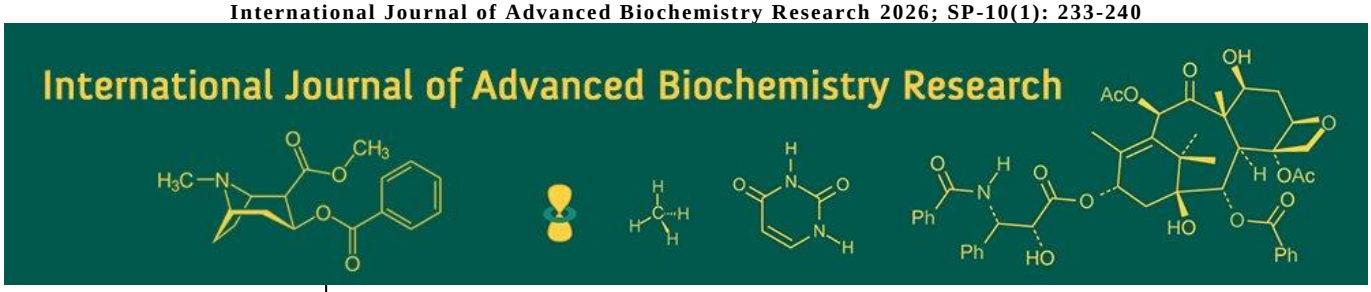


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# Biochemical characterization of popular mango (*Mangifera indica* L.) cultivars grown in Telangana state

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**Abstract**
*Mangifera indica* L. the scientific name for the mango tree, is one of the most significant and extensively eaten fruit crops worldwide. The nutritional and bioactive properties of this juicy fruit have led to its widespread consumption. The antioxidant vitamins, phenolics, flavonoids, and carotenoids found in mango fruits are only a few of the bioactive components they contain. The present study set out to assess biochemical traits in fifty different mango varieties grown for commercial purposes in the Indian state of Telangana. The results of all biochemical aspects showed significant variation among fifty mango cultivars, with some showing greater antioxidant capabilities than others. Among the fifty cultivars that were tested, maximum vitamin C content was noticed in Allampur Baneshan, (31.97mg/100g), Lalmuni recorded maximum beta carotene (2.81 mg/100g), Yerra Mulgoa recorded highest total flavonoids (331.11 mg QE/100g), Mahamooda Vikarabad noticed highest total phenolic compounds (173.20 mg GAE/100g), and Dashehari-35 had highest level of total antioxidant activity (326.38 µg/100g). There is a substantial variety among the cultivars investigated and documented significant quantity of biochemical characteristics important for antioxidant activity. The findings demonstrated that all fifty mango cultivars are of various biochemical characteristics and may be exploited in breeding programs for the enhancement of quality to satisfy the international standard for export. These potential varieties may also be appropriate for a commercial diet, which will provide further health advantages.

**Keywords:** Mango cultivars, Biochemical characters, Antioxidant activity, Breeding program

## Introduction
The mango (*Mangifera indica* L.) is tropical fruit indigenous to Southeast Asia, and is a staple diet and an excellent source of nutrients. Its nutritional value, antioxidants, sweetness, juiciness, and succulence have earned it the moniker "King of fruits" and led to its widespread cultivation in tropical and subtropical regions (Tharanathan *et al*., 2006) [41]. Some of the most significant Indian states for mango agriculture include Andhra Pradesh, Uttar Pradesh, Telangana, Odisha, Gujarat, Bihar and Tamil Nadu. Beta carotene, Ascorbic Acid (Vitamin C), polyphenols, flavonoids, and antioxidants all of which are unique to the human diet and may help reduce the risk of several illnesses, cancers, and cardiovascular diseases are among the well-known anti-oxidant compounds that can be found in mangos (Lemmens *et al.*, 2013) [22]. Chemicals that suppress the oxidation of important biomolecules are known as antioxidants, and they may postpone or avoid cell harm.
It's generally known that mango fruits contain rich sources of bioactive components that work as antioxidants that aid in decreasing degenerative disorders. The significance of estimating these biochemical properties in nutrition is growing since they protect the body from free radical oxidative damage and a host of other disorders (Halliwell, 1997) [12]. Much research has examined the bioactive components of various mango cultivars (Rajput and Pandey 1997; Hamdard *et al*., 2004; Akhter *et al.*, 2010; Muralidhara *et al.*, 2019) [36, 13, 3, 31] are only a few of these investigations. Lakenbrink *et al*. (2000) [21] state that the variation in flavonoid levels across mango cultivars is greatly affected by external variables such as type of fruit and development, climate, season and degree of maturity. Considering into account the possible characteristics present in these pulps, an estimation of the unique biochemical components present in pulp of mango cultivars typically farmed in Telangana state is

