermo Evolution 201 Model spectrophotometer as petroleum ether as blank (Srivastava and Sanjeev, 2014).

$$\text{B-carotene (µg/100g)} = \frac{\text{O.D} \times 13.9 \times 10^4 \times 100}{\text{Weight of sample} \times 560 \times 1000}$$

Total phenols (mg of gallic acid /100g)

Phenols were estimated according to the procedure given by Malik and Singh (1980). One gram of sample was extracted with 10 ml of 80 per cent methanol. The homogenated extracts were centrifuged at 10,000 rpm for 20 min by using "5430 R Eppendorf" centrifuge and the supernatant saved was evaporated to dryness in a water bath. The residue was dissolved in 5 ml of distilled water and 0.5 ml of Folin -Ciocalteau's reagent (1N) was added.

To that, 2 ml of sodium carbonate (20%) solution was added and after mixing thoroughly the tubes were placed in boiling water for one minute, cooled and the absorbance was measured at 650 nm by using Thermo Evolution 201 model spectrophotometer.

Standard curve was drawn by using gallic acid as standard. Different concentrations of gallic acid were prepared and O.D was read at 650 nm. The concentration of samples was calculated based on the standard curve.

$$\text{Total Phenols (mg of GA/100g)} = \frac{\text{O.D} \times \text{Factor} \times \text{Volume made up} \times 100}{\text{Aliquot taken} \times \text{Weight of the sample} \times 1000}$$

Results and Discussion

The data recorded on fruit bio-chemical characters of mango were subjected to statistical analysis. Significant differences were observed among the cultivars for all the characters studied. TSS content ranged from 15.05^{o}Brix to 25.44^{o}Brix with a mean of 18.27^{o}Brix (Table 1 and Fig.1). TSS was observed to be highest in cultivar Cherukurasam (25.44^{o}Brix) followed by Elamandala (23.55^{o}Brix), Banganapalli-1 (21.27^{o}Brix) which was on par with Baramasi (21.04^{o}Brix). Lowest TSS was observed in cultivar Sora Mamidi (15.05^{o}Brix) followed by Navaneetham (15.31^{o}Brix), which was on par with Kowsuri Pasand (15.58^{o}Brix) and Banglora-2 (15.69^{o}Brix). Similar trend in TSS content of mango cultivars is reported by Kulkarni and Rameshwar (1981) in which TSS ranged from 13.1% to 27% and Hameedunissa Begum *et al.