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Effect of Picking Time on Physical and Chemical Characteristics of Sweet Orange

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ABSTRACT

Sweet orange (*Citrus sinensis*) is a delicious and nutritious citrus fruit much liked by the people. Changes in physical and chemical composition of five sweet orange varieties viz, Musambi, Blood Red, Jaffa, Pine apple and Salustiana were studied with time. The fruits were harvested during the months of December, January and February. Fruit weight of Musambi and Pine apple was decreased from 188 to 147 g and 194 g to 173 g, respectively, and increased in all other varieties. Similarly the peel and pulp percentage was also increased significantly while the juice percentage was decreased significantly from 49% to 40%. The quality parameters like pH, titratable acidity, total soluble solids and ascorbic acid significantly increased with time.

Key Words: Sweet orange varities; Picking time; Nutritional quality

INTRODUCTION

Sweet oranges are harvested early due to lack of information about quality improvement with time, while the export is regulated according to the quality standards. Early and immature harvest may reduce the quality of the fruits and ultimately the return of the farmer and a national loss. It has been reported that weight and juice contents of sweet orange and size of kinnow increased with maturity (Jawanda, 1964; Joolka & Awasthi, 1980; Cepeda *et al.*, 1993). It was also reported that rind thickness reduced with maturity and ripening in Hamlin and Valencia late oranges (Sinha *et al.*, 1962). Bakhshi *et al.* (1967) reported that total soluble solids (TSS) decreased in Valencia late when harvesting was delayed beyond Ist March. In case of kinnow, TSS progressively increased towards maturity (Khan *et al.*, 1992). Unlike TSS acid contents of citrus, fruits generally decrease towards maturity. *Sinha et al.* (1962) and Cepeda *et al.* (1993) observed that ascorbic acid contents decreased with time or maturity of Valencia late. The present study describes the proper time of picking of various sweet orange varieties.

MATERIALS AND METHODS

Changes in quality parameters like fruit weight, peel, pulp and juice percentage, pH, TSS, titratable acidity and ascorbic acid of five sweet orange varieties i.e. Muasmbi, Blood Red, Jaffa, Pine apple and Salultiana were studied when stored on trees. The fruit samples were collected from the fruit garden at Barani Agricultural Research Institute Chakwal by the Horticulturist in the months of December, January and February. These fruit samples were brought to the Biochemistry section, Ayub Agricultural Research Institute, Faisalabad and analysed in the laboratory. Ten fruit samples from each variety were taken for physical and chemical analyses. The juice was extracted with citrus juicer, TSS were determined with hand refrectrometer, acidity by titration against 0.1N NaOH and ascorbic acid by titration against oxalic acid (AOAC, 1990)

RESULTS AND DISCUSSION

Physical properties of the fruits:

Fruit weight. The fruit weight was significantly increased with time in all varieties except Musambi and Pine apple (Table I). The weights were higher in the month of February. These results are similar to that of Jawanda (1964) who reported greater fruit volume of sweet oranges harvested after 15 November up to the end of January. Cepeda *et al.* (1993) also reported an increase in fruit weight with harvesting date. The increase in weight might be due to accumulation of photosynthates in fruits (Khan *et al.*, 1992).

Juice contents. Data shows that juice contents significantly decreased with harvesting date (Table I). The juice percentage in all the varieties except Blood Red was higher when harvested in December and gradually lowered in January and February. Maximum reduction (34%) in juice contents with time was observed in Salustiana variety. The juice percentage in Blood Red was maximum when fruits were picked in January.

Table I. Effect of picking time on physical properties of sweet orange varieties

Varieties/ Parameters	Picking time December	January	February	Mean
Fruit weight(gm)				
Musambi	187.7 ef	163.1 h	146.3 i	165.8 d
Blood Red	180.8 f	183.2 f	203.5 d	189.1 b
Jaffa	183.5 f	184.6 f	209.1 cd	192.1 b
Pine Apple	194.0 e	173.2 g	165.3 h	177.5 c
Salustiana	211.8 c	224.8 b	240.9 a	225.8 a
Mean	183.7 b	192.0 a	194.7 a	
Juice (%)				
Musambi	48.9 c	42.8 e	35.5 g	42.4 c
Blood Red	44.8 e	48.3 c	49.9 bc	47.7 a
Jaffa	47.9 cd	46.8 cd	39.8 f	44.9 b
Pine Apple	49.0 c	45.1 de	39.9 f	44.7 b
Salustiana	55.8 a	52.6 b	36.8 g	48.4 a
Mean	49.2 a	47.5 b	40.0 c	
Peel (%)				
Musambi	27.7 def	29.9 abc	31.6 ab	29.7 a
Blood Red	26.9 ef	28.1 cdef	29.7 bcd	28.2 b
Jaffa	24.8 g	27.7 def	31.8 a	28.1 b
Pine Apple	22.2 h	24.3 g	28.7 cde	25.1 c
Salustiana	22.2 h	26.3 fg	28.3 cdef	25.6 c
Mean	25.2 c	26.8 b	30.0 a	
Pulp (%)				
Musambi	23.4 e	27.5 cd	33.1 b	27.9 b
Blood Red	25.8 d	22.0 ef	22.1 ef	23.3 d
Jaffa	23.0 e	27.3 cd	27.9 c	26.1 c
Pine Apple	26.2 cd	31.4 b	32.7 b	30.1 a
Salustiana	20.5 f	22.4 ef	35.0 a	25.9 c
Mean	25.0 b	25.1 b	29.9 a	

Table II. Effect of picking time on chemical properties of sweet orange varieties