essential. Based on the information provided, present study planned to determine the biochemical characteristics in mango pulp from fifty different cultivars grown in the Indian state of Telangana. The goal was to find the best cultivars for commercial usage in daily diets and to use them in a hybridization programme to improve their quality so they can meet export standards.

## Material and Methods

### Sample collection and preparation

Current experiment was set out in 2018 and 2019 to determine the biochemical characteristics of fifty distinct mango varieties cultivated in Telangana state. The Fruit Research Station (FRS) in Sangareddy, the Quality Control Laboratory at PJTSAU at Rajendranagar, Hyderabad and the College of Horticulture at SKLTS Horticultural University at Rajendranagar were among these establishments. From the Fruit Research Station at Sangareddy, fifty different mango cultivars were chosen at maturity stage at random using the °Brix values for each cultivar. Table 1 represents list of cultivars, of these fourteen juicy cultivars and thirty-six table cultivars. The fruits were hand-picked from the tree when they were fully ripe, firm, and had no defects in terms of size, shape, colour, or maturity. Using an en-ripe package (based on ethylene), At room temperature (25°C) for 48 hours fruits were allowed to ripen in closed settings and a further 48 hours in open circumstances after being sanitised. In order to evaluate the biochemical components in all cultivars, the exact amount of fresh pulp from each cultivar was measured using the quartering technique. A completely randomised design with 3 replications was employed for experiment. Five fruits were taken from five different trees for each replication and biochemical compounds of the ripened pulp of all the selected cultivars were analysed.

### Determination of biochemical compounds

To estimate the amount of vitamin C in mango pulp, 2, 6-diphenylphenol-indophenol titration method was followed, following the protocol described by the AOAC (1997)[5]. To do this, 5ml of mango juice was combined with 3% $HPO_3$ until a volume of 50ml was attained. Two layers of muslin cloth were employed for filtering mixture. A light pink colour was achieved by titrating 10ml of filtrate sample with 2,6-diphenylphenol-indophenol dye. Finally, results were measured as mg/100 g.

Srivastava and Sanjeev Kumar's (2002) [39] described the beta carotene estimation. Using a mortar and pestle, five grams of fresh mango pulp, few crystals of anhydrous sodium sulphate along with 10-15ml of acetone were crushed. Next, using a different funnel, the extract was well combined with 10-15 ml of petroleum ether. Two layers will separate out on standing. Transfer upper layer into 100 ml volumetric flask after that dispose lower layer. Repeat until there is no longer any colour in the water layer. Petroleum ether was used as a blank to increase the amount to 100ml. At 452 nm optical density, absorbance was estimated in spectrophotometer. Measurements were recorded in mg/100 g of pulp.

### Sample extraction for total phenols and flavonoids

Using a mortar and pestle, we mixed 1g of sample with 10ml of 80% ethanol. After centrifuging homogenate extracts at 10,000rpm for 20min, the water bath was used to evaporate the supernatant to dryness. 5ml of distilled water was used for dissolving residue.

As per (Singleton and Rossi, 1965) [38] Folin-Ciocalteu method was employed for estimating total phenolic content of mangoes. Findings were measured as milligram Gallic Acid Equivalents (mg GAE per 100g). Half a millilitre of the sample solution must be blended with half a millilitre of Folin-Ciocalteau reagent for this 1.5ml of 20 % of the sodium carbonate must be added at the end. Distilled water was poured into test tubes to brim. After a 90min of incubation period at room temperature (±23°C), sample's absorbance was recorded at 750nm with spectrophotometer and compared to a blank made of deionized water. Triplicates were conducted to record total phenolic content of mango extract.

