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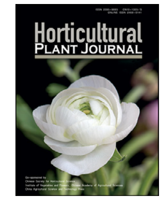


Original article

# Tree age affects postharvest attributes and mineral content in Amrapali mango (*Mangifera indica*) fruits

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A B S T R A C T

The study was carried out to investigate the effect of tree age on postharvest attributes and mineral content of Amrapali mango fruits. Effect of 3 different tree ages (6, 18 and 30 years) on functional components, including the antioxidant activity (AOX), total phenols, total carotenoids, ascorbic acid and minerals like Ca, K, Mg, Fe, Zn, Cu, Mn and B along with total sugars, total soluble solids (TSS) and titratable acidity (TA), respiration rate, polygalacturonase (PG) and pectin methylesterase (PME) activities in Amrapali cultivar were studied. With tree ageing total phenols, ascorbic acid and antioxidant activity decreased whereas total carotenoids increased. Ca diminished and K elevated with the tree age progression while, B, Fe, Cu, Zn, and Mn showed an indefinite pattern. Total soluble solids and total sugars were recorded higher in 18 year old Q3 tree fruits. Fruit respiration rate, polygalacturonase and pectin methylesterase activities showed an upward trend with tree ageing. The study indicates that fruit produced from middle age group mango orchard (18 year old) suits to the requirement of consumers as well as industry.

*Keywords:* Mango (*Mangifera indica*); Tree age; Functional parameter; Mineral

## 1. Introduction

Mango is the most important tropical fruit crop belonging to the botanical family Anacardiacae. Due to its delicate taste, pleasant aroma and high nutritional value it is considered as King of fruits. India is the largest mango producing country in the world. Mango contributes around 20.7% of total fruit production in the country with annual production of 18.43 million tonnes (Anonymous, 2015).

There are many pre-harvest factors which affect production, quality and storage life of mango fruits. These are cultivars (Seymour et al., 1990), orchard soil management, irrigation water (Duran-Zuazo et al., 2004), rootstock (Dayal et al., 2016), foliar application of nutrients (Sarker and Rahim, 2013; Karemera and Habimana, 2014; Taha et al., 2014), canopy management (Lal and Mishra, 2007; Asrey et al., 2013), micro leaf area near fruits, bagging (Wu et al., 2013; Haldankar et al., 2015), vegetative vigor of tree, position of fruit on tree (Kawphaitoon et al., 2016), harvesting stage (Baloch and Bibi, 2012), use of growth regulators (Tandel and Patel, 2011), and insect pests of mango fruit (Whitney et al., 1990; Ketsa et al., 1992; Whiley and Schaffer, 1994; Maqbool and Mazhar, 2007). The different influences of these pre-harvest factors have been investigated for enhancing mango production by researchers world over.

Above reviews reflect that in the past majority of researchers were focused on enhancing production and productivity of mango crop. In the era of consumer awareness toward healthy foods, the quantity aspect has taken backseat and quality food production with enhanced functionality is now remaining a key challenge for researchers.

The sound postharvest management is one of the weak clinch in Indian mango supply chain and above all quality aspects have virtually remained neglected. There are few reports that tree age also affects the nutritive properties and storage physiology of harvested fruits. Old trees of guava showed decline in mineral absorption and accumulation which significantly affected the physicochemical properties and mineral content of guava fruits (Asrey et al., 2007). Khalid et al. (2012) reported that Kinnow fruits harvested from young (3 year old) tree were rich in high rag mass, rind mass, ascorbic acid, non-reducing sugar, rind manganese

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and iron content as compared to 6, 18 and 35 year old trees. Tree age factors influenced the pomological parameters of olive fruits and physiochemical characteristics of virgin olive oil (Bouchaala et al., 2014). Young trees of orange produced poor quality fruits than the older tree (Hearn, 1993). Fruit tree age also affected fruit yield and physical characteristics of pummelo (Nakorn and Chalumpak, 2016) and apple fruits (Arshad et al., 2014). Ozeker (2000) reported that fruits of 20 year old "Marsh Seedless" grapefruit produce heavier fruit with thin rind of superior quality (juice content, total soluble solids and acidity) as compared to fruits of 34 year old trees. Tree age affected acid content of juice and total soluble solids of Satsuma mandarin (Matsumato et al., 1972).

In Asian nations; particularly in South Asian countries, around 30% mango orchards are too old and in senile condition which ultimately affect productivity and quality (Baba et al., 2011). Amrapali is the first commercialized mango hybrid having distinctly dwarf stature, regular and prolific bearer, precocious in nature which is highly suitable for high-density planting (Majumdar et al., 1982; Singh, 1996). The pulp of Amrapali is deep orange-red color which may be used for preparing mango nectar and juice and has about 2.5–3.0 times higher carotene content than its parents (Singh et al., 2001, 2012). This study attempts to find the effect of tree age on the postharvest quality attributes and mineral content of Amrapali mango fruits.

