COMPARATIVE STUDIES ON THE PERFORMANCE OF TWO COMMERCIAL MANGO CULTIVARS UNDER AMBIENT RIPENING CONDITIONS

BY

ISHTIAQ AHMAD, AMAN ULLAH MALIK, MUHAMMAD AMIN, AND RAHEEL ANWAR
Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan
Email: malikaman1@yahoo.com

ABSTRACT
Characterization and development of mango cultivars remains a major focus to boost its market potential in different regions of the world. Pakistan, being an important mango producing country, possesses some ancient indigenous mango cultivars including Anwar Ratole and Chaunsa (Samar Bahisht). The objective of the present study was to evaluate and compare the post harvest quality performance of two cultivars Anwar Ratole and Chaunsa under ambient conditions (28±1°C; 65-70% RH). Analysis of fruit firmness, physiological weight loss (%), fruit color and bio-chemical characteristics (TSS, acidity, sugars, vitamin C, and carotenoids) were performed on daily basis. Both the cultivars took seven days to ripe however; Anwar Ratole expressed better storage performance (lower softness score) under ambient conditions. Studies revealed comparatively higher values of titratable acidity, reducing sugars and lower values for visual peel colour and physiological weight loss, for Anwar Ratole as compared to Chaunsa. Organoleptic evaluation at ripening showed preference for Chaunsa, which had a TSS/acid ratio of 98 against 63 of Anwar Ratole at ripe stage. Both cultivars exhibited higher physiological weight loss during 4th and 5th days of ripening. Most rapid changes from day-1 to day-2 of ripening occurred in vitamin C and TSS in both cultivars. From day-4 to day-5 of ripening, there was rapid decrease in acidity in Anwar Ratole; while a fast increase in total sugars was recorded from day-5 to day-6 in both the cultivars. Results of the study will help to understand the ripening behavior of these two important commercial cultivars of Pakistan and will lead to a series of storage studies under different temperature regimes in future.

KEYWORDS: Mangifera indica; Post harvest, Fruit Quality, Vitamin C, Pakistan

INTRODUCTION
Mango (Mangifera indica L.) is the most important tropical fruit having great demand in international market (Jha et al., 2007). Reputed as fruit par excellence, mango has assumed a leading position among commercial fruits (Singh 2004). At least 87 countries of the world produce mangoes. By continents, the main producer is Asia with 76.9% of the total world production (Rathore et al., 2007). Pakistan ranks third in terms of mango production in Asia after India and China, whereas, world wide the leading exporters are Mexico, the Philippines and Pakistan (Galán Saúco, 2004). More than 260 varieties have been reported to exist in Pakistan (Anonymous, 1965). However, presently 10-15 ancient cultivars like Malda, Anwar Ratole, Dusehri, Langra, Chaunsa, Fajri (Amin and Hanif, 2002) and few relatively recent ones like White Chaunsa, Black Chaunsa and Late Ratole No.12 are cultivated commercially. Chaunsa and Anwar Ratole are the two leading commercial cultivars of Pakistan and are in great demand in local as well as international markets.
Despite the commercial importance of Chaunsa and Anwar Ratole, little post harvest studies have been done locally for the two cultivars. The objective of present study was to evaluate and compare the performance of Anwar Ratole and Chaunsa under ambient conditions (28±1°C; 65-70% RH) with a view to investigate physico-chemical changes during ripening.

**MATERIALS AND METHODS**

120 fruits of each mango cultivar (i.e. Anwar Ratole and Chaunsa) were harvested from a commercial orchard in Multan (Punjab, Pakistan). For practicable comparison, fruits at normal harvest maturity were selected randomly from several healthy trees of uniform age (25 years) avoiding misshapen, bruised and diseased ones. Fruits after harvesting were washed with tap water (pH=7), air dried, packed in corrugated card board boxes, transported and stored (28±1°C; RH 65-70%) at Post harvest Research Laboratory, Institute of Horticultural Sciences (IHS), University of Agriculture, Faisalabad. The fruits were divided into two groups viz ten fruits were taken as treatment unit for physical studies while for biochemical analysis five fruits were taken as treatment unit and both were replicated thrice.

**Physical Analysis**

The fruits were assessed for physiological weight loss, manual firmness and visual peel color.

**Weight Loss:** Fruit weight was recorded with the help of standard top loaded balance and physiological fruit weight loss was calculated according to the equation:

\[
\text{PWL} (\%) = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100
\]

**Skin Colour:** Skin colour development was scored according to the following scale: 0=100% Green & 0% Yellow; 1=75% Green & 25%Yellow; 2= 50% Green & 50% Yellow; 3 = 25% Green & 75% Yellow; 4= 0% Green & 100%Yellow.