*, (2013) reported similar values of TSS in Banganapalli which ranged from 15 to 22^{o}Brix. The range of titratable acidity (Table 1) among the mango cultivars studied in the present investigation was 0.14 to 1.19% with a mean of 0.30%. The cultivar Royal Special recorded the highest titratable acidity (1.19%) followed by Baramasi (0.73%), Kottapalli Kobbari (0.33) while, the cultivar Banganapalli-1 (0.14%) recorded the lowest titratable acidity which was on par with Cherukurasam and Panchadara Kalasa (0.17%). Similarly the lowest titratable acidity content of 0.14% in mango cultivars is reported by Rathor (2005). Maximum TSS: acid ratio was noticed in Banganapalli-1 (155.95) followed by Cherukurasam (147.91), Elamandala (135.23), Panchadara Kalasa (117.33), Suvarnarekha (113.50) and Panukula Mamidi (104.32) while, minimum TSS: acid ratio was noticed in Royal special (17.34) followed by Rajamamidi (49.09) and Jehangir (52.08). Further, Sora Mamidi (49.84) and Kowsuri Pasand (50.38) were on par with Rajamamidi. Similarly high TSS: acid ratio of 162.70 in mango cultivars is reported by Rathor (2005). With respect to important bio-chemical markers namely TSS, titratable acidity as well as TSS: acid ratio, Banganapalli-1, Cherukurasam, Elamandala, Panchadara Kalasa, Panukula Mamidi and Suvarnarekha were found to be promising mango cultivars. These cultivars have TSS amounting to 20^{o}Brix or even more, which is a desirable character, and they had less acidity and high sugar: acid ratio can be used as good donors in future hybridization programme to evolve superior varieties and hybrids. The mean per cent of total sugars was 12.27%, while it ranged from 8.82 to 21.51% (Table 2 and Fig.1). Highest per cent of total sugars were recorded in the cultivars, Cherkurasam (21.51%) followed by Banganapalli-1 (18.28%), Banganapalli-3 (16.45%) and Suvarnarekha (14.68%). Further, the cultivars Tella Rasalu (14.24%) and Tella Gulabi (14.22%) were on par with Suvarnarekha. Lowest per cent of total sugars were recorded in the cultivars, Nuzividu Rasalu (8.82%) which was on par with Banglora-2 (9.10%) followed by Navaneetham (9.68%). Similar results with regard to total sugars were earlier reported by Rathor (2005) in mango. The mango cultivars differed significantly in reducing sugar content while, it ranged from 2.63 to 6.44% with a mean of 4.34% (Table 2). The highest reducing sugar content was found in the cultivar Banganapalli-1 (6.44%) followed by Banganapalli-3 (6.30%), Cherukurasam (6.11%) and Elamandala (5.73%). The lowest reducing sugar content was found in Banglora-2 (2.63%) followed by Nuzividu Rasalu (3.03%). Similar observations are reported by Simi (2006) with respect to average reducing sugars (3.11%) in mango.

