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Studying the Effect of Zinc, Boron and Putrescine on Some of the Physicochemical Properties of Nectarine (Quetta Variety)

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ABSTRACT

This experiment was done the aim of studying various concentrations of zinc sulphate, Boric acid and Putrescence on some physicochemical and storage properties in nectarine (*Prunuspersica* bath).This study was carried out in complete randomized block design with seven treatments and three replications. The fruit baskets were cold stored in 1 degree centigrade temperature and 90% moisture throughout the experiment. The testing traits were measured once in every five days. The traits being tested included wet weight of the fruit, the amount of acid, the percent of solid soluble materials in the fruit, firmness of tissue and the amount of flavonoid. The results showed that the effect of time and different concentration of nutrient on the percent of solid soluble materials and the amount of fruit acid in the level of 1% was significant. There was also a negative and significant relationship with the level of 1% between the tissue firmness with the amount of fruit acid and the percentage of soluble solid material with the dry weight of the fruit. Studying the simple correlation coefficient of the measured compounds showed that there is a positive and significant relationship with the level of 1%between the traits of dry and wet weight of the fruit as well as a negative and significant relationship to the level of 1% between the tissue firmness with rate of fruit acid, the percent of solid material with dry weight of the fruit and tissue firmness with the rate of fruit acid.

KEYWORDS: Nectarine, Zinc sulphate, Boric acid, Putrescine, physicochemical properties.

1. INTRODUCTION

Nectarine or *Prunuspersica* bath is a tree from Rosaceae, Perunodeae subfamily and Prunus genus. It grows up to 50 degrees North and South latitude. In higher latitudes, the vegetative and reproductive organs of these trees do not tolerate clod weather. Nectarine depended on the variety, needs 400 to be 1000-hours cold weather and between 0 to 7 degrees centigrade to remove physiological sleep **[1]**. The problem of fruits and vegetables preserving is their high content of water. In fact, they contain about 80 percent water. This fact leads to their decay. Between 25-85 percent of fruits and vegetables are lost after harvest. This rate is higher in developing countries as compared to the developed countries. This fact emphasizes the importance of postharvest physiology [16,19]. The nutrients' composition in nectarine includes sugar:13%, organic acid:1/5%, Pectine :1%,protein:1/1%,Vitamin A; 8 ml. gr, Vitamin C:12 ml/gr., Phosphorous:40 m/gr., Calcium:0.8 ml/gr. Magnesium :5/14 ml,gr [**2**].Peach and nectarine consist of 87% Waterin eatable parts of the fruit. Nectarine has cold and wet nature. It contains vitamins A-B-C, sugar and minerals **[3,9]**. The harvest parameters in nectarine are the tissue firmness and thermal storage. It should be noted that the fruits have to be harvested a little harder in order to be sent to distant parts **[1]**.Malic acid is the superior acid in peach, nectarine and apricot. The most common and abundant acids found in vegetal eatable tissues are citric acid and malic acid that can consist more than 2percent of the fresh fruit's weight**[1]**.Zinc is a definite essential element for natural growth of all plants and plays an important role in the development and quality of the crops. Zinc deficiency caused yellowing inside the kernel and decreasing the size of the leaves and deformation of the branches. Zinc deficiency in orchards cause baldnessandin. In the other agricultural yields such as crops, citric, cane, cotton and so on is manifested in a variety of forms**[11]**.Polyamines are one group of plant growth regulators with low molecular weight and different hydro-carbonic groups. These elements almost found in all living organisms. They have a role in a wide variety of physiological processes, including embryogenesis, root formation, pollen formation, floral induction, earlier development of the fruit and reaction against stresses. The regulating role of polyamines is concerted of their reaction against stresses and senility. It prevents senility through strengthening cell pellicles and inhibiting hydrolytic enzymes. Most of the existing polyamines are seen in Putrescine, spermidine and spermine forms. Valero *et al*., (2002) showed that Fleshy and juicy fruits like nectarine and peach are severely vulnerable to decay. They have a short period of storage because of their high content of

