Characterization of bioactive and fruit quality compounds of promising mango genotypes grown in Himalayan plain region

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ABSTRACT

~~A study was conducted to examine the~~Twenty mango genotypes grown in the plains of the Himalayas were characterised in their physical, physiological, biochemical, mineral, and organoleptic attributes ~~of 20 mango genotypes grown in the plains of the Himalayas. Various physical attributes such as~~ : fruit firmness, weight, peel thickness, shape, ~~and~~ dry seed weight ~~were measured, along with physiological attributes such as~~, respiration rate, weight loss, and shelf life. Biochemical attributes ~~were also analyzed, including~~ such as soluble solids ~~content~~, total carotenoids, total phenolic content, antioxidant activity, titratable acidity, ascorbic acid, and total sugars were also determined. In addition, mineral content and fruit-softening enzymes were measured, and an organoleptic evaluation was performed. PG, PME, and LOX were ~~estimated using mango fruit pulp taken~~measured from the pulp adjacent to the peel. Similarly, biochemical attributes and mineral content were evaluated using fruit pulp, while organoleptic evaluation included ~~both~~ fruit pulp characters and the fruit's external appearance ~~of fruit~~. The results of the study showed that the 'Malda' genotype exhibited the highest total phenolic content (560.60 µg/100g), total antioxidant (5.79 µmol TE/g~~)~~), and titratable acidity (0.37 %) among the tested genotypes. 'Amrapali' had the highest soluble solid content (25.20 °B), 'Jawahar' had the highest ascorbic acid content (44.20 mg/100g pulp), 'Mallika' had the highest total flavonoid content (700.00 µg/g) and 'Amrapali' had the highest total carotenoid content (9.10 mg/100g). Moreover, the genotypes 'Malda', 'Safed ~~Malda',~~Malda,' and 'Suvarnarekha' had a shelf life of 4-5 days longer than other tested genotypes. The genotypes with high biochemical attributes have practical utility for researchers for quality improvement programmes and processing industries as functional ingredients in industrial products. This study provides valuable information on the nutritional and functional properties of different mango genotypes, which can aid in developing improved varieties with enhanced health benefits and greater practical utility for ~~researchers and~~ processing industries.

KEYWORDS

Mango; Genotypes; Himalayas**;** Nutritional; Organoleptic; Bioactive

Introduction

The mango is ~~an immensely popular~~a trendy tropical fruit known for its delightful flavour, sweet taste, and vibrant colour. It is also highly regarded for its nutritional value, as it contains an array of minerals, vitamins, sugars, and fibre, along with various phytochemicals, such as polyphenols, which provide numerous health benefits (Dars et al., 2019; Hu et al., 2021; Parvin et al., 2023 Mango has been cultivated for over 4000 years, and all varieties are traced back to India and Southeast Asia~~ are considered its center of origin.~~. In India, all cultivable mangoes belong to ~~the species~~ *Mangifera indica* L., although other species, such as *Mangifera odorata*, *M. foetida*, and *M. caesia* can also be found (Aung, 2019). Polyphenols are organic micronutrients found in plants that are known to have unique health benefits. Mango is an excellent source of polyphenols, including mangiferin, gallic acid, gallotannins, quercetin, isoquercetin, ellagic acid, and β-glucogallin, with gallic acid being the most prevalent in the mango mesocarp (Singh et al., 2022). Mango is consumed in both fresh and processed forms, and both forms provide numerous health benefits. ~~From~~Mango has many uses, from promoting digestion to improving skin health~~, mango has a wide range of uses~~ (Prasad et al., 2018; Singh et al., 2022). ~~Overall, mango~~Mango is a highly nutritious fruit ~~that has earned its place as one of the most economically significant fruits~~with a substantial market globally.

The presence of bioactive compounds in fruits is an ~~important~~essential indicator of fruit quality and consumption patterns. The ~~major~~primary polyphenols in mango are catechins, mangiferin, kaempferol, quercetin, rhamnetin, anthocyanins, ellagic acids and gallic, propyl and methyl gallate, benzoic acid, and ~~protocatechic~~protocatechuic acid. These compounds offer numerous preventative health benefits (antioxidative, anticarcinogenic, antiatherosclerotic, antimutagenic, anti-inflammatory, analgesic, antidiabetic and immunomodulator) and can protect against cardiovascular diseases (Masibo and Qian, 2008; Hu et al., 2021). ~~The~~Mango contains a combination of polyphenols and ~~xanthoses in mango is an antioxidant~~xanthones that ~~can help protect~~act as antioxidants, protecting against ~~several~~various ailments (Berardini et al., 2005~~). Mango is known to have comparatively high levels~~), and it has a higher level of carotenoids, particularly β-carotene, ~~compared to~~than other fruits. These compounds ~~largely~~broadly define the nutritive value of mango fruit, and it is possible to increase their levels through proper ~~treatment or processing techniques after~~ post-harvest treatments (Hu et al., 2021). The bioactive compounds in mango make it an excellent fruit for promoting overall health and preventing various diseases~~. Its high carotenoids and other beneficial compounds make it an important addition to~~ when included in a healthy diet.