Table.1 Mean performance of mango cultivars for TSS, titratable acidity and TSS: acid ratio

S. No	Name of the Cultivar	TSS (°Brix)			Titratable Acidity (%)			TSS: acid Ratio		
		2013	2014	Mean	2013	2014	Mean	2013	2014	Mean
1	Banganapalli – 1	21.12	21.43	**21.27**	0.15	0.13	**0.14**	143.56	168.34	**155.95**
2	Banganapalli – 2	17.42	16.87	**17.15**	0.33	0.32	**0.32**	53.11	53.10	**53.10**
3	Banganapalli – 3	19.75	20.98	**20.36**	0.25	0.22	**0.23**	80.18	97.20	**88.69**
4	Banglora – 1	16.67	16.55	**16.61**	0.23	0.24	**0.23**	74.00	69.94	**71.97**
5	Banglora – 2	15.26	16.12	**15.69**	0.28	0.24	**0.26**	55.11	67.59	**61.35**
6	Baramasi	21.65	20.43	**21.04**	0.75	0.71	**0.73**	28.94	28.83	**28.88**
7	Cherukurasam	26.34	24.55	**25.44**	0.17	0.18	**0.17**	155.28	140.55	**147.91**
8	Chinnarasam	16.86	18.89	**17.88**	0.25	0.21	**0.23**	67.68	91.47	**79.57**
9	Chinna Suvarnarekha	15.91	16.76	**16.33**	0.26	0.22	**0.24**	62.32	77.67	**69.99**
10	Elamandala	24.23	22.87	**23.55**	0.18	0.18	**0.18**	141.59	128.87	**135.23**
11	Hyder	18.78	17.54	**18.16**	0.27	0.29	**0.28**	70.67	60.70	**65.68**
12	Imampasand	18.82	17.95	**18.39**	0.26	0.27	**0.26**	74.10	66.56	**70.33**
13	Jalal	16.67	16.23	**16.45**	0.30	0.31	**0.31**	56.62	52.55	**54.58**
14	Jehangir	15.89	15.76	**15.83**	0.30	0.31	**0.31**	53.24	50.92	**52.08**
15	Kolanka Goa	17.21	16.89	**17.05**	0.29	0.27	**0.28**	59.72	62.88	**61.30**
16	Kottapalli Kobbari	17.72	17.43	**17.58**	0.33	0.33	**0.33**	53.98	52.98	**53.48**
17	Kowsuri Pasand	15.84	15.32	**15.58**	0.31	0.31	**0.31**	51.18	49.59	**50.38**
18	Nalla Andrews	17.42	18.54	**17.98**	0.32	0.29	**0.31**	54.59	63.97	**59.28**
19	Nalla Rasalu	16.23	16.33	**16.28**	0.32	0.29	**0.31**	50.83	56.53	**53.68**
20	Navaneetam	14.29	16.32	**15.31**	0.27	0.25	**0.26**	53.89	65.36	**59.62**
21	Nuzividu Tiyya Mamidi	16.63	18.11	**17.37**	0.28	0.27	**0.28**	59.85	67.20	**63.53**
22	Nuzividu Rasalu	16.48	15.66	**16.07**	0.29	0.30	**0.30**	56.86	52.23	**54.54**
23	Panchadara Kalasa	20.64	19.44	**20.04**	0.17	0.18	**0.17**	125.45	109.21	**117.33**
24	Pandurivari Mamidi	19.89	17.99	**18.94**	0.21	0.22	**0.22**	96.17	83.10	**89.63**
25	Paparao Goa	19.43	18.62	**19.02**	0.23	0.25	**0.24**	86.34	74.84	**80.59**
26	Peddarasam	18.86	20.56	**19.71**	0.26	0.23	**0.25**	73.71	89.95	**81.83**
27	Panukula Mamidi	19.88	20.75	**20.32**	0.21	0.19	**0.20**	96.82	111.83	**104.32**
28	Royal Special	21.24	20.12	**20.68**	1.23	1.16	**1.19**	17.31	17.37	**17.34**
29	Rajamanu	17.12	18.53	**17.83**	0.30	0.26	**0.28**	57.25	73.84	**65.54**
30	Sora Mamidi	14.98	15.12	**15.05**	0.31	0.30	**0.31**	48.97	50.72	**49.84**
31	Suvarnarekha	20.86	19.45	**20.16**	0.18	0.18	**0.18**	118.75	108.26	**113.50**
32	Tella Gulabi	18.43	17.98	**18.20**	0.27	0.28	**0.28**	69.14	65.53	**67.33**
33	Tella Rasalu	18.42	17.98	**18.20**	0.27	0.27	**0.27**	68.52	66.98	**67.75**
34	Rajamamidi	15.57	15.64	**15.60**	0.33	0.31	**0.32**	47.35	50.84	**49.09**
	Mean	**18.31**	**18.23**	**18.27**	**0.30**	**0.29**	**0.30**	**72.44**	**74.34**	**73.39**
	SEm±			**0.28**			**0.01**			**0.94**
	C.D 5%			**0.77**			**0.03**			**2.62**
	C.D 1%			**1.01**			**0.04**			**3.46**

