

Cold storage duration on quince quality biology essay

[Science](#), [Biology](#)



Laleh Mosharraf 1, Saeed Malek1, Maryam Mirlohi*1 Agricultural Engineering Research Department, Isfahan Center for the Research of Agricultural Science & Natural Resources, P. O. Box 81785-199, Isfahan, Iran.* Food Security Research Center, School of Nutrition and Food Science, Food Technology Department, Isfahan, Iran* Corresponding Author's E-mail: m_mirlohi@hlth. mui. ac. ir

Quince has an important economic value owing to its demand as jams, jelly or compote because of its pleasant flavor and pectin content. The nutritional value of quince is attributed to its rich dietary fiber as well as phenolic antioxidant . In this study, the effect of cold storage period on the quality of quince fruit (*Cydonia oblonga* cv. Isfahan) was investigated. Fruits used for the study were provided from a controlled orchard in Isfahan, Iran and were stored for 5 months in the cold storage unit at 0 ± 0.1 °C and 90 ± 5 % relative humidity condition. After 5 month cold storage, the pH shifted from 3.79 to 4.20 . Pectin content decreased significantly from 3.11% to 1.58%. Also, Titratable acidity fell to 3.77% from 4.51%. Firmness of fruits flesh fell to 2.13 Kg/cm² from 3.08 Kg/cm² while total soluble solids increased and picked at 16.67 % at the end of storage period. The results indicated that different storage times affected the fruit quality. All the parameters significantly changed (except titratable acidity) by the one month of harvest and continued to be changed during the cold storage however during the last three months of cold storage, the firmness, pectin content, titratable acidity and pH of the quinces did not significantly change.

Key Words: Quince, fruit quality, storage time.

1. INTRODUCTION

Quince is one of the earliest known fruits. For over 4, 000 years, quince trees have grown in Asia and the Mediterranean. Asia has the largest crop area of quince in the world and Africa has the third place after Europe. Iran in Asia with 39000 tons and Morocco in Africa with 33000 tons annual quince production have the fourth and fifth ranking in the world, respectively (FAO, 2008). Quince (*Cydonia oblonga* cv. Isfahan) is a species native to Iran. Isfahan province is the main region where quince is produced and the Isfahan variety has a national fame in Iran. It belongs to the Rosaceae family and *Cydonia* genus. Quince fruit is not very appreciated for fresh market because of pulp hardness and bitterness. But when ripe, it yields pleasant and powerful flavor. It is highly demanded for processing marmalades, jams and jelly (Silva et al., 2002, 2006). Because of wide genetic variability of quince, some studies evaluated its morphological, chemical and organoleptic characteristics (Rodriguez- Guisado et al., 2009). The health and nutritional benefits of eating quince fruit have been investigated in many studies. Consumption of quince is rich in dietary fiber, such as pectic polysaccharides (pectins) has been shown in epidemiological studies to have a number of pharmacological actions, such as hypoglycemic, cholesterol-decreasing, and antiulcerative activity (Ramakrishna et al., 2001; Wang et al., 2002; Hamauzu et al., 2008). In Iran, quince fruit has an important place in fruit export, and leads to the increase of the market share. In the regions where quince is produced, it is essential to store the excess of products. The fruit can be stored at 0 or 2°C for two to six months and storage can be prolonged up to seven months by controlled atmosphere conditions of 2% O₂ + 3%

CO₂ at 2°C (Gunes, 2008). The most important thing about the storage of quince is the ability to determine the harvest time. Different ecological conditions and harvest times affect the fruit flesh browning and fruit quality in quince (Türk et al., 2002). In a previous study, the effect of four quince harvesting times (at 10 days interval period) on quince quality cv. Isfahan during cold storage at 0 ± 0.1 °C and 90 ± 5 % RH was investigated. As a result of the previous study it was calculated that 181 days after full bloom was the best harvesting time for keeping quince quality during the cold storage (Mosharaf et al., 2004). During the cold storage, the characteristics of quince fruit were changed so the present work was conducted in order to investigate the effects of cold storage periods on quince quality during 5 month storage.

