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# Response of Mineral Constituents and Storability of the Postharvest Mango (*Mangifera indica L.)* to Different Storage Treatments

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**Abstract:** Efficacy of storage treatments, namely control, paraffin coating, perforated polyethylene cover, unperforated polyethylene cover, hot water (55±1 $^0$C) and low temperature (4±1 $^0$C) on behavioral pattern of mineral constituents and storability of the two postharvest mango genotypes (*viz.*, Langra and Khirshapat) was examined in the sophisticated laboratory of SRDI, Rajshahi, Bangladesh during the period from June, 2011 to September, 2012. The results of the investigation obtained from genotypes appeared predominant variation in terms of most of the characters studied in the laboratory situation. The Langra enriched a greater amount of P, Mg, Fe and Mn over the Khirshapat and the process of enrichment was gradually increased with the advance of storage period up to the last edible stage. The Khirshapat showed a greater performance in producing of Ca, Cu and Zn, and longer shelf life in comparison with the Langra at all the storage times. The mineral constituents of mango pulp were also changed during storage period. Low temperature (4±1 $^0$C) was found to be more effective in retaining the original green color of mangos for a period of time, but it caused chilling injury and fruits did not ripen at all after removal from low temperature. Paraffin coating was assumed to be better in retarding the ripening process of the postharvest mango, which might be easily adopted by common people for the mango storage.

**Key words:** Genotypes, Mango, Minerals, Storage treatments, Storability

## Introduction

The mango (*Mangifera indica* L.) is one of the most important fruit crops and recognized as the 'King's Fruit' in tropical and subtropical regions of the world. It contains plenty of vitamins and mineral constituents which might be used as good sources of nutrition for human body (Fawaz, 2006). Minerals are very important constituents for improvement of the quality and growth of mango, effective for brain cells development and other physiological activities in human being (Pal, 1998). The storability is also very important consideration for the storage of mango because it is climacteric in nature and highly perishable (Benitez *et al.*, 2006). A considerable amount of fresh mango fruits goes waste every year through postharvest decay (Muy *et al.*, 2004). The magnitude of post harvest decay in fresh fruit is estimated to be about 5 to 25% in developed countries and 20 to 50% in developing countries (Khader, 1985). The controlling of fruit ripening using suitable storage treatments *viz*., wax coating, perforated polyethylene cover, unperforated polyethylene cover, hot water and low temperature are very efficient for enzymatic inhibition (Tefera *et al.*, 2007). Postharvest decay causes a huge amount of economic loss that hampers the total GDP in a country (Fonseca *et al.*, 2004). Therefore, the present study was undertaken to investigate the behavioral pattern of nutrient constituents and shelf life of the postharvest mango.

## Materials and Methods

### *Experimental materials and design*

Mature but green of two mango genotypes, namely the Langra and the Khirshapath picked out for experimental materials were assembled from one of the highest mango growing areas of Kansat of Shibgonj Upazila of Chapai Nowabgonj district, Bangladesh and other components used as storage treatments *viz.*, paraffin coating and polyethylene cover were bought from Royal Scientific shop at cooperative market of Rajshahi city. The mango genotypes were treated with different storage treatments *viz.* control, paraffin coating (PC), perforated polyethylene cover (PPC), unperforated polyethylene cover (UPC), hot water (HW) (55±2 $^0$C) and low temperature (LT) (4±1 $^0$C) in the laboratory of the Department of Biochemistry and Molecular Biology, University of Rajshahi, Bangladesh. The experiment consisted of two factors and assigned in randomized complete block design with three replicates. The short description of the Langra and the Khirshapat are stated bellow.

### *Langra*

The Langra is one of the most popular and the best quality mid mango genotypes in Bangladesh. Its skin color is light green to light yellow at ripening stage. Mesocarp is yellowish, aromatic, tasteful, sweetest and fibreless. Peel color is light green and stone is small in size. It is on an average of 9.7 cm in length, 7.3 cm in width and 5.2 cm in high as well as average weight of 314.10 gm. The sweetest is about 19.7%. Edible portion of this type is approximately 73.1%. It is a seasonal fruit. Ripening stages of this variety is the last of June and available in the market in the month of July. Average yield is good.

