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EFFECT OF STORAGE DURATIONS ON PHYSICO-CHEMICAL CHARACTERISTICS OF POMEGRANATE VARIETIES

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Abstract

The effect of storage duration on Physico-chemical characteristics of pomegranate varieties was investigated at post harvest laboratory, Department of Horticulture, Tarnab Research station Pakistan during the year 2016 using completely randomized design (CRD) with each treatment replicated three times. Two pomegranate varieties (Kandahari and Charat) were stored for different storage durations (0, 2, 4, 6 weeks). The data was recorded on total soluble solids, reducing sugar (%), total sugar (%), non reducing sugar (%), sugar acid ratio and acidity (%). The results showed that the varieties and storage intervals were found significant. Maximum TSS (14.66 ^{0}Brix), total sugar (0.512 %), non reducing sugar (0.414 %), sugar acid ratio of (0.326), and minimum acidity (0.50 %) was found in variety kandahari while in storage durations maximum total soluble solids (16.13 %), total sugar (0.439 %), non reducing sugar (0.624 %), sugar acid ratio (0.389) and minimum acidity (0.11 %) was recorded when stored for six weeks while in both cases reducing sugar was found non- significant. It was concluded that the variety kandhari effected TSS, total sugar, non reducing sugar, sugar acid ratio and acidity having the ability to store up to six weeks with maintained quality attributes.

Key words: Pomegranate, Storage Duration, Physico chemicals, Varieties.

INTRODUCTION

Pomegranate (*Punica granatum* L.) is one of the most important fruit crop in the south of Alicante (Southern Spain) where more than 90% of national production originates. It is estimated that pomegranate cultivation may have started somewhere during Neolithic age (Holland and (Holland, 2008). Although, pomegranate is an old fruit tree and spread over the world it has more synonyms and the same genotype can still be called with different names in different areas. Aril and husk colour can differ greatly when grown in various areas which result in more synonyms. The characteristic phenotypes used in identifying consumer preferences and the niche market are determined by husk colour (ranging from yellow to purple, with pink and red most common), aril colour (ranging from white to red), hardness of the seed, maturity, juice content, juice taste (ranging from sweet to astringent), acidity, as well as fruit size (IPGRI, 2001).

It is one of the important commercial horticultural fruit which is generally well adapted to the Mediterranean climate (Biale, 1981). It has been cultivated extensively in Iran, India and in some parts of U.S.A (California), China, Japan and Russia. Pomegranate fruits are consumed fresh or processed as juice, jellies and syrup for industrial production (Hodgson, 1917). Different parts of its tree (leaves, fruits and barks) have been used traditionally for their medicinal properties and for other purposes such as in tanning (Rania and Ne´jib, 2007).

Pomegranate pests and their management strategies differ greatly, depending on climate, countries and cultivars. Whereas pomegranate trees are attacked by more than 90 species of insects in India while Spain most of these species have not been recorded (Balikai *et al.*, 2011). Literature on pomegranate pests in Spain is not extensive, but it is known that infestation by sucking pests like aphids and mealy bugs is more common in pomegranates in this Mediterranean area (Turfan *et al.,* 2011).

In addition to its ancient historical uses it was lauded in the Old Testament of the Bible, Koran, the Jewish Torah, and the Babylonian Talmud as a sacred fruit conferring powers of fertility, abundance, pomegranate is used in diverse systems of medicine as ailments. It has been featured prominently in all the major religions of the world and has been used for centuries for the treatment of various ailments. The unique chemistry of pomegranate tree has led many studies to be conducted on evaluation of functional efficacy of this fruit due to the claims related to wellbeing. Since the traditional importance of pomegranate as a medicinal plant is well-established by scientific researches, market demand and production of pomegranate products thereof showed a considerable increase.

Currently, there is growing interest in the pomegranate fruit because it is considered to be a functional product of great benefit in the human diet as it contains several groups of substances that are useful in disease risk reduction (Martinez *et al.,* 2006). Pomegranate is one of the few fruits that are still not evaluated even though it is has a potential in the world market. However, data that describe the production, physico-chemical properties, antioxidant, acids and sugars in different cultivars is lacking in Pakistan.