Mango fruits ~~that are~~ grown in the Himalayas' plain region ~~of the Himalayas~~ are believed to be particularly rich in phytochemical contents and compounds that promote good health (Prasad et al., 2020; Neetu, 2022). However, genotype-specific profiling of bioactive compounds in these mangoes has ~~not been~~yet to be explored extensively. To fill this knowledge gap, the present study aims to ~~characterize~~characterise the bioactive compounds in selected commercial mango genotypes grown in the Himalayan plain region. Through this investigation, we hope to gain a deeper understanding of the health-promoting properties of these mangoes and their potential as a source of bioactive compounds.

Materials and Methods

Sampling and estimation

~~About 20~~Twenty commercial mango genotypes viz., 'Alphonso', 'Amrapali', 'Bombai', 'Chausa', 'Dashehari',' 'Gulab Khas', 'Himsagar', 'Jawahar', 'Krishna Bhog', 'Langra', 'Mahmood Bahar', 'Malda', 'Mallika', 'Prabha Sankar', 'Ratna', 'Safed Malda', 'Suvarnarekha', 'Totapuri', 'Zardalu', and 'Fazli' were obtained ~~from university mango orchard~~ (Pusa, Dholi and adjoining area), RPCAU (Dr. Rajendra Prasad Central ~~agricultural university~~Agricultural University), Bihar. The fruits were harvested under dry weather from May-August~~, the day free from rainfall.~~. After harvesting, fruits were de-sapped and precooled immediately with ~~hydrocooling~~hydro cooling to bring the temperature to a uniform level for all varieties. Fruits were stored for ripening under ambient storage conditions (25 ± 4 °C and 65 ± 5 % RH) for 15 days. However, the shelf life of mango genotypes (all genotypes) was completed at and within 12th of storage. The genotypes were investigated for physical, physiological, biochemical, mineral contents, organoleptic evaluation, and fruit-softening enzymes. The parameters, irrespective of their sections, were determined at the peak ripening stage. The experiment was conducted over ~~a period of~~ two years, specifically in 2020 and 2022. The data presented in the study represents the average value obtained from both years.

Determination of physical attributes

~~The weight of~~An electronic balance recorded the fruit and dry seed weight ~~was recorded~~ in grams (g~~) using an electronic balance.~~). The thickness of the fruit peel was recorded in mm using a vernier ~~caliper. The fruit~~calliper. Mango fruits' morphology (shape) ~~of mango fruits~~

was determined using International Plant Genetic Resources Institute (IPGRI) mango descriptors. A texture ~~analyzer (model: ~~analyser (TA-XT Plus) was used to determine the fruit firmness~~, and it was~~ expressed as ‘N’ (Newton).

Estimation of biochemical attributes

Soluble solid contents (SSC) and total sugars

SSC Using a hand refractometer (0–50 °B) was estimated and depicted as Brix° under ambient storage. Lane and Eynon's method, described by Ranganna (1986~~)~~), was used to determine the total sugars.

Titrable acidity (TA)

The procedure followed by Singh et al. (2022) determined the TA of mango genotypes. TA was determined by titrating against 0.1 N NaOH using a few drops of phenolphthalein indicator, which became pink and was depicted as equivalent of citric acid.

Total carotenoid contents (TCC)

TCC was determined ~~as ~~per the procedure followed by Prasad et al. (2020). In 30 ml acetone, 10 g of pulp was ~~homogenized~~homogenised until the pigment was removed ~~completely~~entirely. The golden pigment was obtained by filling a ~~homogenized~~homogenised solution in a separating funnel and washing it with petroleum ether and a pinch of sodium sulfate. For pigment separation shaken funnel was left without any disturbance. After the coloured pigment separation solution was transferred into the volumetric flask. Spectrophotometer was used to record the absorbance at 452 nm, and a blank was prepared using petroleum ether. Against standard curve reading was plotted and displayed as ‘mg 100 g^{-1} FW’.

