Adv. Hort. Sci., 2019 33(1): 139-143 DOI: 10.13128/ahs-22813

Short note

AHS
Advances in Horticultural Science

Effects of packing materials and ethanol concentrations on removal of astringency of 'Rojo Brillante' at room temperature

Z. Hejazi [1] (*), M.I. Sadat [1], B.K. Karimi [2], M. Fawad [3], A. Muneer [3]

[1] *Department of Horticulture, Faculty of Agriculture, Nangarhar University, Afghanistan.*

[2] *Directorate of Agriculture, Irrigation and Livestock (DAIL), Jalalabad, Afghanistan.*

[3] *Perennial Horticulture Development and Research Center (PHDC), Jalalabad, Afghanistan.*

OPEN ACCESS

Key words: calcium carbide, de-astringency, *Diospyros kaki*, ethanol dipping.

(*) **Corresponding author:**
zia.hejazi@yahoo.com

Citation:
HEJAZI Z., SADAT M.I., KARIMI B.K., FAWAD M., MUNEER A., 2019 - *Effects of packing materials and ethanol concentrations on removal of astringency of 'Rojo Brillante' at room temperature*. - Adv. Hort. Sci., 33(1): 139-143

Data Availability Statement:
All relevant data are within the paper and its Supporting Information files.

Competing Interests:
The authors declare no competing interests.

Received for publication 17 April 2018
Accepted for publication 5 October 2018

Abstract: Most of the persimmons grown in Afghanistan are astringent, hence their fruits require de-astringency treatments to become edible at harvest time. The CO_2 with or without ethanol treatment provides an optimal method for the rapid removal of the persimmon astringency. However, this method is sophisticated and currently not feasible for most of the farmers. The present study is therefore carried out to assess a simple and suitable technique for de-astringency of the persimmons at farmer level. The fruits of 'Rojo Brillante', a Pollination Variant Astringent (PVA) Spanish cultivar, were quickly dipped in 0, 10, 20, and 40% ethanol. The treated fruits were packed and sealed in the paper cartons, polyethylene bags or left open at the room temperature. The firmness, total soluble solids and astringency level of fruits were measured after every three days for nine days. The astringency was removed when fruits treated with 20% or 40% ethanol and packed in the polyethylene bags for nine days. The total soluble solids content of the fruits treated with ethanol was lower in any of the used concentrations than the untreated fruits. The commercial firmness of the fruits (1.5-2.5 kg) obtained by packing the fruits in the polyethylene bags or treated with 20% ethanol concentration.

1. Introduction

Persimmon (*Diospyros kaki* Thunb.) is one of the fruits cultivated in the East of Afghanistan. The subtropical climate of this region provides a favorable environment for the persimmon production. On the other hand, the naturally grown wild population of *Diospyros lotus* can be seen in the mountainous area, lies at an altitude between 1500 and 1900 m asl (Samadi *et al.*, 2009).

In the frame of Perennial Horticulture Development Project (PHDP), an *ex situ* germplasm of 24 persimmon accessions was established in Farme-Jaded, Jalalabad (Masini and Giordani, 2016). Currently, this center preserved 22 different varieties, of which ten were donated by University of Florence, Italy (afghanhorticulture.org; Samadi *et al.*, 2009). These cultivars contained both astringent and non-astringent types of the persimmons. Because of the good adaptation with the climate and affinity with a more common rootstock of *Diospyros lotus*, the astringent type is widely spread in the country. Non-astringent persimmons are normally edible at harvest, whereas fruit of the astringent cultivars as 'Rojo Brillante' (Pollination Variant Astringent - PVA) can be consumed after astringency is removed. Natural loss of the astringency of the latter type is achieved by leaving the fruits on the tree until they are overripe, with soft flesh (Taira, 1995). However, it is not desirable for the fruit growers, because it takes a long time, attracts birds eating the fruits and increases protection expenses; furthermore, the handling and marketing of soft fruits is very time consuming and expensive. Due to these limitations, the ripening of the astringent persimmons by the artificial method is required. In Afghanistan, the persimmon producers used Calcium Carbide (CaC_2) to hasten ripening process of the fruits (Samadi *et al.*, 2009). This agent is also commonly used in ripening of mangoes and bananas in several other developing countries (Asif, 2012). Although CaC_2 is widely available, easy to use and cheap, it is associated with health hazards. Recent findings have proved that calcium carbide is carcinogenic (Per *et al.*, 2007; Asif, 2012). Moreover, fruits ripened with CaC_2 have negative quality attributes. They are often soft and less tasty, and have a shorter storage life. Therefore, secure and simple methods that can be used by farmers to remove astringency of persimmons are needed.