Table.2 Mean performance of mango cultivars for total, reducing and non-reducing sugar content

S. No	Name of the Cultivar	Total Sugars (%)			Reducing Sugars (%)			Non-reducing Sugars (%)		
		2013	2014	Mean	2013	2014	Mean	2013	2014	Mean
1	Banganapalli – 1	18.12	18.44	**18.28**	6.34	6.54	**6.44**	11.78	11.90	**11.84**
2	Banganapalli – 2	11.50	11.32	**11.41**	4.32	4.01	**4.16**	7.18	7.31	**7.24**
3	Banganapalli – 3	16.12	16.78	**16.45**	6.29	6.31	**6.30**	9.83	10.47	**10.15**
4	Banglora – 1	11.16	10.98	**11.07**	4.13	4.00	**4.07**	7.03	6.98	**7.01**
5	Banglora – 2	8.32	9.89	**9.10**	2.02	3.24	**2.63**	6.30	6.65	**6.48**
6	Baramasi	12.86	11.86	**12.36**	4.94	4.54	**4.74**	7.92	7.32	**7.62**
7	Cherukurasam	22.01	21.01	**21.51**	6.25	5.98	**6.11**	15.76	15.03	**15.39**
8	Chinnarasam	11.63	12.23	**11.93**	4.12	4.87	**4.49**	7.51	7.36	**7.43**
9	Chinna Suvarnarekha	8.48	11.69	**10.09**	3.04	4.32	**3.68**	5.44	7.37	**6.40**
10	Elamandala	17.23	16.75	**16.99**	5.82	5.64	**5.73**	11.41	11.11	**11.26**
11	Hyder	10.69	9.87	**10.28**	4.12	4.01	**4.07**	6.57	5.86	**6.22**
12	Imampasand	12.69	12.12	**12.40**	4.56	4.32	**4.44**	8.13	7.80	**7.97**
13	Jalal	10.83	10.42	**10.63**	4.12	3.98	**4.05**	6.71	6.44	**6.57**
14	Jehangir	10.87	11.43	**11.15**	4.01	3.76	**3.88**	6.86	7.67	**7.27**
15	Kolanka Goa	12.07	11.65	**11.86**	4.44	4.12	**4.28**	7.63	7.53	**7.58**
16	Kottapalli Kobbari	10.61	10.03	**10.32**	3.13	3.01	**3.07**	7.48	7.02	**7.25**
17	Kowsuri Pasand	11.57	11.12	**11.35**	4.06	3.97	**4.01**	7.51	7.15	**7.33**
18	Nalla Andrews	10.96	11.65	**11.31**	3.67	4.21	**3.94**	7.29	7.44	**7.36**
19	Nalla Rasalu	9.32	10.97	**10.15**	2.84	3.76	**3.30**	6.48	7.21	**6.85**
20	Navaneetam	8.48	10.87	**9.68**	2.96	3.57	**3.26**	5.52	7.30	**6.41**
21	Nuzividu Tiyya Mamidi	9.76	12.32	**11.04**	3.09	3.97	**3.53**	6.67	8.35	**7.51**
22	Nuzividu Rasalu	8.77	8.87	**8.82**	3.04	3.01	**3.03**	5.73	5.86	**5.80**
23	Panchadara Kalasa	12.94	11.61	**12.27**	4.43	4.21	**4.32**	8.51	7.40	**7.95**
24	Pandurivari Mamidi	12.67	12.12	**12.39**	4.71	4.53	**4.62**	7.96	7.59	**7.78**
25	Paparao Goa	13.58	13.54	**13.56**	4.56	4.39	**4.47**	9.02	9.15	**9.09**
26	Peddarasam	10.19	13.02	**11.60**	3.95	4.71	**4.33**	6.24	8.31	**7.28**
27	Panukula Mamidi	11.09	12.87	**11.98**	3.77	4.39	**4.08**	7.32	8.48	**7.90**
28	Royal Special	12.12	11.64	**11.88**	4.59	4.35	**4.47**	7.53	7.29	**7.41**
29	Rajamanu	10.31	11.76	**11.03**	4.68	4.91	**4.80**	5.63	6.85	**6.24**
30	Sora Mamidi	9.93	9.87	**9.90**	3.12	3.00	**3.06**	6.81	6.87	**6.84**
31	Suvarnarekha	15.58	13.78	**14.68**	5.27	5.12	**5.19**	10.31	8.66	**9.49**
32	Tella Gulabi	14.57	13.87	**14.22**	5.13	5.07	**5.10**	9.44	8.80	**9.12**
33	Tella Rasalu	13.64	14.85	**14.24**	5.66	5.28	**5.47**	7.98	9.57	**8.77**
34	Rajamamidi	10.97	11.74	**11.35**	4.44	4.21	**4.32**	6.53	7.53	**7.03**
	Mean	**12.11**	**12.44**	12.27	**4.28**	**4.39**	4.34	**7.82**	**8.05**	7.94
	SEm±			**0.29**			**0.13**			**0.22**
	C.D 5%			**0.80**			**0.35**			**0.62**
	C.D 1%			**1.05**			**0.46**			**0.81**

Table.3 Mean performance of mango cultivars for ascorbic acid, β-carotene and total phenol content