Pomegranate fruit growth and maturity is characterized by different stages, each stage corresponds to an array of defined biochemical, physiological and physical as well as structural and textural attributes that result in changes in flavour, fruit respiration, size and colour which all make the fruit desirable for consumption (Benarie *et al.,* 1984; Al-Maiman and Ahmad, 2002; Fawole and Opara, 2013).

Pomegranate fruit quality can be assessed based on external properties such as shape, size and colour (Kader, 2006; Holland *et al.,* 2009). Factors considered such as aril colour; total soluble solids and acidity to meet market standards (Benarie *et al.,* 1984). Previous studies have reported that physico-chemical attributes of fruit (at different fruit developmental stages) vary across varieties which in turn affect the storage life of fruit therefore the present study was aimed to study the effect of storage durations on physico chemical properties of pomegranate varieties.

MATERIALS AND METHODS

Pomegranate varieties (*Kandahari* and *Charat*) were bought from pomegranate orchid, ARI Tarnab Peshawar- Pakistan. The fruits were harvested early in the morning and immediately brought to Horticulture laboratory and kept under 26^{o}C. Pomegranates of the uniform color, shape, size (350-400g) disease and defect free were selected from both varieties for the experiment. Total number of 9 fruits from each variety were taken and repeated 6 times in the experiment with a total number of 54 fruits. Three fruits from each experimental unit were taken for comparison after second week of testing both the varieties (*Kandahari* and *Charat*). It was tested four times in the experiment. Physico-chemical properties determined include TSS (^{0}Brix), %Acidity, Reducing sugar, Total sugar, non-reducing sugar and sugar acid ratio. Total soluble solids (^{0}Brix) were measured from the fruits juice using standard procedure by AOAC (1994).

Reducing sugar: A sugar that serves as a reducing agent due to its free aldehyde or ketone functional groups in its molecular structure. Reducing sugar was measured by using standard procedure mentioned by AOAC (1990).

Total sugar: Total sugar was obtained by the method as mention A.O.A.C (1990).
Total sugar= reducing sugar + non reducing sugar.

Non reducing sugar: Those sugars are non reducing sugar which is not able to donate electrons to other molecules. 10 ml sample was taken in flask and volume was made with water (distilled) up to 100 ml. And heated for 10 minute the flask till boiling and Solution was added till red color using methylene blue indicator AOAC (1990).

Sugar Acid Ratio: The sugar to acid ratio was measured by dividing the total soluble solids with titratable acidity.

$$\text{Sugar acid ratio} = \frac{\text{Total soluble solids}}{\text{Titratable acidity}}$$

Titratable acidity: It was determined by neutralization reaction as described in AOAC (1990).

Statistical procedure: All the data collected were analyzed using completely randomized design. In case the data was found significant least significant difference test was applied for mean comparison. A statistical package Statistix (8.1) was used for analyses of the data (Jan *et al.,* 2009).

RESULTS AND DISCUSSION

Total Soluble Solids (^{0}Brix): The data regarding TSS is given in Table 1. The statistical analysis of the data showed that TSS was significantly affected by varieties and storage intervals. Maximum TSS (16.13 ^{0}Brix) was recorded at six weeks storage while minimum TSS (13.0 ^{0}Brix) was recorded at freshly harvested fruits whereas in varieties maximum TSS (14.66 ^{0}Brix) and minimum TSS (14.50 ^{0}Brix) was recorded in *Kandhari and Charat* respectively. The increase in the TSS in these fruits is always associated to ethylene synthesis. Since during the ripening of pomegranate cultivar Pedo Sato there was variation recorded in the level TSS with the increased ethylene synthesis. The behavior of the TSS during ripening of climacteric fruits changes when stored for longer period of time. The present results are also in conformity with Ali *et al*. (2011) who observed that higher respiration rate increases results in maximum conversion of starch to sugar. Similar results are also reported by Tsegay *et al.* (2013) who observed maximum TSS in sweet bell pepper varieties.

Reducing Sugar (%): The effect of varieties and storage period was found non significant. The results are shown in Table 1.