## 2. Materials and methods

### 2.1. *Experimental site*

The study was conducted during July-August (peak harvesting time of Amrapali mango) at the experimental farm of Indian Agricultural Research Institute, New Delhi, India. The experimental farm is situated at 28°8′ N and 77°12′ E at an elevation of 229 m above mean sea level.

### 2.2. *Selection of tree age group*

The mango trees were selected from three different age groups (6, 18 and 30 years) grafted on local seedling rootstock (sourced from a single mother plant) and planted at the recommended spacing of 2.5 m × 2.5 m in the experimental orchard. These three tree age groups are important for mango crop as trees start to bear fruits at the age of 5–6 years and their productivity reaches at peak between 15–18 years afterwards it enters into declining phase after 25–30 years.

### 2.3. *Fruit sample*

Fruits were randomly harvested from ten selected trees at commercial maturity stage having total soluble solids (TSS) ~10%. From each age group uniform size (average weight 230 g per fruit) and healthy fruits free from diseases and insect infestation were selected; thoroughly de-sapped and surface cleaned with tissue paper. Fruits from each age group were divided into three separate lots, each having 160 fruits for analysis of various functional and nutritional parameters.

### 2.4. *Study parameters*

#### 2.4.1. *Physical parameters*

The specific gravity of mango fruits/stone was calculated by dividing the weight of the fruit/stone by the volume of the fruits/stone as recorded by water displacement method. Mango stones were obtained by removing peel and pulp of the fruits followed by rinsing in potable water and wiping with tissue paper in order to remove free moisture.

Fruit firmness was determined by using a texture analyzer (Model: TA+Di, Stable microsystems, UK) under compression test adopted by Jha et al. (2010). Each fruit was compressed using a cylindrical probe (2 mm diameter) having a programmed setting for speed as pre-test, test and post-test speed as 5, 2 and 10 mm/s respectively with probe distance of 10 mm. It was measured at three places (top, mid and bottom) of the individual fruit and expressed as mean of three values. First peak force Newton (N) in the force-deformation curve was taken as firmness of the sample.

For computing stone/pulp ratio, the pulp was separated from both peel and stone with the help of knife and peeler. The mango pulp and stone were individually weighed. The ratio was determined by dividing the weight of stone by weight of pulp. Peel thickness of fresh fruits was measured by digital vernier caliper (Precision 150 Digital Caliper, India). For this, the pulp was carefully removed from the peel with minimum damage or scrapping to the peel. Fruit peel thickness was measured at three places (top, mid and bottom) and mean value was expressed in millimeter.

#### 2.4.2. *Biochemical parameters*

Total soluble solids (TSS) content was determined by using hand refractometer (Model: PAL-3, ATAGO, Japan) as suggested by Ranganna (1999). Hand refractometer prism was carefully washed with double distilled water and wiped with tissue paper. Juice of mango was extracted by straining of pulp with the muslin cloth. Then two drops of juice were placed on the prism and corresponding refraction index was read and expressed as %. Percent titratable acidity was determined by taking 10 g mango pulp. Ten milliliter of filtered fruit juice was titrated with standard sodium hydroxide (0.1 mol $L^{-1}$) using phenolphthalein as an indicator for each sample (AOAC, 2006). Q5

Similarly, total sugars (%) were determined by taking 50 mL aliquot filtered mango juice titrated with boiling Fehling's solution using methylene blue indicator till brick red color appeared (AOAC, 2006).

#### 2.4.3. *Physiological parameters*

The fruit respiration rate was estimated by adopting the static headspace technique using gas analyzer (Model: Checkmate 9900 $O_2/CO_2$, PBI Dansensor, Denmark) followed by Barman and Asrey (2014), and results were expressed as mL $CO_2$ $kg^{-1}$ $h^{-1}$.

Pectin methylesterase (PME) activity was measured by following the method of Hagerman and Austin (1986), and expressed as μmol $min^{-1}$ $g^{-1}$ FW. Polygalacturonase (PG) activity was determined by following the method of Lazan et al. (1995) and expressed as μg galacturonic acid $g^{-1}$ $h^{-1}$ FW.

#### 2.4.4. *Functional parameters*

The analysis of total phenols was carried out by Folin-Ciocalteu spectrophotometric method suggested by Singleton and Rossi (1965). Total carotenoids were estimated by the colorimetric method on the spectrophotometer (Model: Jasco V-670 UV-VIS-NIR spectrophotometer, Japan) as suggested by Roy (1973). Total phenols and total carotenoids were calculated and expressed in μg gallic acid $g^{-1}$ and mg $kg^{-1}$ pulp respectively. The antioxidant activity was determined by cupric reducing antioxidant capacity method followed by Apak et al. (2004) and

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