**Textural Softness:** Textural softening was scored using the following scale: 1= Hard; 2= Sprung; 3= Slightly Soft; 4= Eating Soft; 5= Over Ripe

**Bio-chemical Analysis**

Longitudinal slices of fruit pulp were used to extract juice with the help of standard commercial juicer. The juice was homogenized before determining total soluble solids with the help of digital refractometer (Atago, Japan), titratable acidity (TA) through titration against N/10 NaOH, vitamin C by using the procedure stated by Ruck (1961), sugars by Lane and Eynon Method (1923) as described by Hortwitz (1960), while total carotenoids were measured according to the procedure described by Lalel (2003).

**Organoleptic Evaluation**

A Panel of 25 judges was made for organoleptic analysis after nine point’s hedonic scale as reported by Larmond (1987) and fruit characteristics such as peel and flesh color, taste, flavor, texture and aroma were recorded.

**Statistical Analysis**

Analysis of variance (ANOVA) was preformed according to completely randomized design (CRD) along with factorial arrangements by using MSTATC (MSTATC, Michigan, USA). Tukey’s Least Significant (LSD) was used to test the significant difference at the 95% confidence level of each variable.

**RESULTS AND DISCUSSION**

The results regarding different physico-chemical characteristics of both cultivars (Anwar Ratole and Chaunsa) are described in Table-1.
In this study, fruits of both Anwar Ratole and Chaunsa exhibited higher PWL during 4th and 5th days of ripening and relatively higher values were recorded in Chaunsa (2.29%). Higher weight loss in Chaunsa may be due to its bigger fruit size as compared to Anwar Ratole that caused elevated surface evaporation (Doreyappa-Gowda and Hudder, 2001).

Major quality parameter that contributes toward attraction of fruit is its clean physical appearance and attractive color while better firmness makes it suitable for transportation to distant export markets with increased shelf life. Fruit firmness and skin color are important indicators of ripening. In this experiment, trends for manual firmness and visual color observations in the two cultivars were statistically significant. After third day of storage, fruit firmness decreased at higher rates and cultivar Anwar Ratole and Chaunsa attained a score of 4.0 (eating soft) and 3.7 on 6th day of ripening respectively. In another study, Carrillo et al. (2000) reported that fruit ripening in mango varies from variety to variety and depends upon storage conditions. It varies from 4 to 8 days at ambient temperature. A change in peel color is regarded as maturity indicator (Mizrach et al., 1997). In the present study, peel color was observed as a dependent factor on cultivar type and ripening temperature. Standard peel color of the two cultivars did not develop at ripening and the final scores were recorded as 2.9 and 3.3 out of 5.0 for Anwar Ratole and Chaunsa respectively. It may be due to relatively low ambient temperature (28±1°C) than optimum required by the two cultivars for standard color development which needs to be further investigated. Overall, both the cultivars took seven days to ripe. The fruits of Chaunsa cultivar exhibited better peel colour development whereas the fruits of Anwar Ratole had comparatively lower softness at ripe stage under ambient conditions.

**Bio-chemical Characteristics**

Bio-chemical analyses showed significant changes during ripening under ambient conditions except total soluble solids (TSS) and total carotenoids (TC). Both titratable acidity (TA) and vitamin C (VC) expressed decreasing trend during storage while, TSS, TS (Total sugars) and TC were found to be increased (Table 1). Srinivasa et al. (2002) also found similar trend in Alphonso mango either packed in carton or control, expressing 2.17% to 0.08% TA on 12th day when stored at ambient temperature of 27°C. Anwar Ratole expressed higher TA (1.9%) value during early days of ripening as compared to Chaunsa, whereas highest values for TSS (26.72%) and total sugars (25.88%) were observed in Chaunsa during sixth and seventh day of ripening (Table 1). The increase in TSS was correlated with increase in TS and was in accordance with studies on other mango cultivars (Selvaraj et al. 1989; Ueda et al. 2000). In terms of overall post harvest changes, day-2 proved to be most critical with highest changes in both TSS and vitamin C. In cultivar Anwar Ratole, acidity was sharply reduced from day-4 to day-5 of ripening, followed by a rapid increase in total sugars from day-5 to day-6. In Chaunsa cultivar, the increase of total sugars had similar pattern as in Anwar Ratole, the decrease in acidity was gradual. This appears to be a characteristic feature of the individual cultivar. A positive correlation was observed between the color development and TC increments in both the cultivars. The loss of green color is the obvious change in mango during ripening probably due to the breakdown of chlorophyll and increase in carotenoid pigments (Rathore et al., 2007).

**Organoleptic Characteristics**

Hedonic scale taste panel results revealed statistically significant. Obvious preference for Chaunsa cultivar for all the parameters (peel and flesh color, taste, flavor, texture and aroma) was observed as shown in Fig. 1. Highest points (6.63) were recorded for 'taste' characteristic of ripe Chaunsa fruit which were mainly due to sugar acid ratio as perceived by specialized taste buds on the tongue. This was confirmed by comparing the TSS/acid ratio of both cultivars which was 98 for Chaunsa compared to 63 in Anwar Ratole.