***Khirshapat***

The Khirshapat is also a popular genotype produced early in Bangladesh. It is medium and oval shaped genotypes having 8.6 cm long, 7.5 cm wide and 6 cm high on an average. The skin color is light yellow and pulp is yellowish. It is very sweet, succulent, attractive flavor and fibreless. The sweetest of this type is approximate 18.4%. This fruit is somewhat wide and hard like and stone is lighter. Edible portion of this variety is 67.2%. Stage of ripening starts from first week of June. Overall, yield is good but irregular.

***Preparation of storage treatments***

Solid paraffin wax was made liquid by heating in a large aluminum pot. The 19 cm × 15 cm sized polyethylene covers were perforated with scissors at nine equal positions and some of another 19 cm × 15 cm sized polyethylene covers were not perforated and used as unperforated polythelene cover. The tap water was heated in a hot water bath ($55 \pm 2\ ^0$C) for a period of 5 minutes. The mangoes were stored in a refrigerated incubator at $4\pm1\ ^0$C temperature. The temperature of the refrigerated incubator was maintained by adjusting the button on the incubator.

***Application of storage treatments***

The fruits were treated with different prepared storage treatment and kept on brown paper in three blocks. Each block contained twelve treatments in which six fruits were arranged in an individual treatment, one was put aside to record the shelf life and the remaining five fruits were preserved in a deep refrigerator (-85 $^0$C) covered with an extra polyethylene bags at the laboratory to record the data periodically at five different dates at 3 days' intervals. Five mangos from individual treatment of each block were chemically analyzed.

***Determination of different minerals***

Mineral constituents of mango pulp were determined using a scientific method (Petersen, 2002). Ground mango pulp was digested and P, Ca, Mg, Cu, Fe, Mn and Zn were released by digestion with nitric acid, and Ca, Mg, Cu, Fe, Mn and Zn were determined by Atomic Absorption Spectrophotometer (AAS) while P was determined by Ultra Violet Spectrophotometer (UVS).

***Preparation of plant sample***

Drying: The weighed mango pulp was dried in an oven at 105 $^0$C and the moisture content was determined following the conventional method. The dried pulp was stored in an airtight plastic container for experimental purposes.

***Grinding***

The dried material was ground in a mortar with pestle. These were further kept in an oven at 105 $^0$C overnight for the absorption of moisture.

***Digestion procedure***

1. Ground pulp material (0.3 g) was taken into digestion tube. The two remaining tubes were blank. Five ml of 68% nitric acid was added to each of all the 40 tubes. The content was mixed in each tube and kept undisturbed overnight. The tubes were placed in the digester and covered with the exhaust manifold. The temperature was set at 125 $^0$C. The digester was turned on and the digestion was continued for 4 hours after boiling had started. It was observed that no tubes became dry.

2. After cooling, the digestion mixture was completely transferred to a 200 ml volumetric flask and its volume was made up with distilled water. It was mixed well and then filtered through a dry filter into a dry bottle which could be closed with a screw cap. The filtrate was thereafter kept in a closed bottle and used for estimation of minerals.

***Measurement of phosphorus***

Five ml of diluted filtrate was transferred to a 50 ml volumetric flask and approximately 30 ml of distilled water was added to it and mixed well. Then, 10 ml of ammonium molybdate- ascorbic acid solution was added and made volume up to the mark with water and mixed well. After 15 minutes, the absorbance was measured on a Spectrophotometer at 890 nm.

***Measurement of calcium***

Twenty ml of diluted filtrate was transferred into a 50 ml volumetric flask. Five ml of $LaCl_3$ solution was added and made up to the volume with water and mixed well. Then, Ca was measured by atomic absorption spectrometer.

***Measurement of magnesium***

The filtrate (5 ml) was taken in a 50 ml volumetric flask, the $LaCl_3$ solution (5 ml) was added and made up to the mark with water and mixed well. The amount of Mg was measured by Atomic Absorption Spectrometer.

***Standard***

Two ml of each standard solution was taken in a plastic bottle and treated similarly as described above for standard reading.

***Calculation of P, Ca and Mg***

Amount of P, Ca and Mg was determined by the following formula: mg per kg mango pulp= $\frac{a \times 25000}{b \times c}$, where, a = mg of P, Ca or Mg per litre measured on Atomic Absorption Spectrophotometer, b = ml of diluted filtrate and c = g

of ground pulp material taken into the digestion tube (Petersen, 2002)

***Measurement of Cu, Fe, Mn and Zn***

The content of Cu, Fe, Mn and Zn were measured by AAS directly in the undiluted filtrate. For additional dilution was done if needed, the result was multiplied with the dilution factors.