2. MATERIALS AND METHODS

Quince fruits were harvested from a quince orchard located in Isfahan province at 181 days after full bloom. The selected trees were healthy, vigorous, and high yielding quinces. Picked quinces were large, firm, and yellow. Quinces must be handled carefully as they bruise easily. Some chemical and physical properties of the fruit were analyzed before packaging. The fruits were put in carton boxes and stored for 5 months at 0 ± 0.1 °C and 90 ± 5 % relative humidity conditions as it is typically performed in Isfahan area. Maturity stage of fruit is described by quality analysis at harvest time in the figures. The five month storage study is carried out on what is typically performed in area in spite of the fact that storage is recommended for 2 to 3 months (Kader, 2000). After each month

of storage, several tests (pH, titratable acidity, total soluble solids, pectin contents and firmness) were conducted for determining changes in fruits quality. Quince juice pH was measured by a Metrohm pH-meter (model 691 Switzerland). The usual method for the determination of titratable acidity in fruit juices is the AOAC procedure based on the titration of the sample (AOAC, 1984). Titratable acidity values were determined by acid–base potentiometer (NaOH, 0. 1N up to pH 8. 1) and expressed as grams per liter (g/l) of malic acid. Malic acid being the dominant acid in the fruit. Total soluble solids (TSS) were measured at 20 °C with an Atago hand refractometer (model N-20, Japon, 0. 2 °Brix accuracy). The firmness of fruits was definitively assessed by a fruit pressure tester Effegi penetrometer (Alfonsine, 4801, Italy) with an 8 mm deep probe. Pectin content was measured base on AOAC Official Method No. 924. 09. Data analysis: The effects of cold storage times on quince quality were investigated by using completely randomized design method in a factorial experience with ten replications. Data were analyzed by means of statistical software SAS(SAS Institute, 1987).

3. RESULTS AND DISCUSSION

Fig 1 illustrates the results of pH and titratable acidity measurements during the five months cold storag . As it was shown, both parameters undergone significant changes (0. 05 0. 05). Similar observation was reported by Kuzucu et al.(2008)in quince and degradation of malic acid through prolonged storage was attributed to the decrease in acidity. Quince is a climacteric fruit and continues to ripe after harvest (Kader, 1992). During ripening, the

malate content of the fruit decreases. This is accompanied by a steady increase in pH (Fig. 1). Due to variation in buffer capacity, there is no direct relationship between titratable acidity and pH. In general, however, higher acid levels in fruit are often associated with lower pH values and vice versa. Thus the acids of the fruit have a significant bearing on pH (Edson et al., 1995). Figure 1: pH and acidity variation during cold storage period. Mean values for the 2-year study (sample for each evaluated parameter is $n = 10$ fruits). Values showing different letters indicate statistically significant differences in each curve (95% LSD). Total Soluble Solids (TSS) of quince fruits during cold storage period are given in the Fig. 2. There was significant increase in TSS with the passage of time during storage. Data shows that TSS contents of the fresh quince was 15 % and it increased up to 15. 9% after two months of storage , then decreased to 15. 13% at the third month and increased markedly again to 16. 67% at the end of the storage (Fig. 2). Figure 2: Total Soluble Solids (TSS) of quince fruits during cold storage period. Values showing different letters within columns indicate statistically significant differences (95% LSD). Mean values for the 2-year study (sample for each evaluated parameter is $n = 10$ fruits). The increase in the TSS may be attributed to hydrolysis of starch into simple sugars during storage (Biale, 1960). The increase in TSS content of quince might be due to the conversion of carbohydrates into sugars, organic acids and other soluble materials by metabolic process during storage. This result is in line with Kleskchunova who had observed that the TSS contents in different varieties of quince were increased during storage, whereas, the decrease in TSS contents during storage might be due to the increase in respiration rate and conversion of