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water, high rate of vaporization and post-harvest breathing. Postpone of these nascence stage in these types of fruits seems very essential to increase the period of storage **[22].**
Also the storage and some of the quality features of these fruits can be improved by using some materials such as polyamines**[18].** Ethylene production is an effective factor in reducing the time of storage and the fruit's loss in postharvest physiology. However, the present studies showed that putrescence has an effective role in ethylene production reducing. It has been reported that ethylene production increased within the storage period of all fruits. However, Putrescence treatment has significantly decreased ethylene production in the fruits as compared to the control. In strawberry, apricot and cherry, the maximum production of ethylene was independent from the used concentrations of Putrescine. This happened in 13th;15th and 20th day after the storage. The maximum production of ethylene in peach for control and 0.5 and 1 mil/molar Putrescence occurred 15 days after treatment and in the 20th day (with 5 days difference) for other treatments**[23]**.Another factor in preserving of fruits is the temperature. Heating treatment can have a major role in contamination reducing. In an experiment, Malakou *et al*., (2005) treated the peach in 46 ˚C for 25 minutes. The results indicated that thermal treatment with warm water decreased mold contamination in peach during storage **[12,14].**

2. MATERIALS AND METHODS

This study was done in agricultural research center of Shahrood located in 6 degrees and 22 minutes North, 54 degrees and 55 Minutes East. All of the experiments was done in the laboratory of food technology in Bastam road.

2.1 Treatments Being Used

Zinc, Boron and Putrescine were used in this research. Seven concentrations were used, including:
1.control(Immersion in distilled water)
2. concentration of 2 and 5 gr. Per liter zinc sulphate
3. concentration of 2 and 5 gr. Per liter Boric acid
4. concentration of 2 and 5 *ppm* Putrescine
For each concentration, three testing replications and for each replicate, three boxes of fruits were considered. Totally 63 fruit boxes were prepared for the experiments. In addition, 2 kilogram nectarine, Quetta variety, were considered for each fruit box. In the other words, totally 126 kilogram nectarine, Quetta variety, were prepared for the experiments.
126 kg of nectarine, Quetta variety=2(Kg fruit for each fruit box)*63(number of fruit box)
It should be noted that the interval time for tests performing was considered once for each 5 days. Except for the sampling in the first day, all testing traits for all concentrations and replications were measured and evaluated in the other five stages.

2.2Measured Traits

The considered traits include: wet weight of the fruit, treatable acidity, the percent of soluble solid materials, tissue firmness and the rate of flavonoid.

2.3 Measuring wet weight

In order to measure the wet weight of the fruit, 9 fruit from each replications were chosen randomly. They weighted and recorded by digital scale.

2.4 Fruit Acid

The fruit acid was measured by titration method.

2.5 The percent of solid soluble material:

The amount of soluble solid materials were measured by refrectometer.

2.6 Calculating Fruit firmness

The rate of tissue firmness of fruit was measured by penetrometer or firmness tester.
The amount of flavonoid gained by using spectrometer in 420wavelength

2.7 Extracting and analyzing of the data

The present study has been done on randomized complete block design with seven treatments in three replications. The data was first recorded in Excel software and then variance analysis was done using SAS (2001) software.

Comparing of means was done in the level of 5% using LSD test. diagrams were drawn by Excel software. This study was done in complete randomized design as factorial and in three replications.

3. RESULTS

The effect of Nutrients on the rate of fruit acid

The results of variance analysis table showed that the effect of storage in different times and the usage of different concentrations of nutrients on the rate of acidity of nectarine was significant at the 1% probability level. While the interaction of time and concentration had no significant effect on the fruit acidity.

Table 1 Analysis of variance was measured

Variable	Degree of freedom	Acidity	Fresh Weight	TSS	Fruit firmness	Flavonoid content
Block	4	0.4306^{**}	900.5^{**}	250.57^{**}	8182^{**}	0.7366^{**}
Dosage	6	0.4231^{**}	433.37^{**}	86.93^{**}	2281^{ns}	0.5654^{*}
Test error	11	0.5289	214.59	76.39	5562	0.5176
CV	-	9.23	22.29	13.26	11.8	14.26

The Effect of Elements on the Rate of Fruit Acid

The results of data variance analysis showed that the application of different concentration of nutrients on the rate of fruit acid was significant in 1%probability level. While the interaction of time and concentration had no significant effect of the rate of fruit acid. According to fig. 1, the most acid was gained in 2 gr/litre Boron and after that in 2 gr/litre zinc and then in 5*ppm*Putrescineas compared to control.