Ascorbic acid (AA) and antioxidant (AOX) activity

AA was determined according to the procedure followed by Singh et al. (2022). It was examined using a 2,6-Dichlorophenol indophenol titration method. The Antioxidant (AOX) activity of mango genotypes was estimated using DPPH (2,2-Diphenylpicrylhydrazyl) method followed by Lu et al. (2014). After thoroughly mixing 0.1 mL extract with 3.9 mL of a 0.06 mM DPPH solution mixture was left for thirty minutes in the dark and absorbed the absorbance at 517 nm. The AOX activity was expressed as ‘µmol Trolox equivalent /g’.

Total phenolic content (TPC)

Methodology with some modification followed by Prasad et al. (2022b) was used to estimate the TPC. Double-distilled water (2.5 mL) in a test tube was used to dilute the (0.5 mL) pulp and then incubated for 3 min after adding 0.5 mL Folin-Ciocalteu reagent. Following incubation, 2 mL of 20% (w/v~~)~~), Na_2CO_3 was added to the sample tube and kept for 1 minute for boiling in a water bath. At 650 nm, absorbance was recorded while gallic acid anhydrous standard solutions at concentrations ranging from 10 to 100 mg/L were used to construct a five-point analytical curve. The curves demonstrated satisfactory linearity within the absorbance at each concentration ($R^2 = 0.999$). TPC ~~were~~was displayed as 'µg GAE/g FW'.

Total flavonoid contents (TFC)

The TFC was determined per the methodology Zhisen et al. (1999) described using ~~aluminum~~aluminium chloride. An extract aliquot of 0.1 ml was taken in 10 ml of a volumetric flask containing 4 ml of distilled water, 0.3 ml of 5 % $NaNO_2$ and 0.3 ml of 10 % $AlCl_3$. $6H_2O$. At room temperature mixture was left to stand for 6 minutes. After adding 2 ml of 1M NaOH, the solution was diluted up to 10 ml using distilled water. The mixture was mixed using a vortex. The absorbance was recorded immediately at 510 nm in a spectrophotometer (Model: IGENE LABSERVE, IG 94UV, India). Catechin hydrate standard curve at concentrations between 50 and 300 mg/L was used to calculate the calibration curve (R^2=0.999). TFC was expressed as 'µg/100 g FW'.

Determination of minerals

The minerals were determined according to the methodology followed by Drozdz et al. (2018). Mango fruit samples were digested with di acids (nitric acid and perchloric acid) in ultrapure water ~~acquired from the (~~Mili Q system~~ (Milipore~~, Millipore, France) to estimate the mineral content. The Mili Q system was ~~utilized~~utilised for further dilution and ~~digest~~digested the samples. The phosphorous reading was recorded in a Spectrophotometer (IGENE LABSERVE~~) and a~~). A Flame photometer (model no. SP-V325) was used for the minerals such as calcium and potassium, and it was expressed as 'mg/ kg'.

Physiological attributes

The ~~procedure followed by Prasad et al. (2022b) was used for the determination of~~ respiration rate ~~and for this purpose auto~~was measured with an automated gas ~~analyzer~~analyser (Model PBI Densor~~) was used.~~), as described by Prasad et al. (2022b). High-precision electronic balance was used for the determination of the PLW of fruits. ~~On the basis of PLW,~~ Fruits that exhibited more than 10 ~~percent~~% PLW loss were deemed to have a shelf life completed (Prasad et al., 2022a).

Organoleptic evaluation

Mango genotypes were evaluated for the organoleptic parameter using 'panel method' and hedonic scale (Prasad et al., 2018). Mango fruit with superior flavour, texture and colour displayed high-level consumer liking (Prasad et al., 2022a).

Determination of fruit softening enzymes

Polygalactouronase (PG), pectin methylesterase (PME) and Lipoxygenase (LOX) enzyme activity ~~was~~were determined according to the procedure followed by Prasad et al. (2022a) with slight modification.

Statistical analysis

The investigation was conducted in CRD (completely ~~randomized~~randomised design) with ~~3 replications~~three replicates. Using one-way analysis of variance analysis of all parameters data was done between different mango genotypes using SAS software. Results Comparison was ~~done~~made by calculating Critical difference and DMRT (Duncan's multiple range test) at a 5% ~~level of~~ significance level. In the column, the data were expressed as mean ± standard deviation.