S. No	Name of the Cultivar	Ascorbic Acid (mg/100g)			β- Carotene (µg/100g)			Total Phenols (mg of GA/ 100g)		
		2013	2014	Mean	2013	2014	Mean	2013	2014	Mean
1	Banganapalli – 1	28.18	25.76	**26.97**	1689.98	1650.32	**1670.15**	35.99	38.62	**37.31**
2	Banganapalli – 2	27.45	26.76	**27.10**	923.45	910.21	**916.83**	73.95	71.21	**72.58**
3	Banganapalli - 3	27.54	30.87	**29.20**	1012.67	1000.21	**1006.44**	48.60	49.54	**49.07**
4	Banglora - 1	25.25	23.43	**24.34**	1223.43	1211.59	**1217.51**	53.31	50.93	**52.12**
5	Banglora - 2	32.50	35.76	**34.13**	765.21	738.90	**752.05**	64.65	65.73	**65.19**
6	Baramasi	87.25	89.54	**88.40**	706.87	699.61	**703.24**	85.90	83.29	**84.60**
7	Cherukurasam	27.25	26.92	**27.08**	1321.76	1293.81	**1307.79**	37.78	32.71	**35.24**
8	Chinnarasam	37.32	40.71	**39.01**	1708.76	1651.02	**1679.89**	62.35	55.83	**59.09**
9	Chinna Suvarnarekha	28.54	34.70	**31.62**	791.34	740.37	**765.85**	98.12	84.74	**91.43**
10	Elamandala	20.54	23.74	**22.14**	821.34	801.29	**811.32**	39.76	38.88	**39.32**
11	Hyder	22.50	28.63	**25.57**	1698.34	1638.65	**1668.49**	48.22	52.37	**50.29**
12	Imampasand	29.57	36.83	**33.20**	893.56	842.18	**867.87**	56.32	57.83	**57.08**
13	Jalal	23.75	28.95	**26.35**	1193.34	1109.36	**1151.35**	50.97	51.92	**51.44**
14	Jehangir	22.75	29.29	**26.02**	816.78	793.45	**805.11**	45.00	46.73	**45.87**
15	Kolanka Goa	34.75	39.64	**37.19**	1076.77	1011.74	**1044.26**	33.18	28.64	**30.91**
16	Kottapalli Kobbari	21.75	27.94	**24.84**	1587.45	1536.43	**1561.94**	38.45	37.65	**38.05**
17	Kowsuri Pasand	20.90	24.84	**22.87**	1562.51	1502.32	**1532.42**	76.54	73.56	**75.05**
18	Nalla Andrews	31.75	37.52	**34.64**	643.98	603.43	**623.71**	42.89	37.53	**40.21**
19	Nalla Rasalu	25.64	29.31	**27.48**	1300.43	1267.72	**1284.07**	26.87	23.93	**25.40**
20	Navaneetam	21.25	27.42	**24.33**	898.66	842.32	**870.49**	34.65	31.92	**33.28**
21	Nuzividu Tiyya Mamidi	27.98	32.74	**30.36**	906.54	874.37	**890.46**	25.76	22.11	**23.93**
22	Nuzividu Rasalu	22.25	28.94	**25.59**	1166.78	1019.73	**1093.26**	60.47	62.92	**61.69**
23	Panchadara Kalasa	24.57	31.09	**27.83**	976.98	912.32	**944.65**	21.23	27.53	**24.38**
24	Pandurivari Mamidi	25.62	34.87	**30.24**	1278.86	1174.35	**1226.60**	33.19	36.77	**34.98**
25	Paparao Goa	43.67	41.65	**42.66**	925.76	910.22	**917.99**	98.30	97.77	**98.04**
26	Peddarasam	25.21	36.84	**31.02**	978.76	932.54	**955.65**	25.77	22.87	**24.32**
27	Panukula Mamidi	39.19	41.75	**40.47**	1256.66	1203.43	**1230.05**	23.98	20.87	**22.42**
28	Royal Special	69.23	67.93	**68.58**	997.45	834.12	**915.79**	31.92	28.86	**30.39**
29	Rajamanu	43.25	42.12	**42.69**	1324.64	1302.11	**1313.38**	28.55	25.55	**27.05**
30	Sora Mamidi	25.25	26.74	**25.99**	1253.63	1211.83	**1232.73**	19.93	19.87	**19.90**
31	Suvarnarekha	26.75	31.31	**29.03**	1398.54	1324.73	**1361.64**	64.02	62.23	**63.13**
32	Tella Gulabi	25.88	29.06	**27.47**	1464.87	1427.54	**1446.21**	23.90	25.85	**24.88**
33	Tella Rasalu	22.25	28.53	**25.39**	996.56	983.28	**989.92**	75.56	71.12	**73.34**
34	Rajamamidi	25.25	30.18	**27.72**	1043.21	1019.92	**1031.56**	30.34	26.63	**28.49**
	Mean	**30.67**	**34.48**	**32.57**	**1135.47**	**1087.51**	**1111.49**	**47.54**	**46.01**	**46.78**
	SEm±			**0.81**			**37.64**			**0.94**
	C.D 5%			**2.26**			**105.09**			**2.62**
	C.D 1%			**2.98**			**138.71**			**3.46**