***Calculation of Cu, Fe, Mn and Zn***

The quantities of Cu, Fe, Mn and Zn were determined by the following formula: mg per kg mango pulp= $\frac{d \times 200}{c}$, where, d = mg of Cu, Fe, Mn or Zn per litre measured on Atomic Absorption Spectrometer and c = g of ground pulp material taken into the digestion tube (Petersen, 2002)

***Shelf life***

The shelf life of mango genotypes was calculated by counting the days required to ripen fully without being optimum marketing and eating qualities.

***Statistical analysis***

Data were induced to analyze of variance method (ANOVA). The mean values of different parameters were compared using DMRT and LSD was also used in case of graphical representation (Gomez and Gomez, 1984).

## Results and Discussion

***Effect of genotypes on mineral constituents and storability***

The variation was found to be significant in terms of all the mineral constituents and the shelf life of the postharvest mango at different storage periods (Fig 1. and Fig 2.). The Langra produced higher quantities of P, Mg, Fe and Mn as compared to the Khirshapat, but the mineral elements were gradually increased in the mango with the passes of storage period up to 9 days, thereafter it declined. The Khirshapat showed a greater quantity of Ca than the Langra and the mineral elements also gradually increased with longer storage periods (Fig 1. and Fig 2.). In case of Cu and Zn of the mango pulp, the Khirshapat accumulated more quantities than that of the Langra, but the quantities of these two mineral elements decreased with the increase of storage period (Fig 2.).

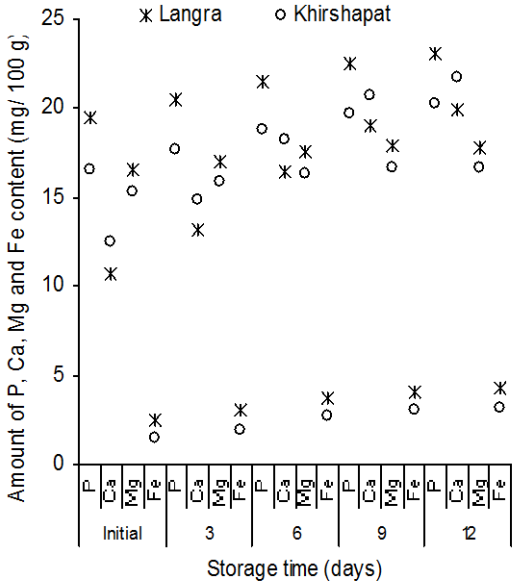


**Fig 1.** Quantitative status of P, Ca, Mg and Fe constituents in the two postharvest mango genotypes at different days of storage

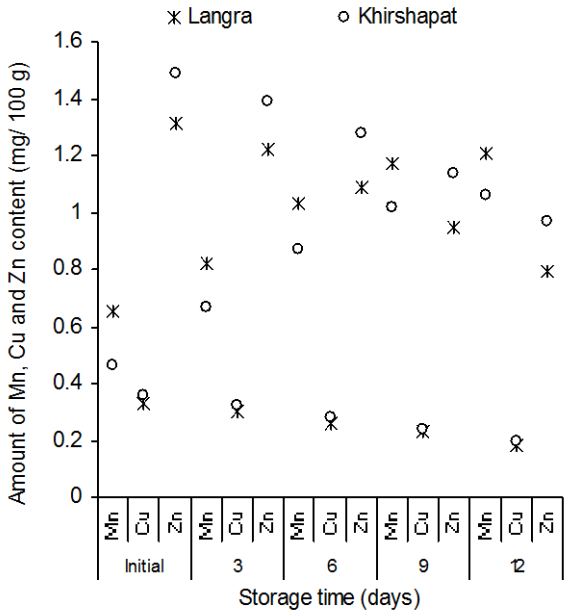


**Fig 2.** Amount of Mn, Cu and Zn constituents in the two postharvest mango genotypes at different days of storage

More or less a greater accumulation of mineral elements (P, Mg, Fe and Mn) was observed in the Langra to a certain stage of the storage times, but thereafter it declined, which might be due to rottening and metabolic activities. The results of the present investigation are strongly supported by the previous reports (Peter et al., 2007; Islam et al., 2011). A greater quantity of Ca in the Khirshapat was partially supported by the preceding findings (Nadkarni, 1963) when he worked with different genotypes of mango

fruits and found different results. The decreasing behavior of Cu and Zn in the mango pulp was reported by the former findings (Islam et al., 2011). The shelf life of the postharvest Langra and Khirshapat ranged between 15.22 to16.44 days, respectively (Fig 6.). Sugar content was enriched in a greater amount in the Khirshapat during storage which might have enhanced shelf life. Normally, sugar acts as a preservative in the mango (Islam, 2008). An extended storage life of the Khirshapat observed during storage is also in agreement with the foresaid findings (Azad, 2001).