Results and Discussion

Physical attributes

The physical characteristics of horticultural produce play a significant role in designing the system for grading, transport, processing, and packaging (Prasad et al., 2022b). Fruit appearance, ~~which is~~ influenced by ~~color~~colour, size, and shape, is one of the consumers' first and most important factors ~~for consumers~~ when purchasing (Kumar et al., 2018). Therefore, various physical characteristics were recorded in different mango genotypes. Our finding displayed that there were significant variations in the weight of the mango. The highest fruit weight was observed in 'Fazli' (404.67g), while the lowest ~~fruit weight~~ was ~~observed~~ in 'Gulabkhas' (121.57g). The peel thickness of mango genotypes was also significant, ~~which was~~ the highest in 'Fazli' (1.85 mm) and the lowest in 'Chausa' (0.62 mm). Similar differences were observed in the seed weight value, which was found to be the highest in 'Fazli' (27.23 g) while the lowest was ~~found~~ in 'Dashehari' (11.97 g). One of the most crucial quality traits of any fruit which determines consumer appeal is fruit firmness, and it was observed the highest in ‘Mahmood Bahar’ (9.37 N) while the lowest was observed in ‘Himsagar’ (4.13 N). Different fruit shape was observed in different selected mango genotypes (Table 1). The genotypes with higher peel thickness and firmness exhibited higher shelf life. The variations in fruit weight, peel thickness, fruit firmness, seed weight and fruit morphology might be due to genetic differences of genotypes. Bora et al. (2017) and Totad et al. (2020) reported similar variations in the physical characteristics of different mango genotypes served as the basis of this investigation. The difference in physical features is also investigated by Gentile et al. (2018).

Biochemical attributes

Soluble solid content (SSC), total sugars and titratable acidity (TA)

In addition to being the primary ingredients in sweet and sour flavours, SSC and TA are also essential indicators of fruit maturity and postharvest fruit flavour assessment during storage (Zhao et al., 2021). SSC in fruits is a crucial quality characteristic linked to ~~the~~ composition and texture (Hossain et al., 2014; Prasad et., 2022a). Our findings displayed that the SSC was reported the highest in ‘Amrapali’ (25.20 °B) whereas the lowest SSC was reported in Totapuri (16.20 °B). The total sugars were observed maximum in ‘Mallika’ (20.12 ~~%)~~%), while the lowest was observed in Zardalu (14.37 %). ~~Fruits~~Fruits' overall taste is ~~governed by~~related to titratable acidity. Our findings revealed that the titratable acidity was found the highest in ‘Malda’ (0.37 %) while the lowest was found in ‘Himsagar’ (0.12 %) (Table 2a). It has been reported that the ~~relation~~relationship between SSC and TA is critical for determining the consumer acceptability of many fruits. Our results were ~~in accordance with the findings of~~per Samal et al. (2012) and Singh et al. (2022), who have reported considerable differences in titratable acidity, soluble solid contents and total sugars among mango genotypes.

Ascorbic acid (AA), antioxidant (AOX) activity and total carotenoid

AA is a crucial quality characteristic of fruits and is particularly valued for its antioxidant properties & AOX protects against the occurrence of oxidative stress (Prasad et al., 2016; Prasad et al., 2022b). The ascorbic acid was observed the highest in ‘Jawahar’ (44.20 mg/100g pulp~~)~~), whereas~~,~~ the lowest was observed in ‘Ratna’ (14.50 mg/100g pulp) (Table 2b). ~~A significant~~Significant differences in AOX activity existed between the studied mango genotypes, and it was found to be the highest in ‘Malda’ (5.79 µmol TE/g) while the lowest in ‘Totapuri’ (2.54 µmol TE/g) (Table 2b). Carotenoids in mango contributed to antioxidant properties. The mango genotypes varied in total carotenoid contents, and it was reported the highest TCC in ‘Amrapali’ (9.10 mg/100g) and the lowest in ‘Langra’ (5.50 mg/100g) (Table

2b). The genotypes rich in these biochemical compounds are highly preferred by consumers. The higher antioxidant value of genotypes might be due to higher levels of total phenol, ascorbic acid and total carotenoid content. This study got evidence from the results of Gentile et al. (2018) and Lu et. (2014), who reported variations in biochemical attributes in selected mango cultivars.