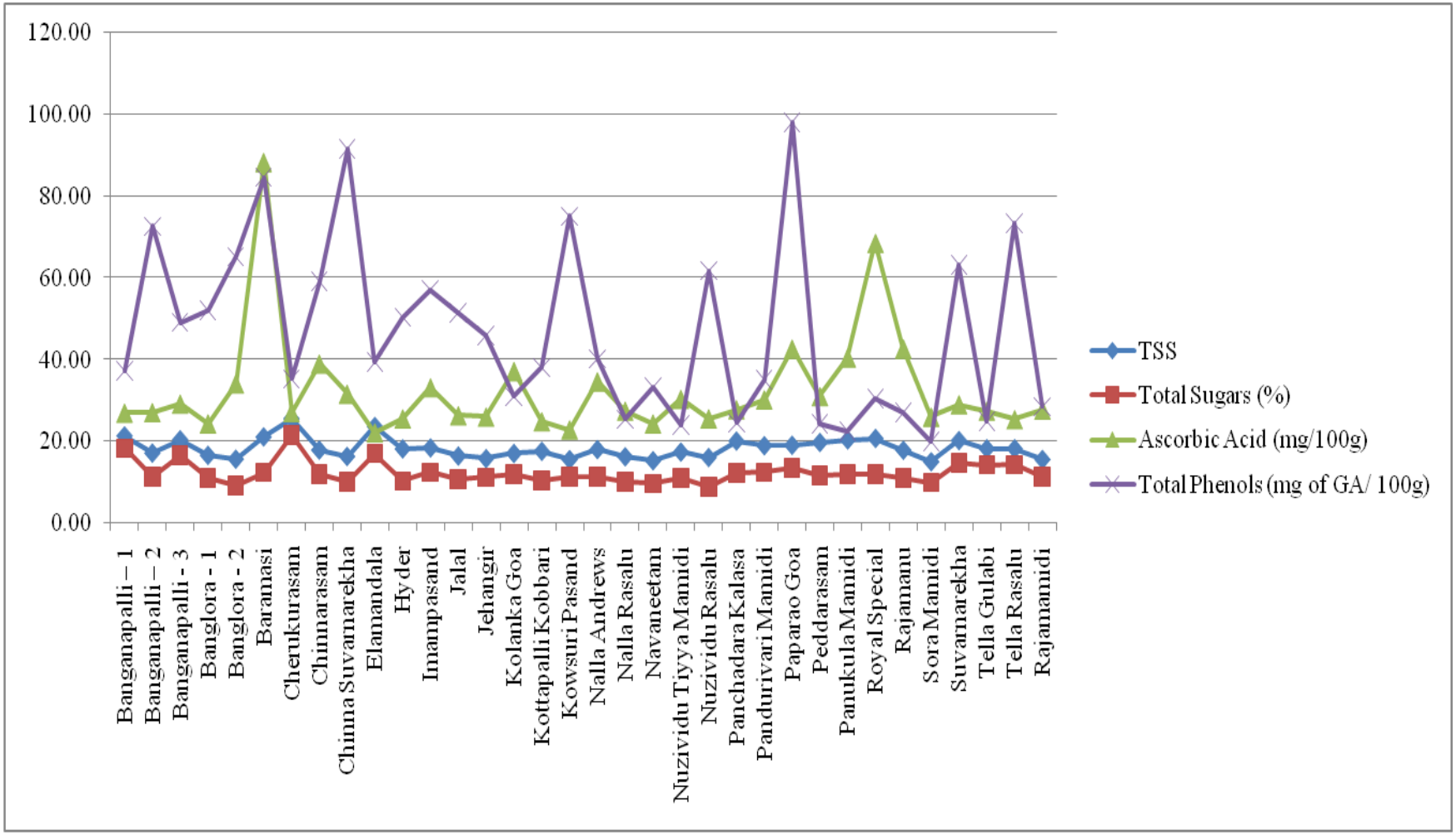

Fig. 1: Mean performance of mango cultivars for fruit bio-chemical characters

Maximum non-reducing sugar content was found in Cherukurasam (15.39%) followed by Banganapalli-1 (11.84%) which was on par with Elamandala (11.26%). Minimum non-reducing sugar content was found in Nuzividu Rasalu (5.80%), which was on par with Hyder (6.22%), Rajamanu (6.24%), Chinna Suvarnarekha (6.40%) and Navaneetham (6.41%). The cultivars, Banganapalli-1, Banganapalli-3, Cherukursam, Elamandala, Suvarnarekha, Tella gulabi and Tella Rasalu having maximum total sugar and reducing sugar content can be used as potential parents for hybridization programme.

The predominant antioxidants in mango pulp are carotenoids (mainly β-carotene), ascorbic acid and total phenols. From the table 3 and figure 1, the highest ascorbic acid content was found in Baramasi (88.40%) followed by Royal Special (68.58%), Paparao Goa (42.66%). Further, Panukula Mamidi (40.47%) was on par with Paparao Goa. While, the lowest ascorbic acid content was found in Elamandala (22.14%) followed by Kottapalli Kobbari (24.84%). Further, the cultivars, Kowsuri Pasand (22.87%), Nuzividu Tiyya Mamidi (24.33%) and Banglora-1 (24.34%) were on par with Elamandala. The results were in agreement with Rathor (2005) who stated that smaller sized mango fruits recorded higher ascorbic acid content than larger sized fruits. Fruit carotenoid is one of the most important parameters attributing yellow to orange color in pulp, the greater the carotenoids, the better the quality of the fruit. The β-carotene content ranged from 623.71 to 1679.89 µg/100g with a mean value of 1111.49 µg/100g (Table 3). Maximum β-carotene content was found in Chinnarasam (1679.89 µg/100g) which was on par with Banganapalli-1 (1670.15 µg/100g) and Hyder (1668.49 µg/100g) while, minimum β-carotene content was found in Nalla Andrews (623.71 µg/100g) which was on par with Baramasi (703.24 µg/100g). From the