sugars to carbon dioxide and H₂O at later stage of storage (Kleskchunova et al., 1994). Fruits contain starch, pectic material, disaccharides and monosaccharides such as sugars like sucrose, fructose and glucose. First TSS increases and then decreases and again increases due to the hydrolytic change in starch and conversion of starch to sugar being an important index of ripening process in fruits (Arthey et al., 1995) This phenomenon could also be explained by the glucose consumption due respiration. Respiration is the oxidative breakdown of complex substrate molecules normally present in plant cells, such as starch, sugars, and organic acids, to simpler molecules such as CO₂ and H₂O (Salunkhe et al., 1984; Saltiet, 2004). Postharvest storage can be used to either prevent any reduction in quality, or to promote changes that increase quality. The climacteric fruits such as quinces are usually harvested before they reach their best quality and storage conditions are optimized to permit the development of optimum quality. In this case, synthesis of some components or conversions of others such as starch to sugar are necessary to attain the maximum quality. These synthetic reactions require energy and organic molecules derived from respiration. Fig. 3 presents the firmness data and the pectin contents of the tested fruits during the five months of cold storage. Rapid decline in the both parameters occurred within the first month. Firmness data followed a slight reduction then after but decrease in pectin content was shown to pave a more sensible changes up to the end stage of the study period. Data shows that pectin content of the fresh quince was 3.11% decreased to 1.58% at the end of the cold storage while firmness of fruits reduced to 2.13 Kg/cm² from 3.08 Kg/cm² (Fig. 3). This suggests some general mechanisms of tissue softening.

Figure 3: Firmness and pectin content variation trends of quince fruits during cold storage period . Mean values for the 2-year study (sample for each evaluated parameter is $n = 10$ fruits). Values showing different letters indicate statistically significant differences (95% LSD). Since quince is a climacteric fruit, the acceleration of ethylene production during ripening may be expected (Kader, 1992). A striking characteristic of climacteric fruit is their autocatalytic ethylene production. Exposure of fruit to a storage temperature of -1 to 0 °C (30.2 to 32 °F) stimulates synthesis of ethylene, because low temperature induces biosynthesis of the immediate ethylene precursor that starts to accumulate and, as a consequence, the fruit begins to produce ethylene and ripen (Lelièvre et al., 1997; Agar et al., 2000). In fruits held at 25 °C a strong decrease in ethylene production and a delay in ripening were recorded, while in fruits held at 4 °C an opposite trend was observed (Bregoli et al., 2005). Fruit softening is characterized by changes in firmness and has long been associated with ripening (Dostal, 1975). These changes in firmness determine quality of the fruits. Softening reflects chemical and physical changes in cell wall. It is associated with cell wall disassembly and modifications in the pectin fraction, which are some of the most apparent changes that take place in the cell wall during ripening (Marin-Rodriguez et al., 2005). Softening is generally accompanied by solubilization of pectin, involving the action of the enzymes (White, 2002). Total and insoluble pectins progressively decreased with fruit ripening, while the soluble pectins increased from the mature-green stage to the ripe stage (Misoon et al., 2005). Some authors reported that pectins from quince fruits had medium and high degree of methylation and low degree of acetylation

and it was decreased during cold storage (Turk et al., 2002; Forni et al., 1994; Thomas et al., 2003). It was reported that the pectin yield from quince was on average 0.53% on fresh weight, which is of a similar order to apple (Forni et al., 1994). The progressive loss of firmness was attributed with ripening to the gradual solubilization of protopectin and pectin in the cell wall to form soluble pectin and other products (Hobson, 1968).

4. CONCLUSION

The results showed that except titratable acidity all the parameters significantly changed after one month of harvesting time and then tended to be stable for the next month. During the last 3 months of cold storage, the firmness, pectin content, titratable acidity and pH of the quinces did not significantly change; total soluble solids however continued rising even at the late stage of cold storage period.

ACKNOWLEDGEMENTS

The authors are thankful to Agricultural Engineering Research Institute and Isfahan Center for the Research of Agricultural Science & Natural Resources for financial support of this project.