Total phenolic ~~contents~~ and ~~total~~ flavonoid contents

Dietary antioxidants ~~which is~~ derived from ~~the phenolic chemicals,~~phenolics lower the risk of various chronic ~~disorders~~diseases (Jayarajan et al., 2019). Flavour (different shades of flavour) and antioxidant activity of fruits are attributed to flavonoids. The concentration of ~~phenol varied considerably~~phenolics is variable among the different mango genotypes~~. The total phenol content in mango genotypes was registered~~, being the highest in 'Malda' (560.60 µg/100g) while the lowest was registered in 'Totapuri' (297.50 µg/100g). The highest TFC were observed in Mallika (700.00 µg/g~~)~~), whereas~~,~~ the lowest TFC was observed in 'Himsagar' (355.00 µg/g) (Table 2b). The genotypes ~~rich in~~with a high TPC and TFC are considered ~~to have~~ high fruit quality and ~~have higher neutraceutical~~nutraceutical value (Rastegar et al., 2019). Such differences between TCC and TFC also have been reported by Totad et al. (2020) in ~~blueberries~~blueberry varieties grown in the northern-~~-~~western Himalayas.

Physiological attributes

The attributes such as respiration rate (ml CO_2 kg^{-1} h^{-1}), physiological loss in weight (PLW) (%) and shelf life (days) differed significantly among selected mango genotypes. A crucial factor affecting a fruit's shelf life is respiration rate (Jhalegar et al., 2014). The maximum respiration rate among mango genotypes was reported in 'Chausa' (137.19 ml CO_2 kg^{-1} h^{-1}~~)~~)), while the lowest was observed in 'Safed Malda' (95.44 77 ml CO_2 kg^{-1} h^{-1}). PLW is assessed by moisture loss from the fruit due to transpiration or respiration, which is governed by fruit peel thickness or environmental ~~factor~~factors. The highest PLW was observed in 'Totapuri' (13.00 ~~%)~~%), whereas~~,~~ the lowest PLW was ~~observed~~ in 'Amrapali' (6.20 %). The highest shelf life was observed in 'Malda', 'Safed Malda' and 'Suvarnarekha' (11-12 days) (Table 3). The genotypes exhibited higher respiration rates, and PLW ~~has~~had a lower shelf life. A similar study investigated ~~in~~ kiwi genotypes (Sharma et al., 2015) and mango (Prasad et al., 2022a).

Organoleptic evaluation

Significant differences were observed for organoleptic evaluation among selected genotypes of mango. The highest organoleptic score was reported in 'Amrapali' (9.0) while the lowest was observed in 'Prabha Sankar' (7.0). ~~In mango genotypes, the~~The greater sensory score ~~is~~in mango genotypes might be due to improved colour, taste, fragrance and flavour (Prasad and Sharma, 2018; Prasad et al., 2022b) (Table 2a).

Determination of minerals

Minerals are necessary for the body's healthy operation, growth and development, and preserving health. Potassium is related to fruit quality, phosphorous stabiles fruit cell ~~wall~~walls and calcium is needed to keep cells rigid (Sinha et al., 2017). Considerable variations in ~~major~~primary mineral ~~constitutes~~constituents among different genotypes of mango were observed. Among the genotypes evaluated, potassium content was reported the highest in 'Bombai' (12.46 mg/kg~~)~~), whereas~~,~~ the lowest was observed in 'Mahmood Bahar' (5.60 mg/kg). Apart from potassium, phosphorous contents also showed considerable variation among different mango genotypes, which was observed the highest in 'Malda' (1.77 mg/kg~~) while~~). In comparison, the lowest was observed in Langra (0.93 mg/kg). The value of calcium among selected mango genotypes was registered the highest in 'Mahmood Bahar' (0.40 mg/kg) while the lowest was registered in 'Ratna' and 'Himsagar' (0.11 mg/kg) (Table 4). The genotypes with higher mineral contents are considered ~~to be~~ nutritionally rich (Kumar et al., 2018). A similar finding has been investigated by Akin-Idowu et al. (2020) in different fruit and Lu et al. (2014) in pineapple cultivars. Drozdz et al. (2018) and Totad et al. (2020) also have reported such differences in minerals among selected wild and cultivated blueberry genotypes, respectively.

Estimation of fruit softening enzymes

Fruit softening enzymes such as PG enzyme (µg ~~galactouronic~~galacturonic acid g^{-1} h^{-1} FW), PME (µmol g^{-1} FW min^{-1}) and LOX (µmol g^{-1} FW min^{-1}) varied significantly among selected mango genotypes. PG and PME enzymes are directly associated with fruit ripening, softening and textural changes processes and cell wall decomposition, while LOX is associated with senescence. The PG enzyme activity was found the highest in 'Himsagar' (36.83 µg ~~galactouronic~~galacturonic acid g^{-1} h^{-1} FW) whereas, the lowest was found in 'Jawahar' (31.57 µg ~~galactouronic~~galacturonic acid g^{-1} h^{-1} FW) (Fig. 1). The PME activity was observed maximum in 'Chausa' (0.40 µmol g^{-1} FW min^{-1}) while the lowest in 'Malda' (0.30 µmol g^{-1} FW min^{-1}) (Fig. 2). The LOX activity was registered the highest in 'Chausa' (5.56 µmol g^{-1} FW min^{-1}~~) while~~). In contrast, the lowest was observed in 'Malda' (3.18 µmol g^{-1} FW min-^{1}) (Fig. 3). This study got the support of Prasad et al. (2020) who observed considerable variations for fruit softening enzymes among genotypes of mango.