Today, the world top persimmon producers make use of either CO_2 or ethanol (EtOH) for the removal of the persimmon astringency (Kato, 1984, 1990; Eaks, 1967). The use of CO_2 is safe and induces rapid ripening, but maintaining a strict control condition of its application wouldn't be easy for the persimmon growers, particularly in remote countryside orchards. De-astringency of the 'Rojo Brillante' persimmons by CO_2 with or without ethanol is already established (Salvador *et al.*, 2007; Novillo *et al.*, 2015), but the removal of astringency using alcohol without CO_2 has not been explored. The aim of the present study was to assess the use of EtOH without CO_2 in different packaging material.

2. Materials and Methods

The fruits of 'Rojo Brillante' from two clones of 5-year-old trees grown in Jalalabad Perennial Horticulture Development and Research Center, formerly named PHDP, were harvested at the yellow-orange color on October 2017. After sorting, fruits (n=180) were mixed for uniformity of size and used for the experiments. The fruits were quickly immersed in 0 (distilled water), 10, 20, and 40% aqueous ethanol solutions and then air dried. Sixty fruits were packed and sealed in the paper catons (2 kg net weight), another 60 fruits were sealed in transparent polyethylene bags (0.018 mm thickness), and the remaining fruits were left open at the ambient temperature. The fruits within each group were further sub-divided into five per pack. Subsequently, all the packaged fruits left at the room temperature. Room temperature measured at 15 min interval using a data logger with thermo-hygro sensor (RC-4HC, Elitech, Jiangsu Jingchuang Electronics Co., Ltd, China). The data were recorded after every three days for the fruit firmness, total soluble solids (TSS) and astringency levels. Fruit firmness was determined for each fruit at two pared equatorial positions after peeled, using a hand-held penetrometer equipped with an 8 mm tip. To measure the astringency and TSS, fruits were cut into two halves. One half was used to estimate astringency and the remaining halve was used to express the juice for the brix with a digital Atago refractometer. The astringency was estimated by tannin print method (Eaks, 1967), where the freshly cut surface of the fruit soaked in 5% ferric chloride and then the black color scored from 0 (non-astringent) to 5 (very astringent).

The data were subjected to repeated measures ANOVA of General Linear Model of SPSS (16.0) statistical software and mean separation was performed using Tukey's (HSD) method at $P \leq 0.05$.

3. Results and Discussion

The room naturally kept almost a consistent temperature that averaged 20.9°C during the experiments. This degree is recommended if faster de-astringency of the persimmons is aimed with CO_2 or CO_2-ethanol treatment (Besada *et al.*, 2010; Novillo *et al.*, 2015).

The results of the ANOVA showed that firmness of the 'Rojo Brillante' fruits were significantly affected by packing and ethanol concentrations; however, the interaction between packing and ethanol was found insignificant (Fig. 1). The fruits packed and sealed nine days in the polyethylene bags were softer (2.5 kg) than of paper cartons (3.0 kg) and unpacked persimmons (2.9 kg). Likewise, fruits treated with 20% ethanol was significantly softer (2.5 kg) than the fruits treated with distilled water (3.1 kg). Kato (1990) stated that high-quality persimmon fruit has a firmness of 1.5 to 2.5 kg; fruit firmer than 2.5 kg is too hard and fruit with a firmness <1.5 kg are too soft to tolerate the physical handling. Hardness of the persimmon fruits is a concern both for the consumers and fruit shelf life, but people in our region are not yet familiar with eating of crispy persimmons.

