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Effect of Optimum Harvesting Dates (OHD) on the Quality of Red Delicious Apple

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Abstract: Apple fruits (Cv. Red delicious) were picked at 1st, 6th, 11th, 16th and 21st September, 2001 in village Ronial (1360 m elevation at sea level) Tehsil Matta, District Swat. The data on different parameters were recorded during pre-storage. The effect of dates of picking on the fruit quality of apple were evaluated. The flesh firmness (Kg cm^{-2}) and strief index decreased significantly ($P < 0.05$), while starch iodine index and total soluble solids (TSS) increased significantly ($p < 0.05$) with the delay in picking.

Key words: Optimum harvesting date, harvesting dates, red delicious apples, quality of apples

INTRODUCTION

In Pakistan apple fruit is mainly produced in North West Frontier Province. But unfortunately most of the fruit are lost from harvest to the consumer. It has been reported that 25-50% of fruit and vegetables produced are lost after harvest^[1]. Red delicious is one of the most popular cultivar of apple, which is grown on larger area than any other cultivar in District Swat.

Physiological maturity of the fruit refers to the stage at which maximum growth and maturation occurs. But the commercial maturity is the state of a plant organ required by market. The term immaturity, optimum maturity and over maturity is related to these requirements. Physiological maturity of apple fruit is a major factor, which influence fruit quality during storage. Early picked fruit are smaller, firmer, greener and have more acid and low flavor. In this case, the physiological disorder such as scald, core flash and shrinkage may be increased. Late picked fruits are larger, redder, yellower, sweeter and have high aromatic flavor. The risk of storage disorders such as low temperature, senescent breakdown, bitter it, brown heart and rotting increases in storage as picking is delayed^[2].

The onset of ripening is associated with the conversion of starch into sugar during the pre-harvest and post-harvest period of fruit. If the fruit is picked before the starch has started to clear, the fruit coming out of cold store lacks the flavor. Moreover, fruit ripening can lead to disorder such as mealiness, because of insufficient water loss^[3]. As the starch clears, then the flavor potential increases, although the storage potential will tend to decrease.

It is therefore necessary to assess the quality of apple fruit picked on different dates. It is hoped that these

findings will help the apple growers a lot to pick their fruit at proper time and store them in cold storage with minimum losses and to present the fruits of best qualities to the consumers too.

MATERIALS AND METHODS

For this study two trees of apple variety (Red delicious) were purchased from the farmer's field in Ronial (Matta), District Swat. The trees were 20 years old and these were open in the center. The elevation of the orchard at sea level was 4460 ft. The picking was at 5 days interval. The picking program was as follows:

S.No.	Picking date
1	01.09.2001
2	06.09.2001
3	11.09.2001
4	16.09.2001
5	21.09.2001

From each date, about two cardboard crates, each having weight of 20 kgs were stored in Ali Ittifaq Commercial Cold Store, Airport Road Mingora, Swat. Each crate was packed with three layers of fruits. The temperature of the cold store was maintained in the range of 1-5°C, by maintaining humidity level of 80-85%.

Physico-chemical analysis: On each picking date, the following parameters were recorded for determination of strief index (maturity index).

Firmness in kg on two opposite sides of the fruit: Flesh firmness of peeled tissues were measured on both sides of each apple with Effegi^[4] penetrometer fitted with 11 mm diameter probe.

Starch iodine index (1-9 score): Starch iodine index was determined by recommended method of Chu and Wilson^[5].

Total soluble solids (TSS): Total soluble solids were determined by the recommended method of A.O.A.C.^[6] using hand refractometer at room temperature. The extracted juice was shaken well. The representative samples of a well shaken juice were placed on absolutely dry refractometer prism and reading were taken directly and necessary temperature corrections were made.