Total Sugar (%): The maximum total sugar (0.512 %) was recorded in variety *Kandhari* where as minimum total sugar (0.383 %) was recorded in variety *Charat.* Among the storage duration maximum total sugar (0.439 %) was observed at six weeks after storage while minimum total sugar (0.253 %) at fresh analysis. Sugar compound of fruit are strongly linked with the genetic makeup of the cultivar while in storage duration the starch convert to sugar due to respiration and other processes take place inside the fruit. These finding are also confirmed by Jan *et al.* (2012) who recorded maximum total sugar in apple cultivars when stored for different duration. Similar observation was also reported by Kulkarni *et al.* (2005) in pomegranate fruit at its growth and development stage.

Non Reducing Sugar (%): Results related to non reducing sugar are shown in Table 1. Maximum non reducing sugar (0.414 %) was recorded in variety *Kandahari* while minimum reducing sugar (0.383 %) was noted in variety *Charat.* Among the storage durations maximum non reducing sugar (0.624 %) was recorded at six weeks after storage while minimum (0.206 %) was observed at freshly harvested fruit. Non reducing sugar was found more in one variety compare to the other this might be due to the genetic makeup of the variety. Similar results are also reported by Varasteh (2008) who observed the physic chemical changes in pomegranate varieties.

Sugar Acid Ratio: Storage durations and varieties have shown their effect on sugar acid ratio. Maximum sugar acid ratio (0.326) was observed in variety *Kandhari* while minimum sugar acid ratio (0.213) was observed in variety *Charat.* Regarding storage durations maximum sugar acid ratio (0.389) was observed at six weeks interval while minimum sugar acid ratio (0.164) was recorded from fresh fruit analysis. These finding are conformity with Labbe *et al.* (2010) who observed different physico chemicals and phenolic composition properties of different pomegranate stored in refrigeration.

Acidity (%): The variety *Kandahari* was found with minimum acidity (0.50 %) compare to variety *Charat* that shown maximum acidity (0.70 %). Storage intervals also affected acidity in which minimum (0.51 %) acidity was recorded six weeks after storage while maximum acidity (0.11 %). These finding are confirmed by Shulman *et al.* (1984) who observed different acidity level that changed from cultivar to cultivar and from various regions. Decline in acidity during fruit growth, development and storage was recorded in cultivar wonderful (Jan *et al.*, 2012; Schwartz *et al.*, 2009). Similar results were reported by Mustafa *et al.* (2008) that decline in acidity pomegranate cultivars occur due to use of organic acid for the production of organic compounds during ripening.

Table-1: Total soluble solid, reducing sugar, total sugar, non reducing sugar, sugar acid ratio and acidity of pomegranate fruit as affected by storage durations and varieties.

Storage Durations (weeks)	TSS	RS	TS	NRS	SAR	Acd
0	13.01 d	0.213	0.253 c	0.206 c	0.164 d	0.51 a
2	14.06 c	0.299	0.332 b	0.285 bc	0.216 c	0.40 b
4	15.12 b	0.403	0.439 a	0.346 b	0.308 b	0.30 c
6	16.13 a	0.642	0.439 a	0.624 a	0.389 a	0.11 d
LSD (<0.05) for S	0.1011	NS	0.0772	0.1014	5.055	0. 0110
Varieties	**TSS**	**RS**	**TS**	**NRS**	**SAR**	**Acd**
Kandahari	14.60 a	0.42	0.512 a	0.414 a	0.326 a	0.50b
Charat	14.50 b	0.36	0.383 b	0.325 b	0.213 b	0.70 a
LSD (<0.05) for V	0.0715	NS	0.0546	0.0717	3.575	0.0715

TSS =Total soluble solids; RS = Reducing sugar; TS = Total sugar; NRS = Non reducing sugar; SAR = Sugar acid ratio; T = Titratable acidity; Acd = Acidity S = Storage and V = Varieties.

CONCLUSION AND RECOMMENDATION: Based on the above results it was concluded that the variety *Kandhari* retain all the quality attributes and have the ability to store for longer period of time. Hence the variety *Kandhari* is recommended for better storage as well as to retain the qualitative attributes of pomegranate fruit.

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