For evaluation of total flavonoid content, an aluminium chloride calorimetric method was utilized, according to Park *et al.* (2008) [35]. A 10-millilitre test tube was filled with 1ml of test sample and 4ml water. After five minutes, 10% aluminium chloride 0.3 ml and 5% of 0.3ml of sodium nitrite were added to the tube. After six minutes, 2ml of 1 M NaOH were taken into the reaction liquid. The final volume was made up of 10ml of distilled water immediately. Reaction mixture was kept for incubation at room temperature (±23°C) for 40min. By employing quercetin as a standard the absorbance values were recorded against blank in spectrophotometer at 520 nm. The values are recorded in milli gram of Quercetin Equivalent per 100 g of mango pulp (mg QE/100 g).

We used the Ottolenghi (1959) [33] method of Thiobarbituric Acid Reactive Substances (TBARS) assay for measuring total antioxidant activity. After adding 10ml of buffer, 1g of mango pulp was crushed. Centrifuging the sample mixture at 2500rpm for 20min. 0.02% W/V concentration of the final sample was used for the process. 2ml of 20% trichloroacetic acid and 0.67% thiobarbituric acid (2 ml) were combined with one ml of the sample mixture. The reaction mixture was kept for 10min in boiling water after cooling, it was centrifuged for 20min at 3000 rpm. Once supernatant's absorbance activity reached its maximum, it was measured at 552 nm and recorded.

### Statistical analysis

We conducted all of our analyses in triplicate, and the findings of the experiments were represented as the mean ± SEM. Using the WINDOWSTAT software version 9.2, one-way analysis of variance (ANOVA) with p-value significant at $p<0.05$ was employed for statistical analysis of data.

## Results and Discussion

### Vitamin C content in ripe mango pulp (mg/100g)

Predominant antioxidant and immune boosters of vitamin C were assessed in fifty different mango cultivars. Fig 1 shows that among the fifty distinct varieties of mangos, there was statistically significant difference ($p$ <0.05). Present results recorded that Ascorbic Acid (vitamin C) levels varied from 19.09-31.97 mg/100 g. Among cultivars, Pandurivari Mamidi (19.09 mg/100g) was found the lowest vitamin C content followed by Kaju-19.74 mg/100g, Rumani-20.16 mg/100g and Chinnarasam-20.76 mg/100g. The highest vitamin C content was found in Allampur Baneshan-31.97 mg/100g, followed by Goa Bander-30.97 mg/100g, Baneshan-29.90 mg/100g, and Shendriya-29.52 mg/100g. Vitamin C of 5 commercial mango varieties (Tommy

Atkins, Keitt, and Kent) was reported by Manthey and Perkins-Veazie (2009) [26] as 22 mg/100 g our results are within this range only. Furthermore, Dutta and Ray (2020) discovered that the vitamin C contents of 3 commercial mango varieties ranging from 15.80-16.4 mg/100 g, as per the Ashfak *et al.* (2024) [6] results in the vitamin C contents of BARI mango varieties ranging from 9.34-9.52 mg/100 g. When compared to aforementioned studies, our results showed a higher content of vitamin C. The particular kind and degree of genetic variability seen in the sample may account for the difference in vitamin C concentration. There is a wide range of ascorbic acid concentration; Mitra *et al.* (2001)[29] reported the range 21.66-125.40 mg/100 g, and Doreyappa *et al.* (1994) [10] found levels between 2.90-136.50 mg/100 g. Notable studies on mango have shown similar vitamin C concentrations in different cultivars (Anowar Hossain *et al.*, 2014; Lokesh Bora *et al.*, 2017; Himabindu *et al.*, 2018; Hus *et al.*, 2018) [4, 24, 16, 17].

