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Cultivar Variability in Ascorbic Acid and Malic Acid Content of Mango Fruits

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Abstract

Ascorbic acid and malic acid are important biochemical constituents that influence nutritional value, flavour, acidity, and consumer acceptability of mango (*Mangifera indica* L.) fruits. The present study evaluated the ascorbic acid and malic acid contents of six mango cultivars, namely Alphonso, Pairi, Batalihapus, Narali, Mankur, and Ratna. Significant varietal differences were observed in both biochemical parameters. Narali recorded the highest malic acid content (2998.40 mg/100 g), whereas Alphonso and Narali exhibited the highest ascorbic acid contents (69.72 and 70.87 mg/100 g, respectively). Batalihapus showed the lowest concentrations of both constituents. These variations indicate strong genetic differences among cultivars and demonstrate the importance of biochemical composition in determining fruit quality, nutritional value, and processing potential.

Introduction

Mango (*Mangifera indica* L.) is one of the most important tropical fruit crops, valued worldwide for its unique flavour, aroma, nutritional quality, and economic significance. The biochemical composition of mango fruits is a major determinant of their eating quality, processing suitability, and consumer acceptance. Among the various biochemical constituents, ascorbic acid (vitamin C) and organic acids are considered important quality parameters because they influence nutritional value, antioxidant capacity, taste, and post-harvest characteristics. The concentration of these compounds varies considerably among cultivars owing to genetic factors, environmental conditions, cultural practices, and the stage of fruit maturity (Bally, 2021; Yahia *et al.,* 2019).

Ascorbic acid is an essential water-soluble antioxidant that protects plant tissues from oxidative stress and plays a vital role in photosynthesis, respiration, enzyme activity, cell division, and fruit ripening. From a nutritional perspective, it is an important dietary antioxidant that enhances the health-promoting value of mango fruits by scavenging reactive oxygen species and supporting immune function. Similarly, malic acid is one of the principal organic acids in mango that contributes to fruit acidity, flavour balance, cellular pH

regulation, and respiratory metabolism. During fruit development and ripening, malic acid serves as an important substrate for metabolic processes and significantly influences sweetness–acidity balance, an important attribute determining consumer preference (Patel, *et al.,* 2022).

The biochemical composition of mango fruits differs widely among cultivars because of variations in genetic makeup and physiological behaviour. Therefore, comparative evaluation of ascorbic acid and malic acid provides valuable information for identifying nutritionally superior cultivars, understanding fruit quality attributes, and selecting genotypes suitable for fresh consumption, processing, and breeding programmes. The present investigation was undertaken to estimate the ascorbic acid and malic acid contents of six important mango cultivars-Alphonso, Pairi, Batalihapus, Narali, Mankur, and Ratna-and to evaluate their biochemical variability in relation to fruit quality and nutritional significance.

Material and Methods

Ascorbic acid

A known weight of finely chopped flesh was properly blended with 15 ml of 3 percent meta phospharic acid in a mortar with pestle. After macerating, the contents were transferred into 100 ml volumetric flask and volume was made up to the mark with 3 percent metaphosphoric acid. A known volume of aliquot of the filtrate was titrated against 0.025 per cent 2, 6-dichlorophenol indophenol dye solution to a faint pink end point which persisted for 15 seconds (Association of Vitamim Chemists, 1966).

Malic acid

Reagents such as 10 percent $CaCl_2$, 0.1N HCl, 1N NaOH, and phenolphthalein indicator are used for the malic acid titration process. A known weight of sample was crushed with distilled water and made volume 100 ml. To this, 10 ml of 10 percent $CaCl_2$ and few drops of ammonia were added and the solution was filtered, after one hour. Then the filtrate was evaporated to 25 ml and then 75 ml of alcohol was added. The mixture was then heated to boiling and filtered. The precipitate obtained was washed with 75 percent alcohol and dried and ignite. The ash of the precipitate was boiled with excess of 0.1 N HCl and back titrated with 0.1 N NaOH. Blank titration was carried out using the same volume of 0.1 N HCl as that used for the sample.

Results and Discussion

The biochemical composition of mango fruits varied significantly among the six cultivars studied, indicating cultivar-specific differences in vitamin C and organic acid accumulation. Ascorbic acid is an important antioxidant that contributes to nutritional quality, while malic acid is one of the principal organic acids responsible for fruit acidity, flavour balance, and metabolic activity during fruit development and ripening.

Among the cultivars, Narali recorded the highest ascorbic acid content (70.87 mg/100 g), followed closely by Alphonso (69.72 mg/100 g). Pairi also contained relatively high ascorbic acid (54.87 mg/100 g), whereas Batalihapus exhibited the lowest concentration (25.52 mg/100 g) represents in

table 1 and figure 1. The elevated vitamin C content in Narali and Alphonso indicates their superior antioxidant potential and nutritional value. Ascorbic acid functions as a powerful antioxidant, protecting cellular structures against oxidative damage while participating in respiration, photosynthesis, enzyme activation, and fruit ripening. Higher vitamin C concentration also enhances consumer preference and increases the health-promoting properties of mango fruits. Similar cultivar-dependent variation in ascorbic acid has been reported in recent investigations, where genetic background and environmental conditions were identified as major determinants of vitamin C accumulation (Bally, 2021; Yahia *et al.,* 2019).