Varieties	Picking time December	January	February	Mean
pH				
Musambi	4.52 a	4.24 b	4.12 cd	4.30 a
Blood Red	3.23 i	3.62 g	3.88 e	3.57 d
Jaffa	3.25 i	3.67 fg	4.05 d	3.65 c
Pine Apple	3.36 h	3.71 fg	4.14 c	3.74 b
Salustiana	3.38 h	3.74 f	4.05 d	3.72 b
Mean	3.57 c	3.77 b	4.07 a	
Acidity (%)				
Musambi	0.29 j	0.51 i	0.69 h	0.50 e
Blood Red	0.95 a	0.86 b	0.85 bcd	0.89 a
Jaffa	0.85 bc	0.79 efg	0.79 fg	0.81 c
Pine Apple	0.81 def	0.77 b	0.68 h	0.76 d
Salustiana	0.83 cd	0.85 bc	0.83 cde	0.84 b
Mean	0.74 b	0.76 a	0.77 a	
TSS (%)				
Musambi	9.0 cd	9.5 bcd	12.0 a	10.2 a
Blood Red	8.5 d	9.0 cd	9.0 cd	8.7 b
Jaffa	9.0 cd	9.0 cd	9.5 bcd	9.2 b
Pine Apple	8.5 d	9.0 cd	9.5 bcd	9.0 b
Salustiana	10.5 b	10.0 cd	9.5 bcd	10.0 a
Mean	9.1 b	9.3 b	9.9 a	
Vitamin C mg 100 g^{-1}				
Musambi	51.9 efg	56.2 de	58.7 cd	55.6 b
Blood Red	57.9 cd	50.4 fgh	46.8 h	51.7 c
Jaffa	49.6 gh	50.6 fgh	54.4 def	51.5 c
Pine Apple	62.5 bc	63.8 b	65.1 a	63.8 a
Salustiana	50.3 fgh	54.6 def	56.2 de	53.7 bc
Mean	54.0 b	55.6 b	58.2 a	

Peel and pulp percentage. The peel percentage significantly increased with time in all varieties (Table I). The peel percentage increased from 25 to 30% which means that the peel got thicker with passage of time. The pulp also increased significantly with time (Table IV). When the varieties were compared, Blood Red had maximum juice and minimum pulp percentage followed by Salustiana. Musambi had minimum juice and maximum pulp percentage and was most affected with time of harvesting.

Chemical changes in fruits:

pH. The pH of sweet oranges juice was significantly increased with the date of harvesting (Table II). This increase in pH was observed in all the varieties except Musambi, in which pH decreased with time. Moreover, pH was also higher in Musambi juice when compared with other varieties. These results are similar to that of Cepeda *et al.* (1993), who reported increased pH in Valencia late with harvesting date.

Acidity. The acidity of Musambi juice increased significantly in contrast to pH with time (Table II). In all other varieties acidity decreased significantly with time. The acidity was maximum in the month of December. A maximum increase (from 0.29 to 0.69%) in acidity was observed in Musambi, while it decreased in other varieties, and remained unchanged in Salustiana. On an average maximum acidity was found in Blood Red and minimum in Musambi. The decrease in acidity of different varieties with time may be due to the accumulation of sugars in the juice.

Total soluble solids (TSS). The TSS increased significantly with harvesting time except Salustiana in which it decreased with time (Table II). During December and January ,TSS remained similar and increased in the month of February except Salustiana. Highest TSS (10.2%) were found in Musambi followed by Salustiana (10.0%) Jaffa (9.2%) Pine apple (9.0%) and Blood Red (8.7%). Ahmad *et al.* (1992) also found an increase in TSS with time in grape fruits.

Vitamin C. Vitamin C content of fruit juice increased with increase in harvesting time in all varieties except Blood Red in wich it decreased with time (Table II). The vitamin C contents were found maximum in February in most of sweet orange varities. However, in Blood Red it increased from 50.4 to 57.9 mg 100 g^{-1} in January and then decreased to 46.8 mg 100 g^{-1} when the fruits were harvested in February. Cepeda *et al.* (1993) and Sinha *et al.* (1962) also reported decrease in ascorbic acid contents of Valencia late with maturity.

REFERENCES

Ahmad, M., J. Maqbool, M Ijaz and M.Z. Kayani., 1992. Chemical changes in grape fruits (Citrus paradise MACF) during maturation and storage. *J. Agric. Res.*, 30: 489-94.

AOAC, 1990. *Official Methods of Analysis.* Association of Official Analytical Chemists.

Bakhshi, J.C., G. Singh and K.K. Singh, 1967. Effect of time of picking on fruits quality and subsequent cropping of valencia late variety of sweet oranges (*C. sinensis*). *Indian J. Hort.*, 24: 63-70.

Cepeda, J.S., R. Baez-Sanndo, M. Angulo, J. Duron, J. Nunez, E. Bringas and M. Baez , 1993. Ascorbic acid and quality losses of valencia oranges stored on tree. *Hort Sci..*, 28: 581.

Jawanda, J.S., 1964. Maturity standard for sweet oranges. *Pb. Fr. J.*, 26/27: 207-10.

Joolka, N.K. and R.P. Awasthi, 1980. Studies on maturity standards of kinnow in Himachal Pradesh. *Pb. Hort. J.*, 20: 149-51.

Khan, M. I., M. J. Ahmad, M. Maqbool and M.Z. Kayani, 1992. Physical changes occurring in grape fruit (Citrus paradise MACF) during maturation and ripening. *J.Agric. Res.*, 30: 359-63.

Sinha, R.B., G.S. Randhawa and W.L.Jain, 1962. Seasonal changes in Hamlin and valencia late oranges. *Indian J. Agric.Sci.*,32: 149-62.

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