**Beta carotene content in ripe mango pulp (mg/100g)**

Carotenoids are pigments that give fruits their yellow to orange pulp colour; their nutritional quality is proportionate to their abundance. Recent studies have shown that carotenoid nutrition and health benefits include a potential reduction in cancer and heart disease risks due to its pro-vitamin A action (Tiburski *et al.*, 2011)[42]. Significant ($p<0.05$) beta carotene levels were observed among all mango varieties and the range is 1.11-2.81 (mg/100g) shown in fig 2. Lalmuni (2.81mg/100g) recorded maximum beta carotene content followed by cultivar Zardalu (2.74 mg/100g), 2.63mg/100g in Dashehari-35, 2.62mg/100g in Suvarnarekha and in Yerra Mulgoa (2.60 mg/100g), whereas the 1.11 mg/100g was recorded lowest in Nazeem Pasand, 1.15 mg/100g in Ranitellakaya and in Panchavarnam 1.18 mg/100g. In mango fruits, carotenoid composition changes depending on a number of variables, including their development, maturity, cultivar, place of origin, and processing (Chen *et al.*, 2007)[8]. Consistent with our results, Ashfak *et al.* (2024) [6] reported that various BARI mango varieties contained beta carotene levels between 1.78-2.98 mg/100 g. A range of mango juices had the greatest ß-carotene content (1.95 mg/100 g), according to Dars *et al.* (2018) [9]. These findings are supported by research on mango published by Abirami *et al.* (2004) [1], Ajila *et al.* (2007) [2], Nehra and Sharma (2012) [32], Liu *et al.* (2013) [23], Monaco *et al.* (2014) [30], Ellong *et al.* (2015) [11], Haque *et al.* (2015) [15], and Muralidhara *et al.* (2019) [31].

**Results of total flavonoid content (mg of QE/100 g)**

Polyphenolic compounds with highest antioxidant potential are flavonoids according to Zuhair *et al.* (2013) these flavonoids are renowned for their antioxidant activity. According to Chang *et al.* (2002), flavonoids are food-based substances with a low molecular weight that enhance antioxidant activity. The quantity of polyphenols and geographical location determine their composition. Fig 3 shows that total flavonoid content varied significantly among the varieties. It is recorded that a total flavonoid concentration ranged from 24.03-331.11mg QE/100g. Among cultivars, highest flavonoid content (331.11 mg of QE/100g) was noticed in Yerra Mulgoa followed by Pulihora cultivar (263.02 mg of QE/100g), whereas the lowest flavonoid contents (24.03, 47.32, 48.06, 50.56 and 50.92 mg of QE/100g) were reported in Kalepahad, Sora, Peddarasam, Vanraj and Nazeem Pasand respectively. Ashfak *et al.* (2024)[6] reported that total flavonoid content in analysed BARI mango cultivars ranged from 380 to 104 mg QE/100g. The present results are also align with the outcom es of research on mango carried out by Ajila *et al.* (2007) [2], Hana Kim *et al.* (2010) [14], Katike Umamahesh (2016) [19], and Kuganesan *et al.* (2017). According to Lakenbrink *et al.* (2000) [21], differentiation in flavonoid content among mango varieties is significantly affected by external variables such as type of fruit and growth conditions, season, climate, and degree of maturity.

**Total phenolic content in mango pulp (mg of GAE/100g)**

Phenolic compounds predominantly contribute total antioxidant activity of fruits. Mangoes are rich source of phenolic compounds. Miletic *et al.* (2012) [27] stated that as fruits mature, their total phenol content decreases and then increases again. Fig 4 represented how total phenolic content of fifty mango cultivars varied significantly, with values ranging from 64.72 milligram GAE/100g - 173.20 milligram GAE/100g). Highest total phenolic content was observed in Mahamooda Vikarabad cultivar (173.20 mg GAE/100g), followed by Shendriya cultivar (164.73 mg GAE/100g) and Sannakulu cultivar (160 mg GAE/100g), on the other hand, Shajahan recorded the lowest amount 64.72 mg GAE/100g, followed by cultivar Ranitellakaya, Kesar, and Dilpasand at 66.91, 67.22, and 67.71 mg GAE/100g respectively. Analysis showed that variation in total phenolic content in ripe mango pulp is influenced by mango variety. Ribeiro *et al.* (2007) [37] noticed that total phenolic content varied across the four varieties of mango, which is in line with our results. Uba pulp had the greatest (about 200 mg GAE/100 g), while Tommy Atkins pulp had the lowest (less than 50 mg GAE/100 g) total phenolic content. According to Palafox-Carlos *et al.* (2012) [34], the pulp of the Ataulfo mango had 174 mg GAE/100 g FW of phenolics after it was mature. The findings of the current study align with the research on mango conducted by Ajila *et al.* (2007b) [2], Monaco *et al.* (2014) [30], John *et al.* (2017) [18], Dars *et al.* (2018) [9], and Ashfak *et al.* (2024)[6].