***Effect of storage treatments on mineral constituents and storability***

The general trend of the development of P, Ca and Mg in the mango pulp with induced different storage treatments is shown in Fig 3. The development rate of P was found to be higher in the control at 6$^{th}$ day of storage, and thereafter it decreased owing to spoilage and transmission. The highest increasing trend of Ca was observed in the control up to 9 days of storage, and then its content decreased possibly due to spoilage. The amount of Mg was more or less similar at the initial stage of storage, but after 3 days, its content significantly increased and then, it declined. The lowest increasing trend of P, Ca and Mg was recorded from Low temperature. The amount of Fe augmented markedly during storage. The highest increase of Fe was obtained from control and the lowest trend was obtained from low temperature. The green mango contained lower quantities of Mn over the ripened mango. The amount of Mn in the green mango increased gradually during the storage period. The increasing trend was found to be higher in control up to 6 days, thereafter it decreased. The amount of Mn of the fruits treated with LT was noticed to accumulate lower followed by the other treated fruits (Fig 4.). The amount of Cu and Zn was found to be higher in the green mango at the initial storage period from all the treated fruits, and thereafter, it decreased with the advance of storage times. The maximum decreasing trend was observed in control and the minimum was recorded from low temperature (Fig 5.). The Increasing behavior of P in the mango pulp at initial period of the storage and thereafter its decreasing trend owing to spoilage and transmitting were not supported by the prior findings (Peter et al., 2007). But, they strongly supported the occurrence of Ca, Mg and Fe transmission in the mango. An increase accumulation of Ca in the mango pulp was formerly reported (Kupferman, 1988). The decrease of Cu may be accounted for by the probability that it acts as a catalyst and passes from pulp to other portion during the metabolic process. The results are in agreement with the preceding reports (Peter et al., 2007; Morton 1987; Paul and Southgate 1978). The increasing behavior of Mn and decreasing behavior of Zn in the mango pulp during storage are strongly supported by the earlier findings (Islam *et al.,* 2011).

The shelf life of postharvest treated and untreated mango fruits is shown in Fig 6. The shelf life of the mango fruit was significantly dependent upon different storage treatments. The longest shelf life (36.50 days) was recorded from the fruits treated with low temperature and the shortest (7.17 days) was recorded from control. Longer shelf life obtained from the fruit treated with low temperature might be due to the inhibition of ethylene synthesis. Inhibition of enzymatic activities retarded the ripening process which delayed the process of decay. The results are in conformity with the former findings (Tefera *et al.*, 2007; Bentaz et al., 2006; Fawaz, 2006). Durigan et al. (2004) also found similar results. Wanlapha *et al.* (1980) observed longer shelf life of mangos when they worked with mangos under preservation at low temperature.

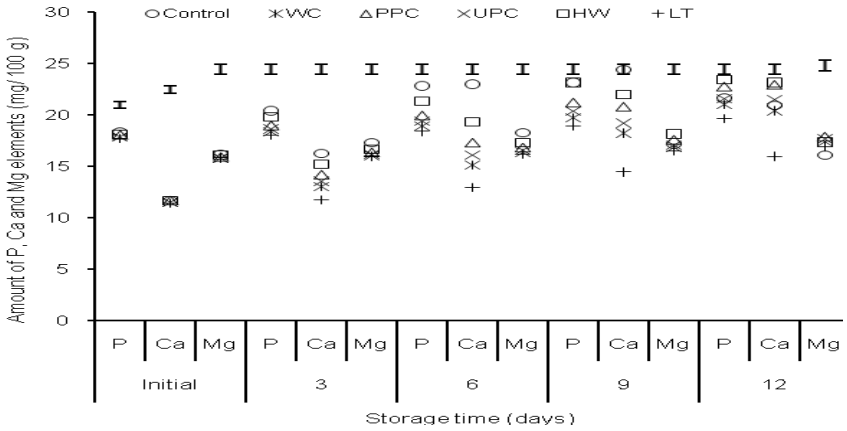


**Fig 3.** Phosphorus, calcium and magnesium components of mango pulp influenced by different storage treatments at different days of storage. Vertical bars represent LSD at 0.05 levels.

