Storage Temperature Effects on the Postharvest Quality of Apple (*Malus domestica* Borkh. cv.Red Delicious)

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Abstract: The apple (*Malus domestica* Borkh.) is belonged to Rosaceae family. Apple contains vitamins, sugar, acid, pectin and tannin and has many uses. Storage temperature is one of the most important factors affecting the life of fruits after harvest. In order to investigate the effect of temperature on the postharvest quality of Red Delicious apple, fruits for one month were stored under three different temperature (0, 5 and 12°C). After one month, factors such as length, diameter, weight, volume, firmness, total titrable acids (TTA), total soluble solids (TSS), elements of sodium and potassium, Marketable quality and color surface were measured. Generally results indicated that storage with 0°C could maintain better product quality. [New York Science Journal .2010;3(3):67-70]. (ISSN: 1554-0200).

Keywords: Apple, Storage, TSS, TTA.

1. Introduction

Nowadays, quality has become one of the most important consumer decision factors in the selection among competing products and services (Montgomery, 1997). There are still a few people around in most types of organizations who remain to be convinced that quality is the most important of the competitive weapons in the contemporary industrial world (Oakland, 1999). Moreover, customers have a variety of choices when they are about to purchase a product or a service. For this reason, it is essential for a business to maintain a perfect quality of the product in order to sustain the competition. Furthermore, improvement in quality is often accompanied by reduction in cost and increase in the profitability of the business (Montgomery, 1997).

The quality of the food products in conformity with consumer requirements and acceptance is determined by their sensory attributes, chemical composition, physical properties, level of microbiological and toxicological contaminants, shelf-life, packaging and labeling (Molnar et al, 1995).

Food quality management has become challenging the last years due to changes in consumption patterns, development in technology and increasing legislative requirements (Luning and Marcelis, 2006). Furthermore, the fact that this century is characterized as the century of cornucopia, with a great abundance of foods, the good quality of the food has been the essential tool for an organization in order to be competitive. On the other hand, food quality management has been classified as rather difficult to accomplish due to the complex character of perishable foods in combination with the unpredictable behavior of people involved in food production chains.

Fruits and vegetables have a high nutritional value, thus they make a vital component of a healthy diet. For a company it is essential to identify what consumer expects regarding as the fruit and vegetable quality. Past studies have shown that the most important criteria for selecting a fruit are the freshness, the taste and the appearance (Wandel and Bugget, 1997).

Fruits and vegetables are two of the most perishable categories of foods and two of the most important causes for malnutrition diseases in the developing world. Losses occur either on the pre-harvest phase or on the harvested product during handling in general. The fact that the fruits and vegetables have a soft texture means that they are easily damaged having as a consequence the deterioration of quality or even making the product inappropriate for human consumption.

The fruits are high in vitamin A and C and other mineral nutrients (Vashishtha, 1998). Temperature and storage duration have been reported to affect the vitamin C content of fruits and vegetables (Lee and Kader, 2000; Kadzere et al., 2006).

Precooling, refrigeration, proper relative humidity, and optimal atmospheric composition in storage facilities and packages are essential to reducing postharvest losses of commodities that are destined to reach the consumer in fresh condition.

Temperature management is one of the most important tools for extending the shelf life of fruits (Lee and Kader, 2000), because it regulates the rate of all associated physiological and biochemical process. Lower temperatures may cause chilling injury and higher ones can reduce the storage life of the product.

Many studies on the effect of storage temperature on quality and storage life of fruits have been done which shows temperature plays an important role on quality of fruits after harvest (Dixon et al, 2004;

Marcilla et al, 2006; Biolatto et al, 2005; Tembo et al, 2008; Pailly et al, 2004; Widayat et al, 2003).

The apple is belonged to species *Malus domestica* and Rosaceae family. It is one of the most widely cultivated tree fruits. Production rate for this fruit in 2008 was equal to 64,255,520 tons that China with produced 27,507,000 tons had first rank (FAO).

The objective of this study was to determine the effects of different storage temperature on the postharvest quality changes of apple (Red Delicious) fruit.

2. Materials and Methods

Samples were harvested in September 2008 from garden of agriculture college of Karaj and brought to the postharvest Horticulture laboratory at the University of Tehran, Iran. Then factors such as length, diameter, weight, volume, firmness, total titrable acids (TTA), total soluble solids content (TSS), and elements of sodium and potassium were measured. Then the samples were transferred to storages with temperatures 0, 5 and 12° C and relative humidity of 80%. After one month the samples brought out from storage and again said factors were measured.