Correlation ~~Analysis~~analysis of parameter for quality traits in mango

The correlation analysis of the selected twenty-one different traits in mango genotypes at their peak ripening stage revealed an overall significant positive correlation (one variable increases with the increase in another variable) among the physical attributes of different mango genotypes (Fig. 4). The soluble solids contents, total sugars, titratable acidity, total carotenoid and organoleptic evaluation also showed positive correlations with each other when compared across different mango genotypes at peak ripening stage. Similarly, total phenolic content, total flavonoid, ascorbic acid, and antioxidant acidity~~,~~ were also found to be positively correlated with each other (Fig. 4). Also, the physiological attributes, such as respiration rate and physiological loss in weight, were also suggested to be positively correlated with each other. This finding reveals that genotypes exhibiting lower respiration ~~rate~~rates and physiological loss in weight exhibit higher shelf life~~ and thus will be available in market for longer duration.~~. The total phenol content was negatively correlated with PME, PG and LOX activity~~ While~~. In contrast, the total carotenoid content was positively correlated with sensory evaluation (Fig. 4). This finding suggests that the better colour development in some genotypes due to carotenoid content is responsible for the higher acceptability of that genotype by consumers. The valuable insights into the correlations between various traits of mango genotypes at the peak ripening stage may aid in selecting and breeding superior mango cultivars with desirable traits and characteristics.

Overall, this study provides valuable insights into the correlations between various traits of mango genotypes at the peak ripening stage. These findings may aid in selecting and breeding superior mango cultivars with desirable traits and characteristics.

Conclusion

~~The~~This study ~~has demonstrated that the analyzed mango genotypes exhibit~~showed significant variations in ~~terms of their~~ the bioactive and fruit quality compounds of the studied mango genotypes. ‘Malda' was found to be superior in terms of total phenolic content (560.60 µg/100g), total antioxidant (5.79 µmol TE/g), and titratable acidity (0.37 %). 'Amrapali' had the highest soluble solid content (25.20 °B), 'Jawahar' had the highest ascorbic acid content (44.20 mg/100g pulp), 'Mallika' had the highest total flavonoid content (700.00 µg/g), and 'Amrapali' had the highest total carotenoid content (9.10 mg/100g). Genotypes such as 'Malda', 'Safed Malda', and 'Suvarnarekha' exhibited higher shelf life, indicating their potential for use in processing and storage. The genotypes with higher biochemical content are considered to have high ~~neutraceutical~~nutraceutical value. The genotypes that exhibited higher TSS and total sugars can be preferred for juice processing~~, for instance, juice (squash, ready-to-serve etc.). Less sugar is needed to be added externally during product preparation. Overall, the~~ . The superior genotypes ~~that were found to be superior in terms of~~regarding bioactive and fruit-quality compounds can be recommended for fresh consumption. Additionally, the practical utility of these results extends to the quality improvement program and processing industry, where the findings can be used to improve the quality and value of mango products.

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Conflict of interest: The ~~author~~authors declare ~~that they have~~ no conflict of interest.

Reference

Aung, A.M.M. 2019. Evaluation of postharvest quality of mango genotypes during storage. Doctoral thesis, Division of Food Science and Postharvest Technology ICAR-Indian Agricultural Research Institute, New Delhi, India

Akin-Idowu, P.E., U.G. Adebo, K.O. Egbekunle, Y.O. Olagunju, O.I. Aderonmu, and A.O. Aduloju. 2020. Diversity of mango (*Mangifera indica* L.) cultivars based on physicochemical, nutritional, antioxidant, and phytochemical traits in South West Nigeria. Int. J. Fruit Sci. 20 (sup2): S352-S376. https://doi.org/10.1080/15538362.2020.1735601

Berardini, N., R. Carle, and A. Schieber. 2004. ~~Characterization~~Characterisation of gallotannins and benzophenone derivatives from mango (*Mangifera indica* L.) cv. Tommy Atkins peels, pulp and kernels by high-performance liquid chromatography/Electrospray ionization mass spectrometry. Rapid Commun. Mass Spectrom. 18(19): 2208–2216. https://doi.org/10.1002/rcm.1611