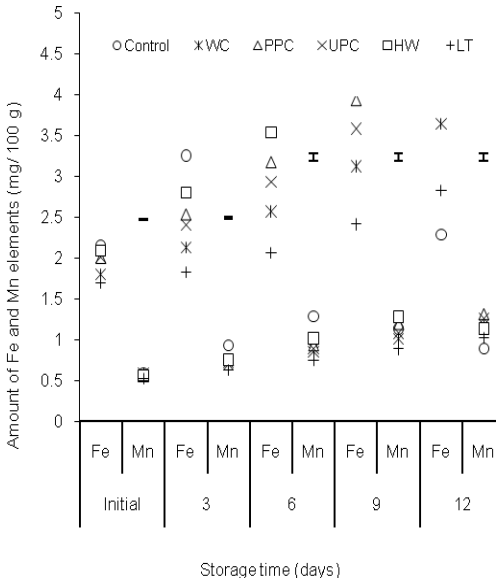


**Fig 4.** Iron and manganese content of mango pulp influenced by different storage treatments at different days of storage. Vertical bars represent LSD at 0.05 levels

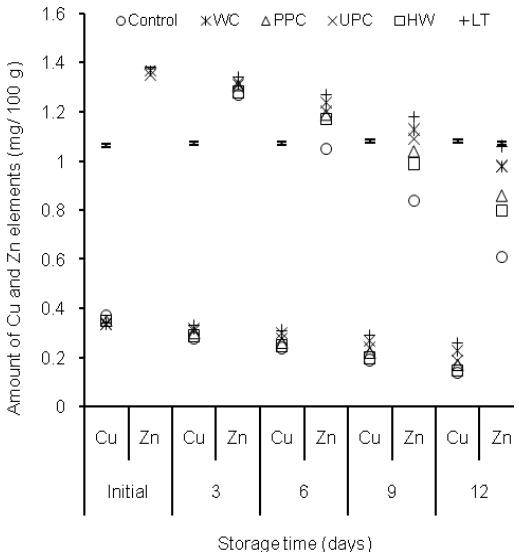


**Fig 5.** Copper and zinc status of the postharvest mango pulp influenced by different storage treatments at different days of storage. Vertical bars represent LSD at 0.05 levels

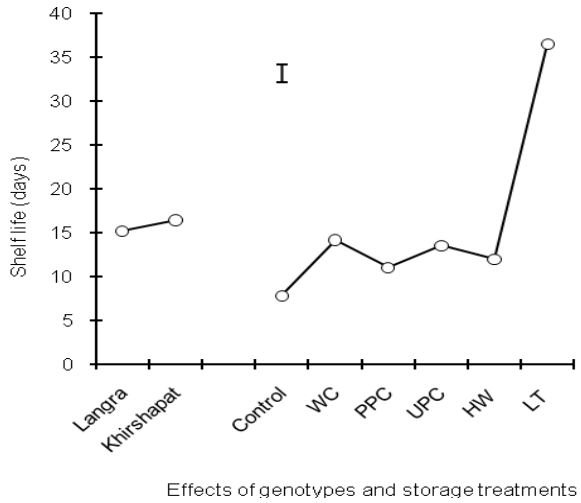


**Fig 6.** Shelf life of the two postharvest mango genotypes. Influence of different storage treatments on the postharvest life of mango. Vertical bars represent LSD at 0.05 levels

***Combined effects of genotypes and storage treatments on mineral constituents and storability***

The treatment combination of the Langra using control significantly increased P (Table 1.) and Mg (Table 3.), and also slightly augmented Ca (Table 2.), Fe (Table 5) and Mn (Table 6.) followed by the Khirshapat with low temperature with the advance of storage period up to the last edible stage. On the other hand, Cu (Table 4.) and Zn (Table 7.) content decreased slowly and accumulated a lower amount from different treatment combination with the passing of storage times. The results of the present study are in agreement with the previous findings of (Islam et al., 2011). The Khirshapat treated with low temperature showed longer storability (38 days) whereas shorter (7.33 days) was observed from the Langra using no treatment, but the mangos treated with low temperature (4±1 $^{o}$C) were found to be deeply shrinkage condition(Table 7.).

