

Effect of Different Periods of Ambient Storage on Chemical Composition of Apple Fruit

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ABSTRACT

The investigations were carried out on five apple varieties viz. Golden delicious, Mashhadi, King Amri, Kalakulu and Amri to study the effect of ordinary storage at room temperature (25°C) during the month of September with two weeks interval. The chemical analysis consisted of sugars, acidity, total soluble solids and ascorbic acids. There was increase in reducing sugar, decreased in non-reducing sugar and increase in total sugars of all varieties when storage period was prolonged. Non-significant decrease in acidity and significant increase in total soluble solids during storage of the five varieties at room temperature was observed. Vitamin C decreased during storage. The experiment enables us to conclude that 'Amri' and 'Golden Delicious' cvs. of apple can be stored up to six weeks to fetch good market price.

Key Words: Apple; Total soluble solids (TSS); Reducing sugars; Non-reducing sugars; Vitamin C.

INTRODUCTION

The Apple (*Malus x malus*) is one of leading fruits which is being grown in temperate region of the world. Its beautiful appearance, crispy flesh, pleasant flavour and sweet taste attract the consumers and fetch high price. In Pakistan apples are grown in temperate region of the country such as Murree Hills (Rawalpindi), part of Peshawar region, Northern areas, Kashmir and Quetta.

Despite multifarious problems, the apple growers obtain a phenomenal profit which leads to ultimate efforts for increasing the fruit of this production. It is an important source of vitamin C, vitamin A, thiamin and other vitamin complexes. Different varieties of apple contain different amount of vitamin C. Bilisili (1970) observed a decrease in malic acid, losses of ascorbic acid and considerable variation in sugar contents during storage. Acidity in different varieties of apple is reduced during storage. Bilisili (1970) in an experiment, when fruit was stored at 2-3°C for six months examined at different intervals, observed a great loss of malic acid, had some losses of ascorbic acid, were also noticed some changes in reducing, non-reducing and total sugars. Robert and Von Loeska (1960) reported the changes of sugars in several varieties of apple during storage. In general, there was an increase in total sugars followed by the gradual decline during the remaining life of apple fruit.

Apple fruit is mainly harvested during the month of August and September and maximum fruit is supplied to the market during these two months. The growers do not get proper price during these days due to glut of fruit in the

market. To get the fair price and to keep it in the edible condition without hampering its availability throughout the year, this fruit has to be stored in ordinary and cold storage condition. The apple fruit has a good potential for storage under favourable conditions, especially in Kashmir and Murree hills where the natural cold storage facilities are present due to low temperature.

The purpose of present studies was to explore the optimum storage duration at which the chemical composition of fruit is least deteriorated and to compare the response of different varieties to these storage durations.

MATERIALS AND METHODS

Fruits of five apple varieties as given below were randomly harvested at full maturity from Rawalakot and Dirkot Azad Kashmir. The fruit was brought to the post graduate research laboratory, Institute of Horticultural Sciences, University of Agriculture Faisalabad. The varieties Golden Delicious, Mashhadi, King Amri, Kalakulu and Amri were used in these studies. The fruit of each variety was divided in four samples and kept in storage as, fresh; and two, four, and six weeks intervals. Each sample comprised of five fruit that were used for chemical analysis to find out the effect of storage on fruit at room temperature. The experiment was laid out in Completely Randomized Design (CRD) with factorial arrangement. Data were collected on reducing sugars using Lane and Eynon method, non-reducing sugar, total sugar, and total soluble solids following Hortwitz (1960). Vitamin C (ascorbic acid) was determined by the method described by Ruck (1961).

RESULTS AND DISCUSSION

Effect on reducing sugar. At the initial stage of storage reducing sugar was 10.15% which increased to 14.30% during six weeks storage in King Amri. In Mashhadi reducing sugar increased from 11.30 to 14.0% during six weeks storage. In golden delicious at the starting of storage there was 11.0% reducing sugars which increased to 14.30% during six week's storage. In Kalakalu variety at the beginning of storage, the reducing sugars were 12.0% and at the end of storage increased to 14.6%. King Amri reducing sugar increased from 10.55 to 13.80% during six weeks storage. All differences were different at 5% levels (Fig. 1).

In the storage period of six weeks as a whole the four varieties viz, King Amri Mashhadi, Golden Delicious and Kalakulu had significantly higher percentage of reducing sugars as compared to Amri. However, they did not differ among themselves. The results of these investigations are in conformity with the finding of Wright and Whiteman (1955) who reported that reducing sugars tended to increase during storage.

Effect on non-reducing sugars percentage. Higher quantities of non-reducing sugar percentage was 2.15% in Golden delicious and 2.0% in Kalakulu at initial stage of storage while lower quantities of non-reducing sugar percentage was found 1.54% in King Amri, 1.45% in Mashhadi and 1.15% in Amri at initial stage of storage. There was decrease in non-reducing sugar during six week of storage. Decrease in non-reducing sugar during six week of storage in five varieties of apple was 2.15 to 1.11% in Golden delicious, from 1.15 to 0.84% in King Amri, from 1.45 to 0.88% in Mashhadi and from 1.15 to 0.76% in Amri (Fig. 2).