**CONCLUSION**

For better post harvest management as well as developing new varieties with desirable characteristics, complete understanding of varietal performance from physiological and qualitative perspectives is very important. The above studies show the dynamics of physico-chemical changes as well as quality characteristic of both cultivars.
Within first 48 hours of ripening, the most significant changes occurred in TSS and vitamin C, while total sugars increased sharply from day-5 to day-6 of ripening at ambient temperature in both cultivars. Overall, the storage performance of Anwar Ratole was better at ambient temperature; however, fruit peel colour was better developed in cultivar Chaunsa. On the basis of the results, future studies on storage performance, temperature optimization and better colour development are suggested.

ACKNOWLEDGEMENTS
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Table-1: Comparative physical and bio-chemical Analysis of Anwar Ratole and Chaunsa mango cultivars ripened at ambient temperature (28±1°C RH 65-70%)

<table>
<thead>
<tr>
<th>Varieties</th>
<th>DAH</th>
<th>TA</th>
<th>VC</th>
<th>TSS</th>
<th>TS</th>
<th>RS</th>
<th>NRS</th>
<th>TC</th>
<th>VPC</th>
<th>FRM</th>
<th>PWL</th>
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<tr>
<td>Anwar Ratole</td>
<td>1</td>
<td>1.90a</td>
<td>82.92a</td>
<td>12.62</td>
<td>8.91h</td>
<td>2.66cde</td>
<td>6.33gh</td>
<td>33.99</td>
<td>1.0j</td>
<td>1.04jk</td>
<td>0.00h</td>
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<td></td>
<td>2</td>
<td>1.90a</td>
<td>64.10b</td>
<td>17.49</td>
<td>9.47h</td>
<td>2.68cde</td>
<td>6.79g</td>
<td>42.72</td>
<td>1.07ij</td>
<td>1.22i</td>
<td>1.93d</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.80a</td>
<td>45.27c</td>
<td>17.30</td>
<td>8.63h</td>
<td>2.89bc</td>
<td>5.74h</td>
<td>25.27</td>
<td>1.53h</td>
<td>1.82g</td>
<td>1.90d</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1.82a</td>
<td>24.88de</td>
<td>19.0</td>
<td>11.92fg</td>
<td>2.69cde</td>
<td>8.96f</td>
<td>37.39</td>
<td>1.83g</td>
<td>2.26f</td>
<td>1.99c</td>
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<tr>
<td></td>
<td>5</td>
<td>0.55bc</td>
<td>17.71de</td>
<td>25.20</td>
<td>12.69f</td>
<td>3.30a</td>
<td>9.39f</td>
<td>42.42</td>
<td>2.33e</td>
<td>3.44d</td>
<td>2.02c</td>
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<td></td>
<td>6</td>
<td>0.46cd</td>
<td>14.38de</td>
<td>26.37</td>
<td>22.47c</td>
<td>2.85bcd</td>
<td>19.67c</td>
<td>36.43</td>
<td>2.75d</td>
<td>3.78c</td>
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<td>7</td>
<td>0.42de</td>
<td>12.87e</td>
<td>26.47</td>
<td>26.45a</td>
<td>2.94b</td>
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<td>32.31</td>
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<tr>
<td></td>
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<td>0.60b</td>
<td>65.52b</td>
<td>11.24</td>
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<td>8.84f</td>
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<td>3</td>
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<td>Chaunsa</td>
<td>4</td>
<td>0.31efg</td>
<td>28.91d</td>
<td>22.50</td>
<td>15.21e</td>
<td>2.69cde</td>
<td>12.52e</td>
<td>51.11</td>
<td>2.10f</td>
<td>2.74e</td>
<td>1.52f</td>
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<td></td>
<td>5</td>
<td>0.29fge</td>
<td>27.57de</td>
<td>23.95</td>
<td>18.29d</td>
<td>2.18g</td>
<td>16.11d</td>
<td>69.99</td>
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<td>3.83c</td>
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<td>20.49de</td>
<td>26.75</td>
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<td>21.95b</td>
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<tr>
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<td>17.57de</td>
<td>26.72</td>
<td>25.88a</td>
<td>2.27fg</td>
<td>23.61a</td>
<td>49.07</td>
<td>3.33a</td>
<td>4.26a</td>
<td>1.77e</td>
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<td>LSD Values</td>
<td></td>
<td>0.12</td>
<td>15.02</td>
<td>NS</td>
<td>1.14</td>
<td>0.24</td>
<td>1.03</td>
<td>NS</td>
<td>0.12</td>
<td>0.11</td>
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</table>

DAH= Days after harvest; TA=Titratable Acidity (%); VC=Vitamin C (mg/100ml); TSS= Total Soluble Solids (°Brix); TS= Total Sugars (%); RS= Reducing Sugars (%); NS= Non Reducing Sugars (%); TC= Total Carotenoids (ug/g); VPC= Visual Peel Color; FRM= Fruit Firmness; PWL= Physiological Weight Loss (%)

Fig.1: Organoleptic analysis of Anwar Ratole and Chaunsa ripened under ambient (28±1°C; 65-70% RH) temperature
REFERENCES