The content of soluble solids was significantly affected by the ethanol concentrations, while the effects of packing and the interaction were not considerable (Fig. 2). The TSS of the fruits immersed in 20% ethanol solution were significantly lower (17.9) than of distilled water (19.5). More in a similar pattern, ethylene treatment decreased total soluble solids of the astringent type of 'Hiratanenashi,' but increased in fruits of 'Fuyu,' which is a non-astringent persimmon (Takata, 1975).

Except for the ethanol concentrations, the astringency of the 'Rojo Brillante' fruits was significantly influenced by packing and the interaction between packing and ethanol concentration at $P \leq 0.002$. Despite that after six days of the treatment, recurrence of the astringency (Edagi *et al.*, 2009; Sestari *et al.*, 2009) was evident in some treatments, fruits treated with 20% or 40% ethanol concentrations and placed nine days in the polyethylene bags remained slightly to non-astringent (Fig. 3 and 4). These findings are in accordance with Kato (1987) who attained de-astringency of the persimmons by ethanol vapor method. In our study, packing alone was not effective to remove the astringency, because the fruits treated with distilled water and placed nine days in the paper cartons or polyethylene bags were similar as those exposed to the room ambient. Although the anaerobic condition of the package or chamber promoted de-astringency of the persimmons (Eaks, 1967; Novillo *et al.*, 2015; Monteiro *et al.*, 2017), no effect of the polyethylene bags or paper cartons

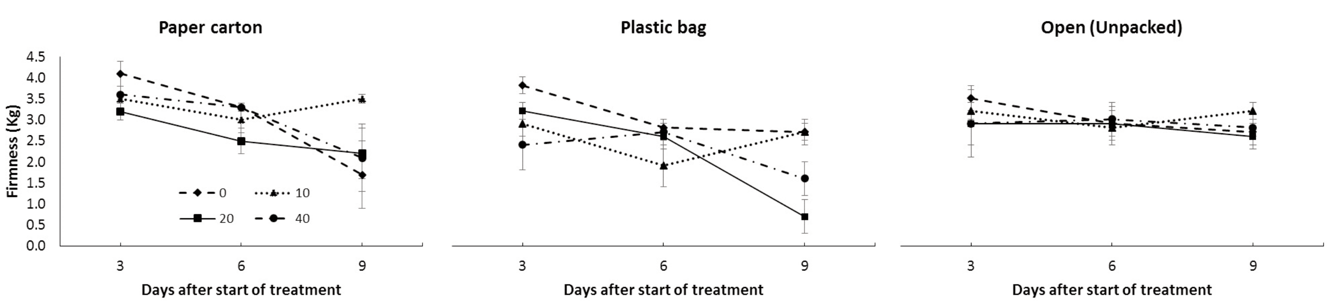

Fig. 1 - Changes in the firmness of 'Rojo Brillante' fruit treated with 0, 10, 20, and 40% ethanol and then packed and sealed in paper cartons, polyethylene bags or left open during three days at the room ambient. Bars indicate SE (n= 5).