2.1. Length, diameter, volume, and firmness

Length and diameter were measured by digital vernier. In order to measurement of volume, the first container filled with water and then the sample is immersed in water, increasing the amount of volume that can be seen, equal is with volume of sample. The weight measured by scale with sensitivity 0/1 to 0/01 gr. To measure the firmness was used from Penetrometer with 0.8 cm diameter cylinder.

2.2. Total titrable acids (TTA)

To measure the total titrable acids (TTA) was used from titration method. In this method for titration was used from 0/1N NaOH. 10 ml homogenate was mixed with 0/3 ml 1% phenolphthalein, the mixture was titrated with 0/1N NaOH to permanent pink color (PH 8.1). Then in order to obtain organic acid percentage was used from following formula:

$N_1V_1 = N_2V_2$

N_1: normality of apple most acid

N_2: normality of NaOH

V_1: volume of extract

V_2: volume of NaOH

2.3. Total soluble solid (TSS)

TSS was measured by hand Refractometer. In order to measurement of TSS, a drop of the fruit extract was placed on the prism of the digital refractometer and the total soluble solid was read in ºBrix.

2.4. Na and K elements

Sodium and Potassium was measured by atomic emission using a flame photometer (310 C, Teif Azmoon Pars, Iran).

2.5. Marketable quality and color surface

Marketable quality and color surface were rated on each fruit using the following subjective scale 1= very poor quality, 2= poor quality, 3= moderate quality, 4= good quality and 5= excellent.

3. Results and Discussion

Results indicated that storage temperature had little effect on surface color of fruits. While marketable quality decreased with increase in temperature (Fig 1).

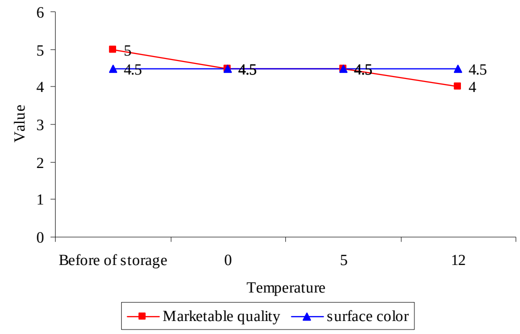

Fig 1. Influence of storage temperature on marketable quality

Pollution percentage of fruits increased with increase in temperature. The higher of pollution (1.9%) was observed in the higher of temperature and the lower of pollution (1%) was observed in the minimum of temperature (Fig 2).

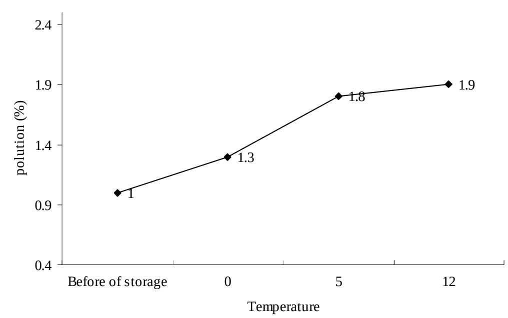

Fig 2. Influence of storage temperature on fruits pollution (%)

Data of this study indicated that diameter, length, and volume decreased with increase in storage temperature. Diameter, length, and volume loss was significantly higher in fruits stored at 12°C than those stored at both 0ºC and 5°C (Fig 3 and Fig 4).

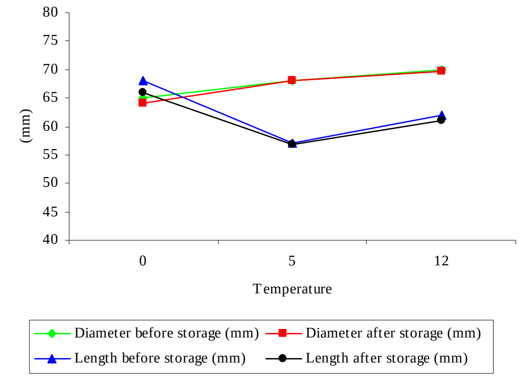

Fig 3. Influence of storage temperature on fruit diameter and length (mm)

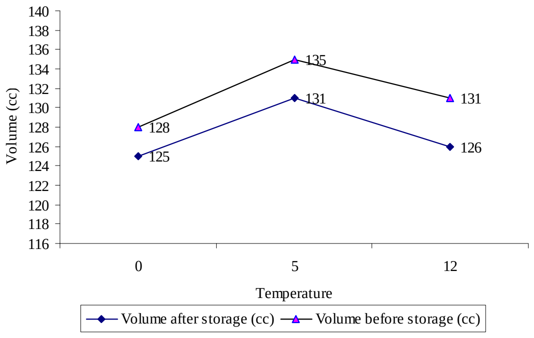

Fig 4. Influence of storage temperature on fruit volume (cc)

The fruits stored in lower temperature were firmer than fruits stored in higher temperatures. The maximum firmness (5.5 kg) was obtained with fruits stored in 0°C and the lowest firmness was obtained with fruits stored in 12°C (Fig 5).

