Changes in chemical characteristics of peach (cv. TA-170) fruits at different growth stages

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Introduction

The cultivar TA-170 is a low chilled peach variety, imported from U.S and was named as Partap in India, which require only 100-400 chilling hours during the year for proper flowering and fruiting. It is large fruited with average weight of 61.96 g and the fleshy mesocarp adheres to the stone (clingstone). The taste of the fruit is sweet, aromatic and rich in flavour (Singh *et al.*, 2007).

The studies were conducted on seven years old peach plants cv. TA-170. The trees were selected on the basis of their uniform growth, vigour, productivity and free from insect and pest attack. These trees were grown under rainfed conditions and spaced at 4x4m distance and trained to open centre system. The research was laid out at Horticultural Research farm, ICAR Research Complex for NEH Region, Umiam (Meghalaya).

Fruit sample collection-The steps undertaken for collection of fruit samples:-

1. When plant came to flowering, the flowers of the same age group were tagged.
2. Regular observations were made on the growth and development of fruit.
3. Fruit samples were collected from these tagged plants.

Stages of harvesting

The fruits were harvested in the following Days After Fruit Set (DAFS)

1. 50 DAFS (D_1)
2. 55DAFS (D_2)
3. 60DAFS (D_3)
4. 65DAFS (D_4)
5. 70DAFS (D_5)
6. 75DAFS (D_6)
7. 80 DAFS(D_7)

The above DAFS represented the different stages of maturity of fruit *i.e* Mature green, Colour break, Half red and Full red stage according to visual observations.

Materials and Methods

The TSS of the pulp were determined by placing the small quantity of pulp on the prism of digital refractometer (0-53^{0}C) and were expressed in ^{0}Brix. The titratable acidity was determined by dissolving a known weight of pulp in a known volume of distilled water. The aliquot was titrated against 0.1 N sodium hydroxide using phenolphthalein as indicator. The acidity was recorded in terms of percent citric acid on fresh weight basis (AOAC, 1995).

Ascorbic acid content was determined by using 2, 6-Dichlorophenol-indophenol dye method of Freed (1966). Five grams of the sample was grounded with about 25 ml of 4% oxalic acid and filtered through Whatman No.4 filter paper.

Reducing sugar content was estimated following the method of Lane and Eynon (Ranganna, 1994) in a known weight of composite sample using lead acetate for precipitating extraneous material and potassium oxalate to remove excess of lead.

Non-reducing sugar was obtained from the difference of total sugars and reducing sugars.
% Non-reducing sugar = (% total sugars - % reducing sugars) x 0.95

The sugar: acid ratio was calculated by dividing the value of total sugar by that of titratable acidity.The total Carotenoid colour intensity was measured in a spectrophotometer at 460 nm using petroleum ether as blank. The results were expressed in terms of β- carotene as µg/ 100 g and µg/ g of the sample (Ranganna, 1994).

Pectinmethyl esterase (PME) activity was determined by the method described by Ranganna (1994). PE U/g= $\frac{\text{mlof } 0.02 \text{ NNaOHconsumed} \quad \text{x } 3.1\text{x}1\text{min}}{\text{mlofenzymepreparationxtotaltimeofdeterminationinmin}}$

Experimental Findings

The **Total Soluble Solids** content was influenced by the different stages of fruit growth and development (Table 1). It was observed that the TSS content of the fruits increased with the advancement of maturity and the lowest being observed at 50 DAFS (9.00^0 Brix) and the maximum during 70-75 DAFS (13.43-13.50^0 Brix). However, the TSS content recorded in 80

DAFS (13.53^0 Brix) was statistically at par with 70 and 75 DAFS. The increase in sugar content beyond 70 DAFS was found to be negligible which may be due to the utilization of sugar as a substrate for increase rate of respiration due to increased ripening. It was also reported by Porter *et al*., (2000) in peach fruits.

A significantly higher ascorbic acid content of fruits was observed during 50 to 60 DAFS (52.50, 50.20 and 48.30 mg/100g pulp, respectively) and subsequently declined in the later stages. The retention of ascorbic acid was found to be significantly at par at 65 DAFS (45.70 mg/100g pulp) and 70 DAFS (45.69 mg/100g pulp). Significant fall in ascorbic acid was noticed from 70 DAFS (45.69 mg/100g pulp) to 80 DAFS (45.60 mg/100g pulp). These reductions might have happened due to accelerated ripening in these stages compared to the other stages, which resulted in rapid conversion of ascorbic acid to de-hydro ascorbic acid. Similar results were also reported by Meredith *et al*., (1989) and Babu *et al*., (2011) in different varieties of peach fruits.