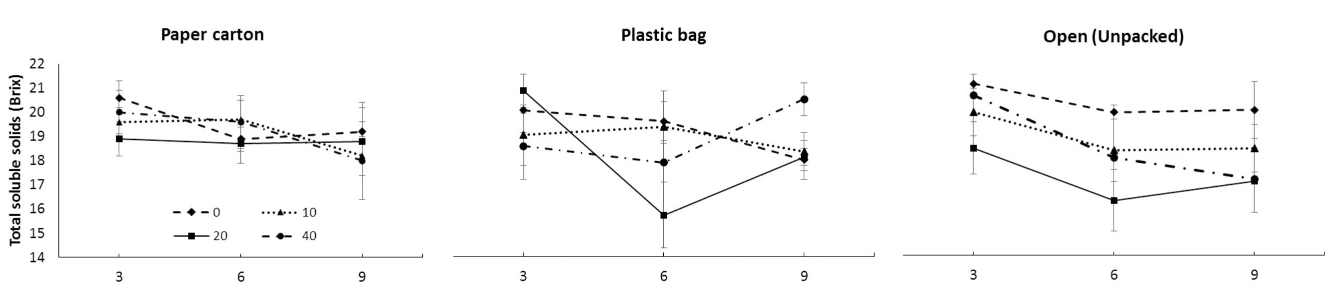

Fig. 2 - Changes in total soluble solids of 'Rojo Brillante' fruit treated with 0, 10, 20, and 40% ethanol and then packed and sealed in paper cartons, polyethylene bags or left open during three days at the room ambient. Bars indicate SE (n= 5).

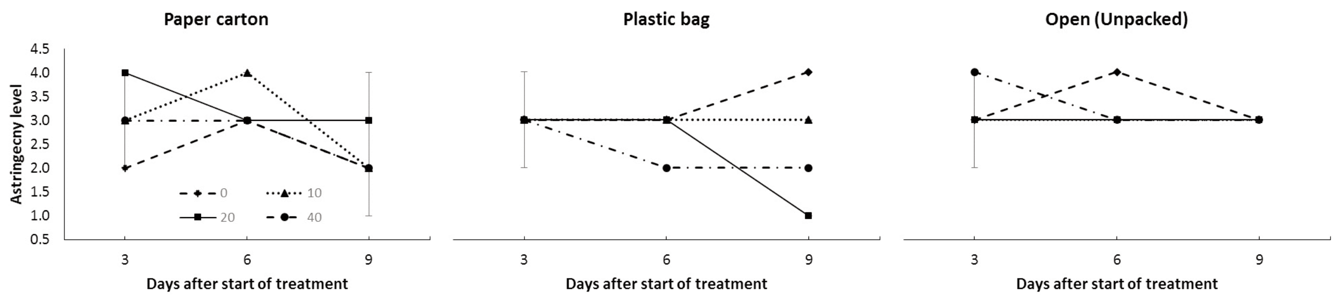

Fig. 3 - Changes in astringency level of ‘Rojo Brillante’ fruit treated with 0, 10, 20, and 40% ethanol and then packed and sealed in paper cartons, polyethylene bags or left open during three days at the room ambient. Bars indicate SE (n= 5).

would be associated with materials permeability. Monteiro *et al*. (2017) reported that among three different polyethylene packages, polyethylene-polyamide succeeded to remove ‘Giombo’ astringency faster, whereas low-density polyethylene and polypropylene didn’t work because of their greater permeability to gases. Moreover, the result of de-astringency of the closed chamber with no-addition was alike with the chamber added ethyl alcohol (Eaks, 1967).

Astringency will be removed when soluble tannins are becoming insoluble because of the polymerization with acetaldehyde in the fruit flesh during the treatments (Taira, 1995). Since acetaldehyde is known to be generated *in situ*, it can be triggered by exogenous ethanol application (Novillo *et al.*, 2015). Kato (1984) revealed that during de-astringency of the persimmons, acetaldehyde increased with the increase of ethanol concentration. He further explained that alcohol treatment caused a rise in ethylene evolution and induced carbon dioxide. Thus, the effectiveness of the polyethylene bags to astringency removal in higher doses (20%, 40%) of the ethanol solutions of this study might be referred to ethylene and through CO_2 production, which probably preserved better by the polyethylene bags than of paper cartons.

Fig. 4 - Tannin prints of the freshly cut surface of ‘Rojo Brillante’ fruits treated with 20% ethanol solution, then left open at the room ambient (A), or packed and sealed in paper cartons (B), or polyethylene bags for nine days (C).

4. Conclusions

This study suggests that it is feasible to remove astringency of the ‘Rojo Brillante’ persimmons by packing them nine days in the polyethylene bags after immersed in 20% ethanol solution. However, to assure complete sweetness, time might be extended for two or three more days, depending on fruit maturity, temperature, and package permeability. Future researchers may test polyethylene bags in different thickness along with some modifications to improve this protocol for a more rapid loss of the persimmon astringency.