Malic acid content also differed markedly among cultivars. Narali exhibited the highest concentration (2998.40 mg/100 g), followed by Mankur (2078.65 mg/100 g), Ratna (1920.91 mg/100 g), Alphonso (1534.14 mg/100 g), Pairi (1334.49 mg/100 g), and Batalihapus (815.09 mg/100 g) showed in table 1 and figure 1. Organic acids play a significant role in determining fruit taste, maintaining cellular pH, regulating respiration, and influencing post-harvest quality. Higher malic acid concentration contributes to a pleasant sweet-acid balance and provides substrates for respiration during ripening. The exceptionally high malic acid content of Narali suggests greater metabolic activity and enhanced flavour complexity compared with other cultivars. Previous studies have demonstrated that the concentration of organic acids declines progressively during ripening because they are utilized as respiratory substrates, although considerable differences remain among cultivars due to genetic variation (Sivankalyani et al., 2016; Lalel et al., 2020).

Alphonso combined high ascorbic acid with moderate malic acid concentration, producing a favourable balance between sweetness and acidity. This biochemical composition may contribute to the characteristic aroma, flavour, and premium market value of Alphonso mangoes. Pairi also contained appreciable vitamin C but comparatively lower acidity, suggesting suitability for fresh consumption. In contrast, Batalihapus recorded the lowest values for biochemical constituents, indicating comparatively lower antioxidant capacity and reduced organic acid content.

Table 1: Variability in ascorbic acid and malic acid content in fruit pulp of some mango cultivars

Cultivars	Alphonso	Pairi	Batalihapus	Narali	Mankur	Ratna
Ascorbic acid (mg/100g)	69.72	54.87	25.52	70.87	29.88	29.86
Malic acid (mg/100g)	1534.14	1334.49	815.09	2998.40	2078.65	1920.91

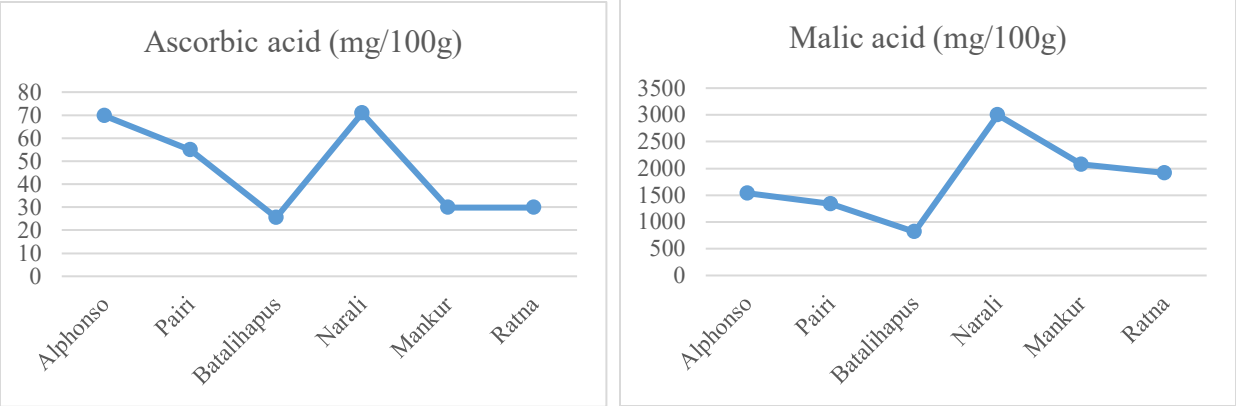


Figure 1: Ascorbic and malic acid content in different mango cultivars

Conclusion

Overall, the results demonstrate considerable biochemical diversity among mango cultivars. Narali appears to possess superior nutritional quality because of its high vitamin C and malic acid contents, whereas Alphonso maintains an optimal balance between antioxidant capacity and fruit acidity that contributes to its exceptional eating quality. These findings emphasize the importance of biochemical characterization in cultivar selection, breeding programmes, nutritional evaluation, and quality improvement of mango. the data indicate that cultivars with higher ascorbic acid do not necessarily possess proportionally higher malic acid, except in Narali. Ascorbic acid primarily reflects antioxidant capacity and nutritional quality, whereas malic acid largely determines fruit acidity, flavour balance, and respiratory metabolism. Their combined evaluation provides a more comprehensive assessment of fruit quality than either parameter alone. Cultivars such as Narali and Alphonso combine desirable biochemical characteristics, making them valuable for fresh consumption, processing, and breeding programmes aimed at improving nutritional quality and consumer acceptability.

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