The data in the table 1 reveals that the **reducing sugar** in general showed an increasing trend with the advancement of maturity. The increase in reducing sugar content was more than 146 per cent at 80 DAFs over 50 DAFS. The observations elucidate the findings of Babu *et al*., (2011), who reported that the reducing sugars and total sugars increased as fruits continue to ripen in the tree.

The **non-reducing sugar** content also showed an increasing trend with the advancement of maturity. The lowest value was recorded in 50 DAFS (1.40 per cent) and the highest was observed between 70-75 DAFS (2.49-2.53 per cent). This increase in non-reducing sugar may be attributed to the hydrolysis of starch into simple sugars and also by continuous mobilization of sucrose from leaves to the fruits. Similar results were reported by Babu *et al*.,(2011) in peach fruits.

The **acidity** content was found highest at 50 DAFS (0.80 per cent) which was statistically at par with 55 DAFS (0.79 per cent) and 60 DAFS (0.79 per cent). The acidity content of fruits however declined with maturation and advancement of days after fruit set and the maximum fall in acidity was observed till 70 DAFS (0.45 per cent). The lowest acidity content was observed at 75 DAFS (0.44 per cent) which was however, statistically at par with 80 DAFS (0.44 per cent). Overall the reduction in fruit acidity was upto 45 per cent at 75 DAFS and no further reduction in fruit acidity was observed thereafter. The decrease in acidity content might be due to conversion

of acids into salts and sugars by enzymes. The decrease in acidity could also be attributed to dilution of acid with increase in juice content with maturity as reported by Choudhury and Baruah, (2003) in carambola fruits.

It was clearly evident from the data presented in table 1 that the sugar:acid showed a significant increasing trend with the advancement of days after fruit set. The lowest ratio was recorded at 50 DAFS (11.25) and reached maximum value of (30.72). The increase in sugar: acid was over 173 per cent at 80 DAFS (30.72) as compared to 50 DAFS. Similarly Aggarwal *et al*., (2002), while studying the ripening of peach fruits to determine maturity, reported that sugar:acid increased because of low acid and high sugar content.

Similar to sugar:acid, the total carotenoid content (Table 1) also showed an increasing trend with the advancement of fruit maturity. The highest value of total carotenoid (23.59 µg/g pulp) recorded at 80 DAFS was found statistically at par with 75 DAFS (23.56 µg/g pulp). Ground color of fruits changes from green to yellow as chlorophylls decline and carotenoids are synthesized. This is in agreement with the findings of Chalmers and Van den Ende, (1975) in peach.

PME activity showed a significant increasing trend with the advancement of fruit maturity. The lowest PME was recorded at 50 DAFS (0.31 U/g pulp) and significantly rapid increasing trend was recorded from 70 DAFS (0.92 U/g) to 80 DAFS (1.11 U/g pulp). PME activity increased by 258 per cent at 80 DAFS over 50 DAFS. The PME is responsible for initiation of pectin degradation which causes softening of fruits. Polygalacturonase cannot degrade pectin unless PME has de-esterified the pectin molecule. This was in accordance with the findings of Abu- Sarra *et al*., (1992), Fischer *et al*., (1991) and Nagar (1994) in peach fruits. Softening of a harvested peach is prompted by cell-wall-degrading enzymes that become active during the final stages of ripening (Nagar, 1994).

Conclusion

Peaches are climacteric fruits, which means they will continue to ripen even after harvest. For distant marketing fruits can be harvested at colour break stage *i.e* 60-65 DAFS, for local

market when fruits attain reddish colour *i.e* 65-70 DAFS and for immediate consumption 70-75 DAFS when fruits attain complete maturity.

Table1.

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Treatment	TSS ^{0}B	Ascorbic acid mg/100g	Reducing sugar (%)	Non-reducing sugar (%)	Acidity (%)	Sugar:acid	Total carotenoid (µg/g pulp)	PME activity(U/g)
D_1	9.00	52.51	1.31	1.40	0.80	11.25	8.98	0.32
D_2	9.23	50.21	1.32	1.59	0.79	11.68	9.19	0.39
D_3	11.20	48.33	1.60	1.90	0.79	14.17	15.55	0.54
D_4	12.67	45.71	2.21	2.30	0.51	24.70	18.61	0.64
D_5	13.44	45.69	3.11	2.49	0.45	29.87	23.22	0.93
D_6	13.54	45.64	3.20	2.53	0.44	30.70	23.55	1.04
D_7	13.56	45.60	3.21	2.54	0.44	30.73	23.57	1.12
CD 5%	0.162	0.015	0.069	0.018	0.016	0.016	0.149	0.017

D_1 (50DAFS), D_2 (55DAFS), D_3 (60DAFS), D_4 (65DAFS), D_5 (70DAFS), D_6 (75DAFS), D_7 (80DAFS)

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