Acknowledgements

We would like to appreciate the effort of the European Commission (EC), in the particular University of Florence for granting the elite cultivars of persimmons to the national fruit collection of Jalalabad, Afghanistan.

References

ASIF M., 2012 - *Physico-chemical properties and toxic effect of fruit-ripening agent calcium carbide*. - Ann. Trop. Med. Public. Health, 5: 150-156.

BESADA C., ARNAL L., SALVADOR A., MARTÍNEZ-JÁVEGA J.M., 2010 - *Optimization of the duration of deastrin-*

gency treatment depending on persimmon maturity. - Acta Horticulturae, 858: 69-74.

EAKS I.L., 1967 - *Ripening and astringency removal in persimmon fruits*. - Proc. Amer. Soc. Hort. Sci., 91: 868-875.

EDAGI F.K., SESTARI I., TERRA F.A.M., CHIOU D.G., KLUGE R.A., ANTONIOLLI L.R., 2009 - *Effect of ripening stage on astringency removal of ‘Rama Forte’ persimmon*. - Acta Horticulturae, 833: 269-274.

KATO K., 1984 - *Astringency removal and ripening as related to ethanol concentration during the de-astringency by ethanol in persimmon*. - J. Jpn. Soc. Hort. Sci., 53: 278-289.

KATO K., 1987 - *Large-scale trials for the short term de-astringency in persimmon fruits by ethanol.* - J. Jpn. Soc. Hort. Sci., 56: 92-100.

KATO K., 1990 - *Astringency removal and ripening in persimmons treated with ethanol and ethylene*. - HortSci., 25(2): 205-207.

MASINI G., GIORDANI E., 2016 - *From traditional orchards to advanced fruitculture: establishing the bases of commercial horticulture in Afghanistan.* - Adv. Hort. Sci., 30(4): 197-205

MONTEIRO M.F., AGUILA J.S.D., PESSOA C.D.O., KLUGE R.A., 2017 - *Vacuum packaging is efficient to remove astringency and to maintain the firmness of ‘Giombo’ persimmon.* - Rev. Bras. Frutic., 39: e-358.

NOVILLO P., GIL R., BESADA C., SALVADOR A., 2015 - *Astringency removal of ‘Rojo Brillante’ persimmon by combining CO_2 and ethanol application.* - Acta Horticulturae, 1079: 599-604.

PER H., KURTOĞIU S., YAĞMUR F., GÜMÜŞ H., KUMANDAŞ S., POYRAZOĞIU M.H., 2007 - *Calcium carbide poisoning via food in childhood.* - J. Emerg. Med., 32(2): 179-180.

SALVADOR A., ARNAL L., BESADA C., LARREA V., QUILES A., PÉREZ-MUNUERA I., 2007 - *Physiological and structural changes during ripening and deastringency treatment of persimmon fruit cv. ‘Rojo Brillante’*. - Postharvest Biol. Technol., 46: 181-188.

SAMADI G.R., MIAKHEL I.M., ABDIANI S.A., 2009 - *Status of persimmon cultivation in Afghanistan.* - Acta Horticulturae, 833: 31-34.

SESTARI I., EDAGI F.K., TERRA F.A.M., CHIOU D.G., KLUGE R.A., ANTONIOLLI L.R., 2009 - *Influence of ripening stage and astringency removal on quality of cold stored ‘Rome Forte’ persimmon.* - Acta Horticulturae, 833: 263-268.

TAIRA S., 1995 - *Astringency in persimmon,* pp. 97-110. - In: LINSKENS H.F., and J.F. JACKSON (eds.) *Fruit analysis*. Springer, Hannover, Germany, pp. 160.

TAKATA M., 1975 - *Effects of ethylene on the respiration and ripening of fruits.* - J. Jpn. Soc. Hort. Sci., 44(1):82-88.