**Table 1.** Combined effects of genotypes and different storage treatments on phosphorus content of the postharvest mango pulp

| Treatment combination | | Phosphorus content (mg 100 g $^{-1}$) at different days | | | | |
|---|---|---|---|---|---|---|
| Genotypes | Treatments | Initial | 3 | 6 | 9 | 12 |
| Langra | Control | 19.75 | 21.87 a | 24.29 a | 24.62 a | 23.13 c |
| | WC | 19.45 | 19.98 d | 20.52 e | 21.36 f | 22.62 d |
| | PPC | 19.55 | 20.46 c | 21.43 c | 22.66 c | 24.22 b |
| | UPC | 19.35 | 20.08 d | 20.84 d | 21.83 e | 22.98 c |
| | HW | 19.65 | 20.85 b | 22.38 b | 24.23 b | 24.49 a |
| | LT | 19.25 | 19.58 e | 19.92 g | 20.44 g | 21.06 g |
| Khirshapat | Control | 16.85 | 18.95 f | 21.38 c | 21.72 e | 20.21 h |
| | WC | 16.35 | 16.86 j | 17.39 j | 18.22 j | 19.47 i |
| | PPC | 16.65 | 17.55 h | 18.52 h | 19.79 h | 21.35 f |
| | UPC | 16.45 | 17.18 i | 17.94 i | 18.89 i | 20.12 h |
| | HW | 16.58 | 18.75 g | 20.28 f | 22.13 d | 22.38 e |
| | LT | 16.22 | 16.62 k | 16.96 k | 17.48 k | 18.25 j |
| Level of significance | | NS | *** | *** | *** | *** |
| CV% | | 0.58 | 0.55 | 0.52 | 0.49 | 0.48 |

**Table 2.** Combined effect of genotypes and different storage treatments on calcium content of the postharvest mango pulp

| Treatments combination | | Calcium content (mg 100 g $^{-1}$) at different days | | | | |
|---|---|---|---|---|---|---|
| Genotypes | Treatments | Initial | 3 | 6 | 9 | 12 |
| Langra | Control | 10.75 | 15.32 | 22.12 | 23.52 | 20.13 |
| | WC | 10.65 | 12.16 | 14.28 | 17.39 | 19.62 |
| | PPC | 10.82 | 13.34 | 16.45 | 19.92 | 22.05 |
| | UPC | 10.72 | 12.75 | 15.25 | 18.34 | 20.63 |
| | HW | 10.85 | 14.34 | 18.45 | 21.15 | 22.23 |
| | LT | 10.62 | 10.92 | 12.13 | 13.64 | 15.16 |
| Khirshapat | Control | 12.58 | 17.14 | 23.86 | 25.27 | 21.78 |
| | WC | 12.45 | 13.95 | 16.07 | 19.18 | 21.29 |
| | PPC | 12.62 | 15.12 | 18.24 | 21.73 | 23.86 |
| | UPC | 12.42 | 14.45 | 16.95 | 20.05 | 22.36 |
| | HW | 12.53 | 16.08 | 20.18 | 22.87 | 24.11 |
| | LT | 12.36 | 12.65 | 13.85 | 15.36 | 16.86 j |
| Level of significance | | NS | NS | NS | NS | NS |
| CV% | | 0.90 | 0.74 | 0.60 | 0.52 | 0.50 |

Mean values having the same letter(s) in a column are not significantly different as per DMRT at 5% level.

**Table 3.** Combined effects of genotypes and different storage treatments on magnesium content of the postharvest mango pulp