**Total antioxidant activity in ripe mango pulp (µg/100g)**

Phenolic compounds found in fruits are primarily responsible for their antioxidation action, which possess redox properties. These compounds have the ability to degrade peroxides, neutralise free radicals, quench both singlet and triplet oxygen due to their redox characteristics (Mishra *et al.*, 2010) [28]. A Significant variation ($p<0.05$) was found in total antioxidant activity among 50 mango cultivars, which ranged between 91.74-326.38 µg/100g seen in fig 5. As per results, Dashehari-35 had the greatest total antioxidant activity (326.38 µg/100g), followed by Kothapalli Kobbari (285.41 µg/100g), which is on par with Panakalu (285.01 µg/100g), whereas Azam Us Samar (91.74 µg/100g) recorded lowest. Data revealed that the predominant contributors to antioxidant capacity in mango varieties were the total phenolic content, total flavonoid content, and beta-carotene levels in the fruit pulp (Muralidhara *et al.*, 2019) [31]. Findings of mango study align with investigations conducted by Madalageri *et al.* (2015) [25] and Kothawala *et al.* (2018).

**Table 1:** List of fifty mango cultivars used for the characterisation of biochemical parameters

| List of mango cultivars | | | |
|---|---|---|---|
| **S. NO** | **Table cultivars** | **S. No** | **Juicy cultivars** |
| 1 | Dasehari 35 | 37 | AryavarthamIrsalu |
| 2 | AllampurBaneshan | 38 | Cherukurasam |
| 3 | Ausif Us Samar | 39 | Chinnarasam |
| 4 | Azam Us Samar | 40 | KothapalliKobbari |
| 5 | Baneshan | 41 | MeetavariPeechumanu |
| 6 | Chinna Suvarnarekha | 42 | NagulapalliIrsalu |
| 7 | Dashehari | 43 | Navaneetham |
| 8 | Dilpasand | 44 | Panakalu |
| 9 | Goa Bandar | 45 | Panchavarnam |
| 10 | Himayath | 46 | PandurivariMamidi |
| 11 | Jehangir | 47 | Peddarasam |
| 12 | Kaju | 48 | Yellow Arati |
| 13 | Kalepahad | 49 | Yerra Arati |
| 14 | Kesar | 50 | Zardalu |
| 15 | Lalmuni | | |
| 16 | Latif Us Samar | | |
| 17 | MahamoodaUppal | | |
| 18 | MahamoodaVikarabad | | |
| 19 | Manjeera | | |
| 20 | Mulgoa | | |
| 21 | Nazeem Pasand | | |
| 22 | Neeleshan | | |
| 23 | Neelum | | |
| 24 | ParasapalliDoodiya | | |
| 25 | Pulihora | | |
| 26 | Ranitellakaya | | |
| 27 | Rumani | | |
| 28 | Sannakulu | | |
| 29 | Shajahan | | |
| 30 | Shendriya | | |
| 31 | Sora | | |
| 32 | Suvarnarekha | | |
| 33 | Totapari | | |
| 34 | Vaddepalli Selection | | |
| 35 | Vanraj | | |
| 36 | YerraMulgoa | | |