Bora, L, A.K. Singh, and C.P. Singh. 2017. Characterization of mango (*Mangifera indica* L.) genotypes based on physio-chemical quality attributes. J. Appl. Sci. 9(4): 2199-2204. https://doi.org/10.31018/jans.v9i4.1510

Dars, A.G., K, Hu, Q. Liu, A. Abbas, B. Xie and Z. Sun. 2019. Effect of thermo-sonication and ultra-high pressure on the quality and phenolic profile of mango juice. Foods 8(8): 298. https://doi.org/10.3390/foods8080298

Drozdz, P., V. Seziene, and K. Pyrzynska. (2018). Mineral composition of wild and cultivated blueberries. Biol. Trace Elem. Res. 181: 173-177. https://doi.org/10.1007/s12011-017-1033-zh

Gentile, C., E. Di Gregorio, V. Di Stefano, G. A. Mannino Perrone, G. Avellone, and V. Inglese Farina. 2019. Food quality and nutraceutical value of nine cultivars of mango (*Mangifera indica* L.) fruits grown in Mediterranean subtropical environment. Food chem. 277: 471-479. https://doi.org/10.1016/j.foodchem.2018.10.109

Hossain, M., M. Rana, Y. Kimura and H.A. Roslan. 2014. Changes in biochemical characteristics and activities of ripening associated enzymes in mango fruit during the storage at different temperatures. BioMed Res. Int. 2014. https://doi.org/10.1155/2014/232969

Hu, K., D Peng, L. Wang, H. Liu, B. Xie and Z. Sun. 2021. Effect of mild high hydrostatic pressure treatments on physiological and physicochemical characteristics and carotenoid biosynthesis in postharvest mango. Postharvest Biol. Technol. 172: 111381. https://doi.org/10.1016/j.postharvbio.2020.111381

Jayarajan, S., R.R. Sharma, S. Sethi, S. Saha, V.K. Sharma, and S. Singh. 2019. Chemical and nutritional evaluation of major genotypes of nectarine (*Prunus persica* var nectarina) grown in North-Western Himalayas. J. Food Sci. Technol. 56: 4266-4273. https://doi.org/10.1007/s13197-019-03896-2

Jhalegar, M.J. R.R. Sharma, and D. Singh. 2014. Antifungal efficacy of botanicals against major postharvest pathogens of ‘Kinnow’ mandarin and their use to maintain postharvest quality. Fruits 69(3)**:** 223-237. https://doi.org/10.1051/fruits/2014012

Kumar, P., S. Sethi, R.R. Sharma, S. Singh, S. Saha, V.K. Sharma, M.K. Verma, and S.K. Sharma. 2018. Nutritional characterization of apple as a function of genotype. J. Food Sci. Technol. 5: 2729-2738. https://doi.org/10.1007/s13197-018-3195-x

Kuria, M.W., J.W. Matofari, and J.M. Nduko. 2021. Physicochemical, antioxidant, and sensory properties of functional mango (*Mangifera indica* L.) leather fermented by lactic acid bacteria. J. Agric. Res. 6: 100206. https://doi.org/10.1016/j.jafr.2021.100206

Lauricella, M., S. Emanuele, G. Calvaruso, M. Giuliano, and A. D’Anneo. 2017. Multifaceted health benefits of *Mangifera indica* L. (Mango): the inestimable value of orchards recently planted in Sicilian rural areas. Nutrients 9(5): 525. https://doi.org/10.3390/nu9050525

Lu, X.H., D.Q. Sun, Q.S. Wu, S.H. Liu, and G.M, Sun. 2014. Physico-chemical properties, antioxidant activity and mineral contents of pineapple genotypes grown in China. Molecules 19(6): 8518-8532. https://doi.org/10.3390/molecules19068518

Parvin, N., A. Rahman, J. Roy, M. H. Rashid, N. C. Paul, M. A. Mahamud, and M. A. Kader. 2023. Chitosan Coating Improves Postharvest Shelf-Life of Mango (*Mangifera indica* L.). Horticulturae 9(1): 64. 4. https://doi.org/ 10.3390/horticulturae9010064

Prasad, K., and R.R. Sharma. 2018. Salicylic acid influences lenticel discolouration and physiological and biochemical attributes of mango (*Mangifera indica* L.) fruits. J. Plant Biochem. Biotechnol. 27: 293-299. https://doi.org/10.1007/s13562-018-0439-9