| Treatments combination | | Magnesium content (mg 100 g $^{-1}$) at different days | | | | |
|---|---|---|---|---|---|---|
| Genotypes | Treatments | Initial | 3 | 6 | 9 | 12 |
| Langra | Control | 16.85 a | 17.95 a | 18.92 a | 17.82 | 16.72 |
| | WC | 16.35 e | 16.62 d | 16.95 f | 17.43 | 17.94 |
| | PPC | 16.45 de | 16.88 c | 17.35 d | 18.21 | 18.52 |
| | UPC | 16.55 cd | 16.75 cd | 17.14 e | 17.65 | 18.24 |
| | HW | 16.75 ab | 17.25 b | 17.92 b | 18.73 | 17.94 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | LT | 16.65 bc | 16.72 cd | 16.94 f | 17.25 | 17.65 |
| Khirshapat | Control | 15.52 f | 16.64 d | 17.65 c | 16.55 | 15.49 |
| | WC | 15.36 f | 15.58 g | 15.92 i | 16.39 | 16.92 |
| | PPC | 15.45 f | 15.89 f | 16.38 h | 17.03 | 17.34 |
| | UPC | 15.15 g | 15.65 g | 16.04 i | 16.55 | 17.15 |
| | HW | 15.45 f | 16.08 e | 16.75 g | 17.58 | 16.79 |
| | LT | 15.15 g | 15.32 h | 15.53 j | 15.84 | 16.23 |
| Level of significance | | *** | * | * | NS | NS |
| CV% | | 0.65 | 0.63 | 0.61 | 0.60 | 0.63 |

**Table 4.** Combined effects of genotypes and different storage treatments on copper content of the postharvest mango pulp

| Treatments combination | | Copper content (mg 100 g $^{-1}$) at different days | | | | |
|---|---|---|---|---|---|---|
| Genotypes | Treatments | Initial | 3 | 6 | 9 | 12 |
| Langra | Control | 0.35 | 0.27 | 0.23 | 0.18 | 0.13 |
| | WC | 0.32 | 0.31 | 0.29 | 0.26 | 0.22 |
| | PPC | 0.33 | 0.29 | 0.25 | 0.21 | 0.16 |
| | UPC | 0.32 | 0.30 | 0.27 | 0.23 | 0.18 |
| | HW | 0.34 | 0.28 | 0.24 | 0.19 | 0.14 |
| | LT | 0.33 | 0.32 | 0.30 | 0.28 | 0.24 |
| Khirshapat | Control | 0.38 | 0.29 | 0.25 | 0.20 | 0.14 |
| | WC | 0.36 | 0.33 | 0.31 | 0.28 | 0.24 |
| | PPC | 0.37 | 0.31 | 0.27 | 0.22 | 0.17 |
| | UPC | 0.35 | 0.32 | 0.29 | 0.25 | 0.20 |
| | HW | 0.36 | 0.30 | 0.26 | 0.21 | 0.15 |
| | LT | 0.35 | 0.34 | 0.32 | 0.30 | 0.27 |
| Level of significance | | NS | NS | NS | NS | NS |
| CV% | | 3.00 | 3.41 | 3.18 | 4.44 | 5.58 |

Mean values having the same letter(s) in a column are not significantly different as per DMRT at 5% level.

**Table 5.** Combined effects of genotypes and different storage treatments on iron content of the postharvest mango pulp

| Treatments combination | | Iron content (mg 100 g $^{-1}$) at different days | | | | |
|---|---|---|---|---|---|---|
| Genotypes | Treatments | Initial | 3 | 6 | 9 | 12 |
| Langra | Control | 2.65 | 3.74 | 5.24 | 4.69 | 2.74 |
| | WC | 2.35 | 2.68 | 3.11 | 3.66 | 4.18 |
| | PPC | 2.55 | 3.08 | 3.72 | 4.48 | 5.12 |
| | UPC | 2.49 | 2.92 | 3.44 | 4.09 | 4.72 |
| | HW | 2.59 | 3.32 | 3.94 | 4.66 | 5.25 |
| | LT | 2.25 | 2.38 | 2.63 | 2.98 | 3.42 |
| Khirshapat | Control | 1.65 | 2.75 | 4.25 | 3.72 | 1.82 |
| | WC | 1.25 | 1.58 | 2.02 | 2.57 | 3.09 |
| | PPC | 1.45 | 1.97 | 2.62 | 3.38 | 4.02 |
| | UPC | 1.52 | 1.88 | 2.42 | 3.07 | 3.74 |
| | HW | 1.59 | 2.28 | 3.12 | 3.84 | 4.16 |
| | LT | 1.12 | 1.26 | 1.48 | 1.83 | 2.22 |
| Level of significance | | NS | NS | NS | NS | NS |
| CV% | | 5.32 | 4.19 | 3.26 | 2.91 | 2.81 |