Two varieties Kalakulu and Golden delicious do not differ between each other and their non reducing sugars contents were significantly higher as compared to king Amri, Mashhadi and Amri. However, King Amri and Mashhadi varieties have more non-reducing sugar as compared to Amri but they did not differ among themselves. Similar results were reported by Srivastava and Souza (1962) who determined the effect of storage on non-reducing sugar in five different Japanese plus varieties and reported that the non – reducing sugar decreased during storage.

Effect on Total Sugars percentage. The highest percentage of total sugars was 14.25% in Kalakulu at initial stage of storage. Other three varieties showed higher percentage of total sugar, 2.90% in Mashhadi, 12.75% in Golden delicious and 12.75% in King Amri and lowest amount of total sugars were found in Amri 11.80% at initial stage of storage. After two week this percentage of total sugars increased from 14.25% in Kalakulu, from 12.90 to 14.38% in Mashhadi, from 12.75 to 14.10% in Golden Delicious, from 12.75 to 14.69% in King Amri and 11.80 to 13.50% in Amri variety of apple during storage at room temperature , after four weeks of storage. The percentage of

Fig. 1. Effect on the reducing sugar in apple at room temperature

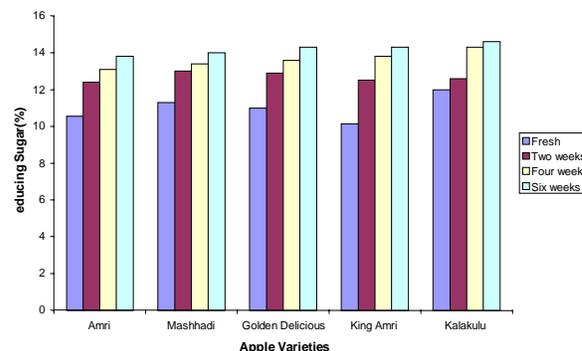


Fig. 2. Effect on non-reducing sugar percentage in Apple at room temp

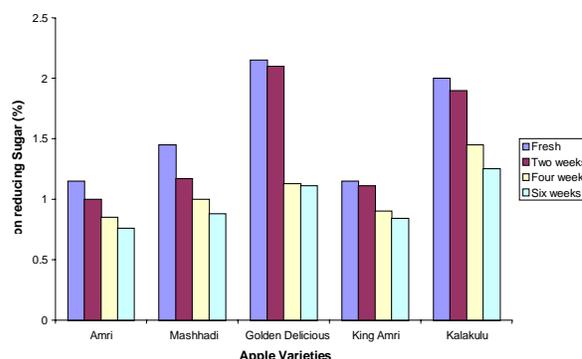
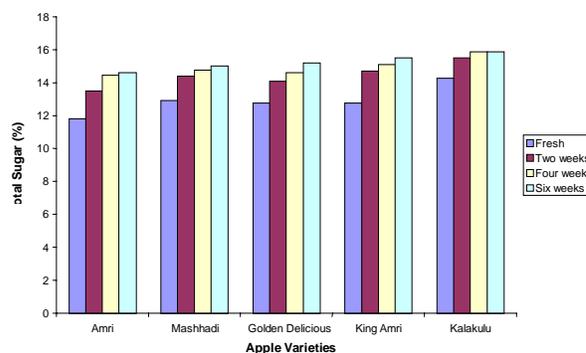


Fig. 3. Effect on Total Sugar Percentage in Apple at room temp



total sugars increased in all varieties as with the time of storage (Fig. 3).

During six weeks storage period, the Kalakulu variety differed from all other varieties due to higher total sugars percentage. Three varieties Mashhadi, Golden Delicious and King Amri did not differ among themselves but their sugars were significantly higher than Amri variety. Tahir and Ericsson (2003) found that the sweetness increased 10% after storage. These findings also confirm the results of Krotkov and Helson (1946), Wright and Whiteman (1955), Robert and Von-Loeske (1960), Bidabe (1970) and Stranzhey (1973) who reported that there was increase in total sugars with the increase in storage time.

Effect on the acidity percentage. The results showed that amount of Acidity was found in Golden Delicious (0.44%), while in Mashhadi and in King Amri it was 0.4 and 0.39%, respectively. The lowest amount of acidity percentage was found in Amri (0.33%) and Kalakulu (0.31%) at initial stage of storage. As the storage period increased, the percentage of acidity gradually decreased. Acidity decreased from 0.44 to 0.09% in Golden Delicious, from 0.40 to 0.16% in Mashhadi, from 0.39 to 0.15% in King Amri, from 0.33 to 0.11% in Amri and from 0.31 to 0.12% in Kalakulu at the end of six week storage (Fig. 4).