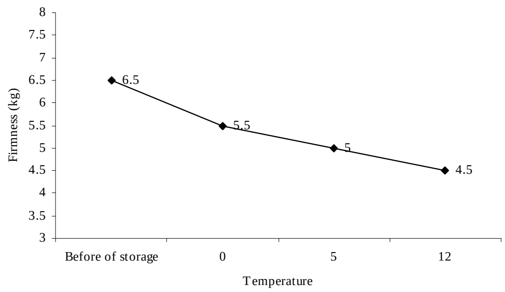

Fig 5. Influence of storage temperature on fruit firmness (kg)

Data of this study indicated that weight loss % was gradually increased with increase in temperature of storage. Weight loss % was not significantly in fruits stored at 0°C and 5°C but Weight loss % was significantly in fruits stored at 12°C (Fig 6.).

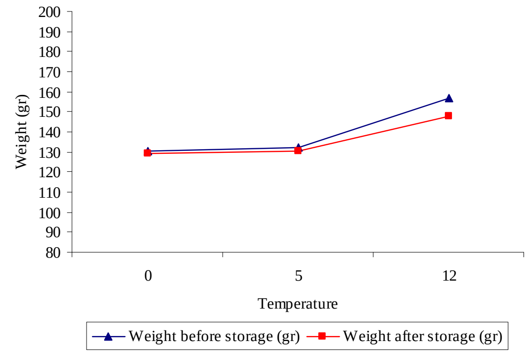

Fig 6. Influence of storage temperature on fruit weight (gr)

The results showed that after one month of storage TSS % and TTA % was significantly lower in fruits stored compared to before storage. The reducing TSS % and TTA % was significantly highest at fruits stored in higher temperature. The minimum TSS (8%) and TTA (0.33 %) were related to fruits stored in 12 °C and the highest TSS (9 %) and TTA (0.53 %) were related to fruits stored in 0 °C (Fig 7. and Fig 8.).

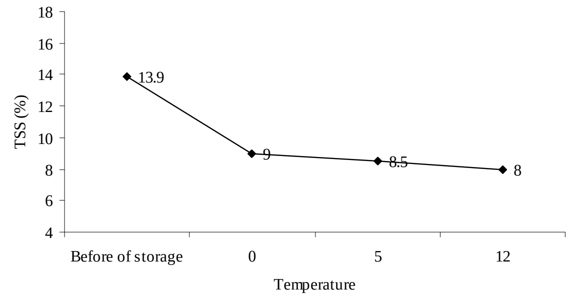

Fig 7. Influence of storage temperature on TSS (%)

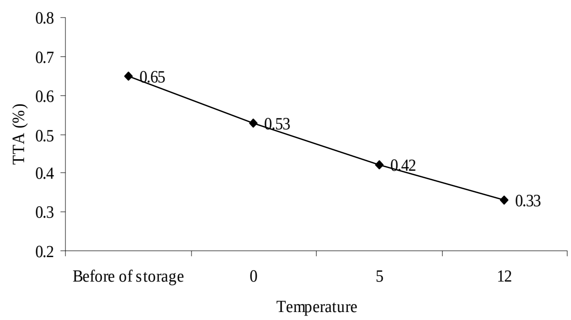

Fig 8. Influence of storage temperature on TTA (%)

Concentration of Na was gradually increased with increase in storage temperature. The highest Na concentration (46.89 ppm) was obtained to fruits stored in 12°C. While the lowest of Na concentration (37.45 ppm) was related to fruits that stored in 12°C. storage temperature did not significantly affect on concentration of K. But, the maximum K concentration (2.75 ppm) was related to 0°C and the minimum K concentration (1.74 ppm) was related to 12°C (Fig 9).

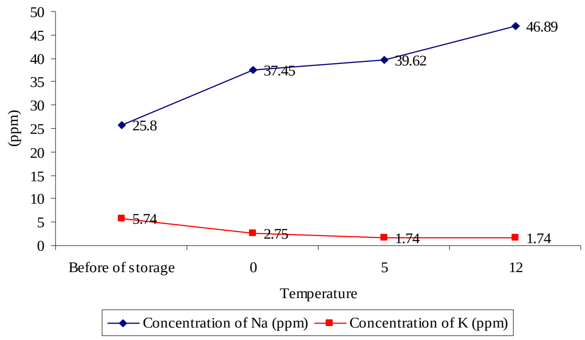

Fig 9. Influence of storage temperature on concentration of Na and K

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