Strief index: The strief index as maturity index was determined by the following formula:

$$\text{Strief index} = \frac{\text{Firmness in kg}}{\text{Refractometer reading} * \text{starch iodine index}^{[7]}}$$

RESULTS AND DISCUSSION

Firmness: Apples were analysed for firmness on each picking date from 1st September to 21st September at 5 days interval. Results regarding the effect of treatments (picking dates) on the flesh firmness of apples are presented in Table 1. The data revealed that the effect of different dates of picking on mean values of flesh firmness (kg cm^{-2}) was not statistically significant. Baumann^[8] reported that firmness and soluble solids content were not uniformly rising or descending before optimum harvesting date (OHD). He further reported that firmness was constant in Elestar and Jonagold in 1989, 1990 and 1992. Therefore, the result was in conformity with the result of Baumann^[8]. The table also revealed that the effect different date of picking of central fruits (Sub. T.I.) was significantly decreasing. The mean values of flesh firmness (kg cm^{-2}) at D₁, D₂, D₃, D₄ and D₅ were 6.45, 6.39, 6.37, 5.87 and 5.83 respectively. In these 21 days the fall in average firmness (kg cm^{-2}) was 0.06 kg day^{-1} though fruit firmness varies from season to season and is known to be influenced by mineral composition and crop load^[9]. Similarly, the fall in average firmness has been reported $0.04\text{-}0.05 \text{ kg day}^{-1}$ by Luton^[10]. The effect of different dates of picking on flesh firmness (kg cm^{-2}) of lateral fruits (Sub. T.2) was statistically significant ($P < 0.05$). But the influence was irregular. The highest flesh firmness (kg cm^{-2}) was recorded by D₁ (6.45), while lowest flesh firmness was recorded by D₅ (5.83).

Starch iodine index (1-9): Apples were analysed for starch iodine index on each picking date from 1st September to 21st September at 5 days interval. Results regarding

Table 1: Effect of different picking dates (treatment) on firmness of Apple fruits before cold storage

Treatments	Firmness		Means
	L	C	
D ₁	6.45a	6.34ab	6.40a
D ₂	6.34a	6.36ab	6.35a
D ₃	6.37a	6.08abc	6.22a
D ₄	5.87c	6.10abc	5.98a
D ₅	5.83c	5.99bc	5.91a
Means	6.18	6.17	-

Figures with similar letters are not statistically significant ($P < 0.05$)

L = Fruits picked from the lateral sides of apple trees

C = Fruits picked from the central sides of apple trees

D₁ = First date of picking (1st September, 2001)

D₂ = Second date of picking (6st September, 2001)

D₃ = Third date of picking (11st September, 2001)

D₄ = Fourth date of picking (16st September, 2001)

D₅ = Fifth date of picking (21st September, 2001)

Table 2: Effect of different picking dates (treatment) on starch iodine index of Apple fruits before cold storage

Treatments	Starch iodine index		Means
	L	C	
D ₁	1.60de	1.20e	1.40c
D ₂	1.60de	2.00cde	1.80bc
D ₃	2.20cd	2.00cde	2.10bc
D ₄	2.60bc	2.60bc	2.60a
D ₅	4.00a	3.20ab	3.60a
Means	2.40	2.20	-

Figures with similar letters are not statistically significant ($P < 0.05$)

the effect of treatments (Picking dates) on starch iodine index of apples are presented in Table 2. The effect of different dates of picking on the mean values of starch iodine index (Score 1-9) was increasing significantly ($P < 0.05$) in lateral fruits of the tree. The mean values of starch iodine index (1-9 score) for lateral fruits at D₁, D₂, D₃, D₄ and D₅ were 1.60, 1.60, 2.20, 2.60 and 4.00, respectively.

Similarly, the starch iodine index (1-9 score) of central fruits of the tree was increasing significantly ($P < 0.05$). The mean score of starch iodine index of lateral fruits of the tree at D₁, D₂, D₃, D₄ and D₅ were 1.20, 2.0, 2.0, 2.6 and 3.20, respectively.

The mean score of both the central and lateral fruits were also increasing significantly ($P < 0.05$). The mean values of starch iodine index at D₁, D₂, D₃, D₄ and D₅ were 1.4, 1.8, 2.1, 2.6 and 3.6, respectively. Though, the starch iodine test offers a less reliable guide to the maturity of fruit than ethylene measurement. But was for classifying local orchards in order of their probable maturity^[11].

The starch degradation index at D₄ and D₅ were 2.60 and 3.60, respectively. It can be concluded that the first probable date of physiological maturity was D₄ (16th September). Which can be called first acceptable harvesting date of picking. Similar results have been observed by Priest and Loughed^[12].