Prasad, K., G. Singh, S.K. Singh, J. Pradhan, U. Kumar and H. Singh. (2022b). Plant extract and essential oil coating prolongs shelf life and maintains keeping quality of papaya fruit during storage. J. Food Process. Preserv. 46(11): e17015. https://doi.org/10.1111/jfpp.17015

Prasad, K., R.R. Sharma, and M. Srivastav. 2016. Postharvest treatment of antioxidant reduces lenticels discolouration and improves cosmetic appeal of mango (*Mangifera indica* L.)

fruits without impairing quality. J. Food sci. Technol. 53: 2995-3001. https://doi.org/10.1007/s13197-016-2267-z

Prasad, K., R.R. Sharma, M. Srivastava, and R. Asrey. 2020. Relationship between lenticel discoloration and biochemical and quality attributes in mango (*Mangifera indica* L.) fruit. Acta Physiol. Plant. 42: 178. https://doi.org/10.1007/s11738-020-03168-z

Prasad, K., R.R. Sharma, R. Asrey, S. Sethi, M. Srivastav, D. Singh, and A. Arora. 2022a. Hydrocolloid edible coatings extend shelf life, reduce postharvest decay, and maintain keeping quality of mango fruits (*Mangifera indica* L.) under ambient storage. J. Food Biochem : e1441. https://doi.org/10.1111/jfbc.14481

Prasad, K., S. Jacob, and M.W. Siddiqui. 2018. Fruit maturity, harvesting, and quality standards. In Preharvest Modulation of Postharvest Fruit and Vegetable Quality (pp. 41-69). Academic Press. https://doi.org/10.1016/B978-0-12-809807-3.00002-0

Ranganna, S. (1986). Handbook of analysis and quality control for fruit and vegetable products. Tata McGraw-Hill Education.

Rastegar, S., H. Hassanzadeh Khankahdani. M. Rahimzadeh. 2019. Effectiveness of alginate coating on antioxidant enzymes and biochemical changes during storage of mango fruit. J. food biochem. 43(11): e12990. https://doi.org/10.1111/jfbc.12990

Samal, K.C., R.C. Jena, S.S. Swain, B.K. Das, and P.K. Chand. 2012. Evaluation of genetic diversity among commercial cultivars, hybrids and local mango (*Mangifera indica* L.) genotypes of India using cumulative RAPD and ISSR markers. Euphytica 185: 195-213. https://doi.org/10.1007/s10681-001-0522-y

Saroj, N. (2022). Evaluation of postharvest quality of mango genotypes during storage. Master's thesis, Department of Horticulture, Post-Graduate College of Agriculture, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar, India.

Sharma, R.R., M.J. Jhalegar, S.K. Jha, and V. Rana. 2015. Genotypic variation in total phenolics, antioxidant activity, enzymatic activity and quality attributes among kiwifruit cultivars. J. Plant Biochem. Biotechnol. 24: 114-119. https://doi.org/10.1007/s13562-013-0242-6

Singh, S.K., M. Srivastav, J. Prakash, S. Saha, S. Pradhan. 2022. Physico-chemical characterization and biochemical profiling of mango genotypes during different fruit development stages. S. Afr. J. Bot. 149: 476-486. https://doi.org/10.1016/j.sajb.2022.06.023

Sinha, R., U.S. Jaiswal, M.F. Ahmad, P.K. Mishra, and S. Sinha. 2017. Elemental accumulation in mango (*Mangifera indica* L.) as a function of maturity stage and variety. J. Plant Nutr. 40(13): 1805-1815. https://doi.org/10.1080/01904167.2016.1269348

Totad, M.G., R.R. Sharma, S. Sethi, A. Joshi, M.K. Verma, V.K. Sharma, S. Singh, M.K. Dhiman, S. Jaiswal. 2020. Genotypic variability in nutritional and functional attributes of blueberry varieties grown in northern-western Himalayas. J. Food Sci. Technol. 57: 2251-2258. https://doi.org/10.1007/s13197-020-0426-4

Zhao, Y., X. Zhu, Y. Hou, Y. Pan, L. Shi, X. Li. 2021. Effects of harvest maturity stage on postharvest quality of winter jujube (*Zizyphus jujuba* Mill. cv. Dongzao) fruit during cold storage. Sci. Hortic. 277: 109778. https://doi.org/10.1016/j.scienta.2020.109778

Zhisen, J., T. Mengcheng, and W. Jianming. 1999. The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. Food Chem. 6: 555−559. https://doi.org/10.1016/S0308-8146(98)00102-2