After the storage of six weeks, Golden Delicious and Mashhadi varieties differ from all other varieties because their acidity was significantly higher as compared with varieties. Amri and Kalakulu did not differ with each other but differs among other varieties of apple at initial stage of storage. As regards the effect of storage period there was a non-significant decrease in acidity at each interval during storage. These results confirm the findings of Crouch (2003) who reported that there was decline in titrable acidity in apple fruit after harvesting. Apple fruit stored for six months were found to bear great losses of malic acid (Billisli, 1970). Tahir and Ericsson (2003) also found a marked difference in acidity of apples after storage.

Effect on total soluble solids percentage. The storage period increased the percentage of total soluble solids increased from 15.40 to 17.3% in Kalakulu, from 15.25 to 16.20% in Golden Delicious, from 14.60 to 16.30% in Mashhadi, from 14.46 to 16.80% in King Amri, and from 13.15 to 15.85% in Amri variety of apple at the end of six week storage (Fig. 5).

These results confirm the findings of Bidabe *et al.* (1970). They observed the increase in total soluble solids, starch and sugar contents, when different varieties of apple were stored at room temperature, same results were observed by Isagullyan (1976) and Crouch (2003). The present investigations have clearly indicated that total soluble solids in apple fruit would increased throughout storage period.

Effects on vitamin C percentage. The highest amount of vitamin C contents were found 12.68% in King Amri, 12.19% in Golden Delicious and lowest amount of vitamin C contents were found 9.70% in Mashhadi, 9.10% in Amri and 8.70% in Kalakulu at initial stage of storage. Vitamin C in these varieties of apple ranged from 8.70 to 12.68%

Fig. 4. Effect on Acidity Percentage in Apple at room temperature

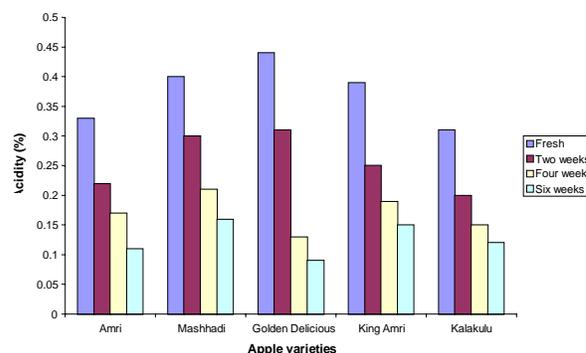


Fig. 5. Effect on Total Soluble Solid Percentage (TSS) in Apple at room temperature

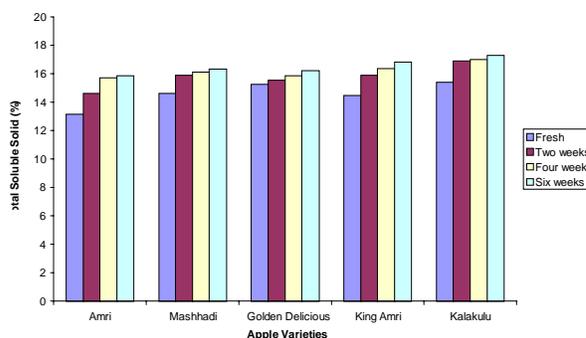
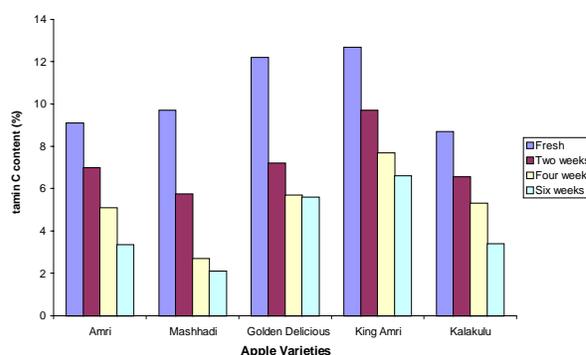


Fig. 6. Effect on Vitamin C in Apple storage at room temperature



which reduced significantly during six weeks storage (Fig. 6).

During six weeks storage period, the King Amri variety as a whole was significantly higher in vitamin C

contents as compared to all other four varieties. Golden Delicious variety of apple was also higher in vitamin C contents as compared to Mushhadi, Amri and Kalakulu. The two varieties Mashhadi and Amri did not differ between themselves but their vitamin C contents significantly higher than Kalakulu. The storage periods at different intervals had a profound effect in decreasing of vitamin C contents. Same results were reported by Martin (1968), Manaschiffmann (1971), Ahmed *et al.* (1979) and Purvis (1983).

CONCLUSION

Our experiment shows that the reducing sugar increases by prolonging storage periods while significant decrease in non-reducing sugar occurs. As the storage period increases there was significant increase in total sugar, non-significant decrease in acidity, increase in total soluble solids (TSS) in all apple varieties and vitamin C contents decrease in all apple varieties with different proportions during storage at room temperature. However, the maximum decrease in acidity of 'Golden Delicious' lead us to the conclusion that it can be stored up to six weeks after maturity to fetch good market price. At the end of the experiment 'Amri' possesses the most desirable levels of vitamin C, total sugars, TSS and acidity so it may also be stored up to six weeks with out deteriorating its internal fruit quality.

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