Table 3: Effect of different picking dates (treatment) on total soluble solids (TSS) of Apple fruits before cold storage

Treatments	Starch iodine index		Means
	L	C	
D ₁	11.01e	9.61g	10.31d
D ₂	10.53ef	10.53f	10.53d
D ₃	13.04b	11.67d	12.35c
D ₄	13.52ab	12.29c	12.90b
D ₅	13.56a	13.20ab	13.38a
Means	12.33	11.46	-

Figures with similar letters are not statistically significant (P<0.05)

Table 4: Effect of different picking dates (treatment) on total soluble solids (TSS) of Apple fruits before cold storage

Treatments	Starch iodine index		Means
	L	C	
D ₁	0.40b	0.59a	0.50a
D ₂	0.42b	0.33bc	0.37ab
D ₃	0.64cde	0.29bcd	0.27bc
D ₄	0.18def	0.19def	0.18c
D ₅	0.11f	0.14ef	0.12c
Means	0.27	0.31	-

Figures with similar letters are not statistically significant (P<0.05)

TSS (Brix at 20°C): Apples were analysed for TSS (Total soluble solids) on each picking date from 1st September to 21st September at 5 days interval. Results regarding the effect of treatments (picking dates) on the TSS of apples are presented in Table 3. The data pertaining to TSS of lateral fruits were significantly difference (P<0.05) between the mean values at different dates of picking. The mean values of lateral fruits at D₁, D₂, D₃, D₄ and D₅ were 11.01, 10.53, 13.04, 13.52 and 13.56, respectively.

The data pertaining to mean values of TSS of central fruits were statistically significant (P<0.05). The mean values of TSS of central fruits at D₁, D₂, D₃, D₄ and D₅ were 9.16, 10.53, 11.68, 12.29 and 13.20, respectively.

Similarly the mean values of TSS of both the central and lateral fruits showed statistically significant difference (P<0.05). the mean value of TSS at D₁, D₂, D₃, D₄ and D₅ were 10.31, 10.53, 12.35, 12.90 and 13.38, respectively. Baumann^[8] reported that soluble solid showed little difference just before optimum harvesting date (OHD) in Janagold variety during 1989, 1990 and 1992, respectively.

Similar results have been reported by Argenta *et al.*^[13]. He observed that at optimum harvesting date, there were variations in the internal indices among orchards and seasons and found that the TSS increased to a greater extent in apples as the picking time delayed.

Strief index: Apples were analysed for strief index (maturity index) on each picking date from 1st September to 21st September at 5 days interval. Strief index was obtained by calculation of Firmness, TSS and Starch iodine index.

Results regarding the effect of treatments (picking dates) on the strief index are presented in Table 4. The mean values of lateral fruits, affected by different dates of picking were statistically significant (P<0.05). The mean values of strief index for lateral fruits at D₁, D₂, D₃, D₄ and D₅ were 0.408, 0.424, 0.264, 0.180 and 0.116, respectively. The mean values of D₁ and D₂ were not significant with one another.

The data pertaining to the mean values of central fruits, affected by different dates of picking were statistically significant (P<0.05). The mean values of strief index for central fruits at D₁, D₂, D₃, D₄ and D₅ were 0.592, 0.338, 0.294, 0.194 and 0.148, respectively. The lowest mean values 0.148 were obtained by D₅, followed by 0.194 at D₄, respectively.

Similarly the mean values of strief index for both the lateral and central and fruits were statistically significant (P<0.05). The mean values of strief index at D₁, D₂, D₃, D₄ and D₅ were 0.50, 0.37, 0.27, 0.18 and 0.12, respectively.

Similar results have been confirmed by Skrzyński^[14] and reported the mean values of strief index for 4 varieties i.e. Mespur, Spartane, Jonathan and Golden delicious were 0.15, 0.31, 0.17 and 0.11, respectively.

In this study different parameters i.e. flesh firmness, starch iodine index, total soluble solids and strief index were recorded to determine the proper maturity time of apple fruits. The results showed that the recommended maturity time of this cultivar was beyond 11th September.

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