results presented above, it was found that mango cultivars with yellow colored pulp were having maximum β-carotene content than mango cultivars with white colored pulp. More carotenoid content is known to result in dark orange coloured flesh which is a feature of consumer's preference. These genotypes may be considered promising as genitors for breeding programmes. The mean value of total phenol content was 46.78 mg/100g while, it ranged from 19.90 to 98.04 mg/100g (Table 3 and Fig.1). Approximately, the same trends observed for the ascorbic acid, relative to cultivar type, also occurred in the values for total phenol content measurements (Samal *et al.*, 2012). The highest total phenol content was found in Paparao Goa (98.04 mg/100g) followed by Chinna Suvarnarekha (91.43 mg/100g) and Baramasi (84.60 mg/100g) which recorded higher ascorbic acid content. The lowest total phenol content was found in Sora Mamidi (19.90 mg/100g) which was on par with Panukula Mamidi (22.42 mg/100g) which showed lower ascorbic acid content. An identical result with respect to total phenol content is reported by John *et al.*, (2009) in mango. The cultivars Baramasi and Paparao Goa were extraordinarily high in ascorbic acid and total phenols compared to the other cultivars.

Similarly, the present study revealed some indigenous cultivars with superior fruit quality characters. In the present study, the selected cultivars expressed variable bio-chemical properties. Of the 34 mango cultivars subjected to bio-chemical characterization and evaluation, few were found to be horticulturally superior with respect to fruit bio-chemical characteristics. Fruit quality characterization and their evaluation are the prerequisites for proper conservation and efficient utilization in improving the better cultivars. These local promising germplasm can be used as potential

parents for hybridization program for development of new hybrids.

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