**Table 6.** Combined effects of genotypes and different storage treatments on manganese content of the postharvest mango pulp

| Treatments combination | | Manganese content (mg 100 g $^{-1}$) at different days | | | | |
|---|---|---|---|---|---|---|
| Genotypes | Treatments | Initial | 3 | 6 | 9 | 12 |
| Langra | Control | 0.68 a | 1.02 a | 1.37 | 1.22 | 0.98 |
| | WC | 0.66 bc | 0.77 d | 0.92 | 1.08 | 1.25 |
| | PPC | 0.64 d | 0.82 b | 1.03 | 1.25 | 1.38 |
| | UPC | 0.65 cd | 0.79 c | 0.96 | 1.14 | 1.32 |
| | HW | 0.67 ab | 0.82 b | 1.08 | 1.33 | 1.19 |
| | LT | 0.62 e | 0.72 e | 0.84 | 0.98 | 1.12 |
| Khirshapat | Control | 0.49 g | 0.83 b | 1.18 | 1.03 | 0.79 |
| | WC | 0.52 f | 0.63 h | 0.78 | 0.94 | 1.11 |
| | PPC | 0.45 hi | 0.68 f | 0.82 | 1.12 | 1.24 |
| | UPC | 0.44 i | 0.65 g | 0.82 | 1.01 | 1.19 |
| | HW | 0.46 h | 0.69 f | 0.95 | 1.22 | 1.08 |
| | LT | 0.42 j | 0.52 i | 0.64 | 0.77 | 0.92 |
| Level of significance | | *** | *** | NS | NS | NS |
| CV% | | 1.86 | 1.55 | 5.72 | 4.77 | 4.60 |

Mean values having the same letter(s) in a column are not significantly different as per DMRT at 5% level.

**Table 7.** Combined effects of genotypes and different storage treatments on zinc content and shelf life of the postharvest mango pulp

| Treatments combination | | Zinc content (mg 100 g $^{-1}$) at different days | | | | | Shelf life |
|---|---|---|---|---|---|---|---|
| Genotypes | Treatments | Initial | 3 | 6 | 9 | 12 | Total days |
| Langra | Control | 1.35 | 1.19 | 0.97 | 0.75 | 0.52 j | 7.33 f |
| | WC | 1.28 | 1.21 | 1.14 | 1.04 | 0.88 g | 13.67 cd |
| | PPC | 1.32 | 1.23 | 1.11 | 0.96 | 0.78 h | 10.67 e |
| | UPC | 1.27 | 1.22 | 1.12 | 1.01 | 0.91 f | 13.33 d |
| | HW | 1.33 | 1.20 | 1.04 | 0.86 | 0.67 i | 11.33 e |
| | LT | 1.28 | 1.25 | 1.18 | 1.09 | 0.98 d | 35.00 b |
| Khirshapat | Control | 1.55 | 1.35 | 1.13 | 0.92 | 0.69 i | 8.33 f |
| | WC | 1.45 | 1.42 | 1.34 | 1.22 | 1.08 b | 14.67 c |
| | PPC | 1.48 | 1.38 | 1.26 | 1.12 | 0.94 e | 11.33 e |
| | UPC | 1.43 | 1.39 | 1.28 | 1.17 | 1.04 c | 13.67 cd |
| | HW | 1.52 | 1.36 | 1.30 | 1.12 | 0.92 ef | 12.67 d |
| | LT | 1.48 | 1.43 | 1.36 | 1.26 | 1.14 a | 38.00 a |
| Level of significance | | NS | NS | NS | NS | ** | * |
| CV% | | 3.73 | 4.00 | 4.39 | 4.99 | 2.37 | 4.36 |

Mean values having the same letter(s) in a column are not significantly different as per DMRT at 5% level.

The results of the present study are in agreement with the former findings ( Islam, 2008) and the more or less the similar results were observed from the preceding investigation (Azad, 2001).

## Conclusion

The two mango genotypes, used in the experiment, namely the Langra and the Khirshapat are very nutritious, tasteful and popular fruits in Bangladesh. But the nutritional qualities between genotypes vary in manifold. Comparatively, the Langra enriches in plenty of mineral elements over the Khirshapat. Different mineral elements in both the genotypes are not found in constant and rather these have been changed with the advance of storage period. On the contrary, the Khirshapat demonstrates a better performance in storability over the Langra. However, further investigation is needed for obtaining information regarding the mineral sources from where and why mineral constituents are being enriched or discharged in mango pulp during storage.

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