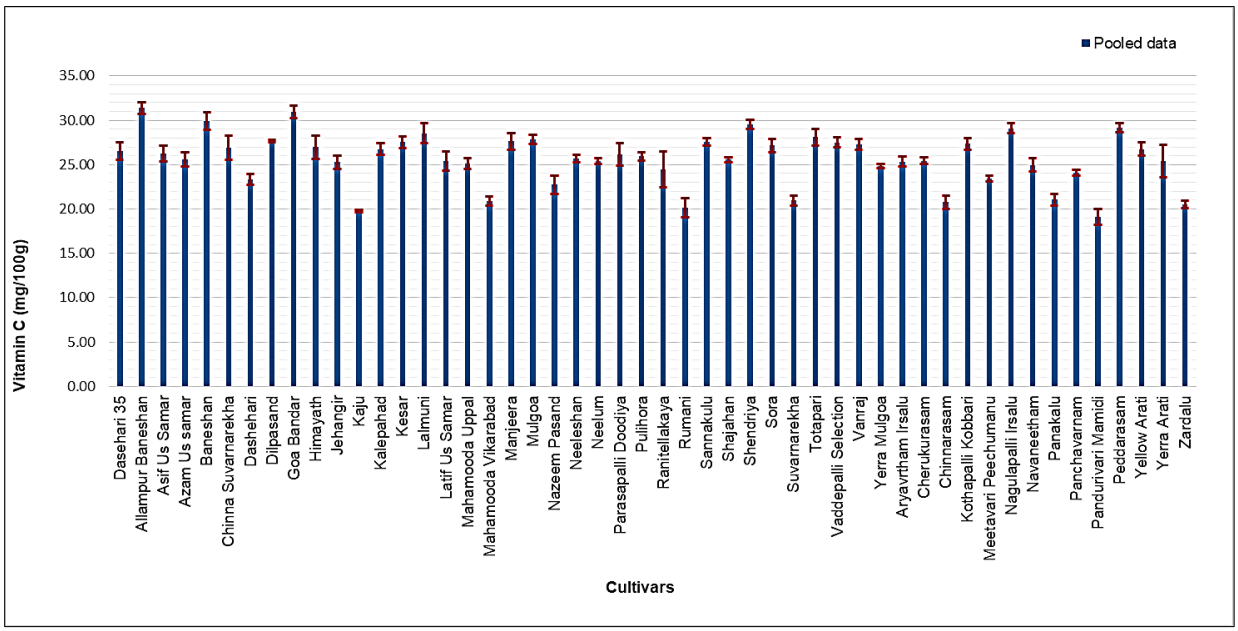


**Fig 1:** Mean Vitamin C (mg/100g) of fifty mango cultivars under Telangana conditions

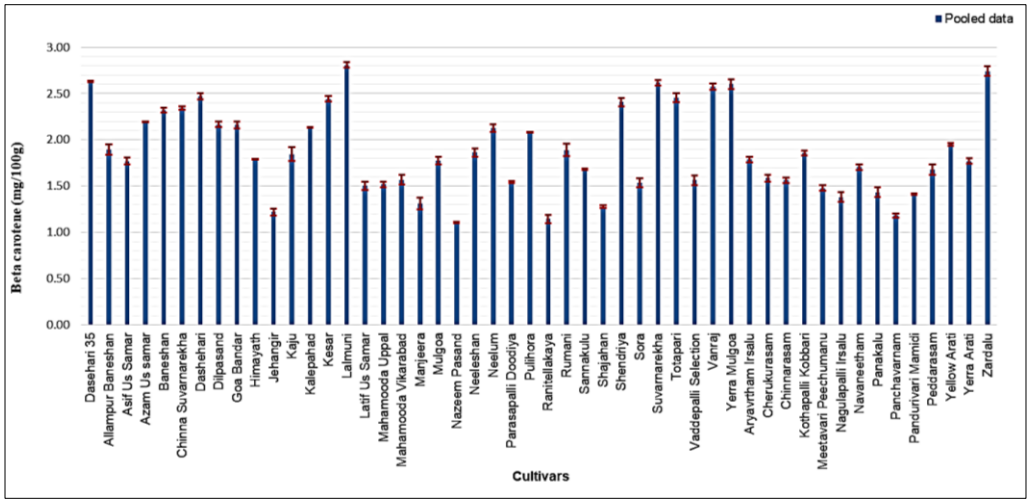


**Fig 2:** Mean beta carotene (mg/100g) of fifty mango cultivars under Telangana conditions

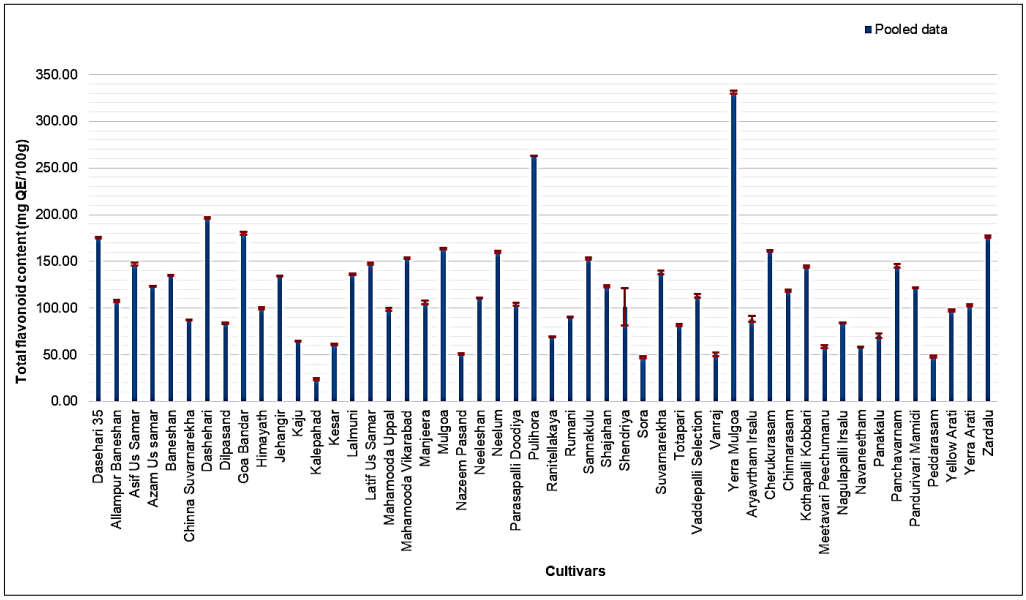


**Fig 3:** Mean total flavonoid content (mg QE/100g) of fifty mango cultivars under Telangana conditions

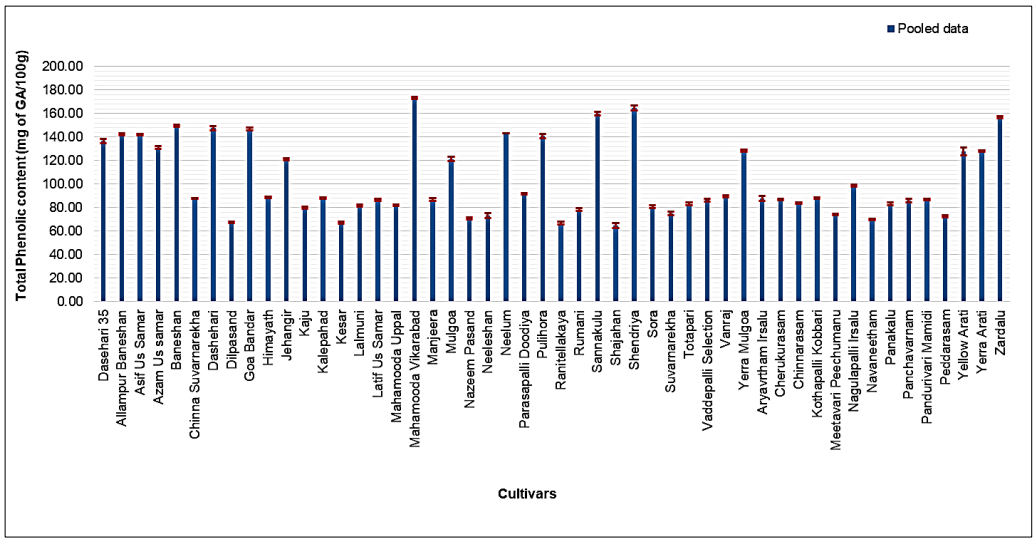


**Fig 4:** Mean total phenolic content (mg of gallic acid/100g) of fifty mango cultivars Telangana conditions

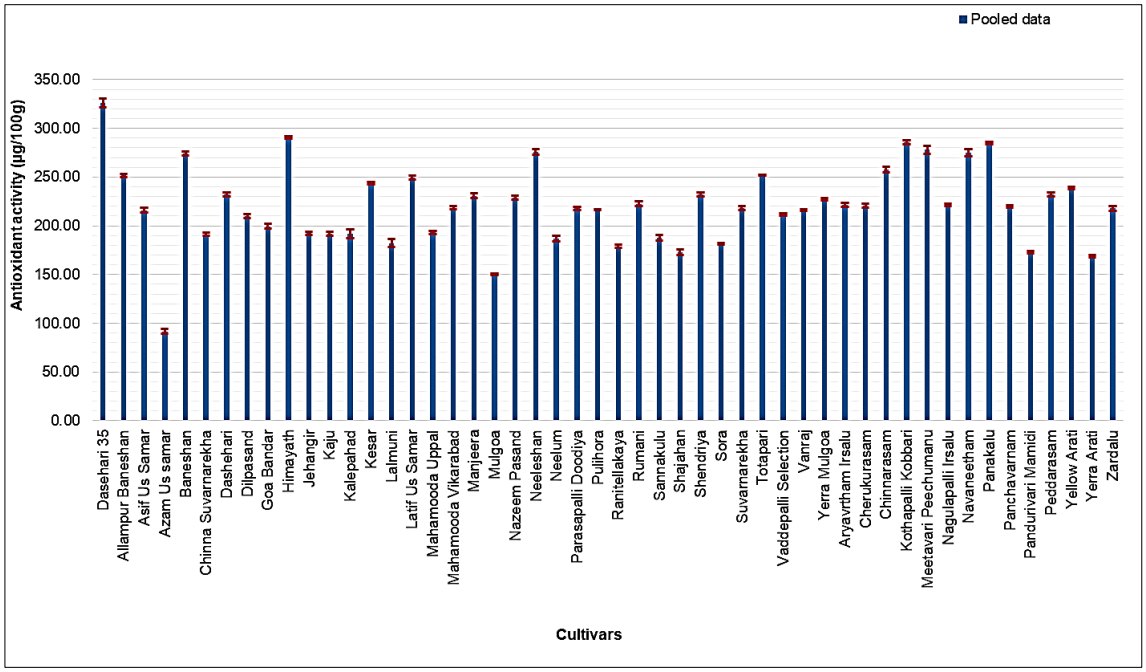


**Fig 5:** Mean total antioxidant activity (µg/100g) of fifty mango cultivars under Telangana conditions

## Conclusion

Present research indicated that all mango varieties contain significant quantities of Ascorbic acid (vitamin C), total flavonoids, beta-carotene, phenolic content, along with antioxidant activity in pulp. However, there were distinct variations in these parameters among the different cultivars. Based on biochemical characterization of fifty different mango cultivars, Allampur Baneshan (31.97mg/100g) and Goa Bandar (30.97mg/100g) had the highest amounts of vitamin C. The maximum beta carotene contents were found in the Lalmuni, Dashehari-35, and Suvarnarekha cultivars, with 2.81mg/100g, 2.63mg/100g, and 2.62mg/100g, respectively. Yerra Mulgoa and Pulihora cultivars recorded the highest total flavonoid content 331.11 and 263.02 mg QE/100g respectively. The cultivars Mahamooda Vikarabad, Shendriya, and Sannakulu demonstrated highest total phenolic content, with values of 173.20, 164.73, and 160 mg GAE/100g, respectively. In terms of total antioxidant activity, Dashehari-35 recorded the highest level at 326.38 µg/100g, followed by Neeleshan at 276.07 µg/100g, which was statistically similar to Baneshan (274.30 µg/100g).In addition to the aforementioned cultivars, other cultivars also contained significant levels of biochemical compounds in their ripened pulp. Therefore, these promising cultivars could be effectively utilized in breeding programs aimed at enhancing quality to meet international export standards. Furthermore, due to their rich biochemical profiles, these varieties may also be suitable for commercial inclusion in daily diets, offering additional health benefits.

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