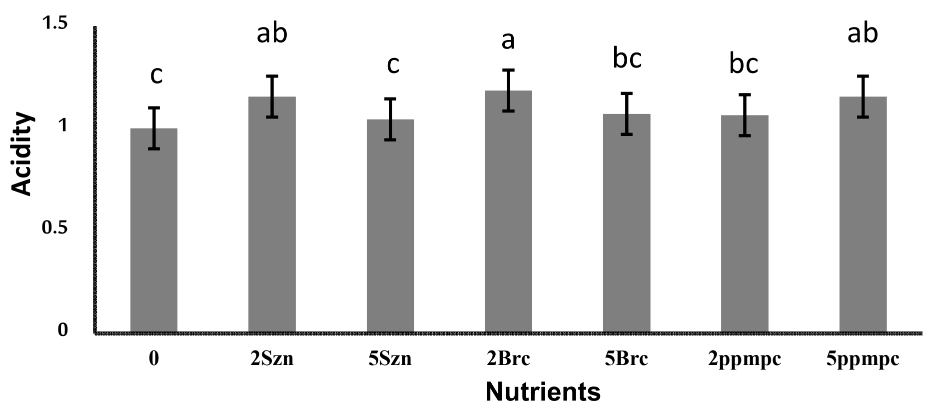

Fig.1-The effect of nutrients on fruit acid

The Effect of Food Element on Wet Weight of the Fruit

The results of variance analysis table showed that the application of different nutrients on the rate of wet weight of nectarine Quetta variety in 1% level was significant while the interaction between time and concentration had no significant effect on wet weight of fruit. Considering the diagram of comparing the means, the most amount of acid was seen in control concentration, and no significant difference was seen between the nutrients and concentration. While in 2gr./liter zinc treatment, a considerable reduction was seen in wet weight of the fruits. No significant difference was seen between the dates August 23, August 3 and August 8. While the least wet weight was seen on August 13 and August 18.These elements through the preserving of cuticle layer wax lead to wall stability. In this way, they paly a crucial role in reducing water exchange of the skin.

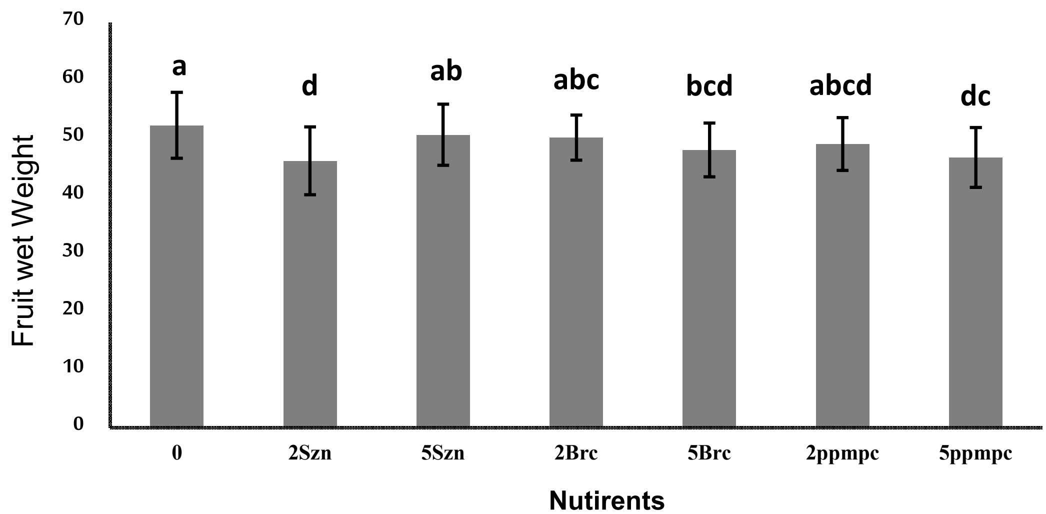

Fig 2. The effect of Nutrients on Fruit Wet weight

The Effect of Nutrients on the Percent of Soluble Solid Materials

The results of variance analysis table showed that the application of different concentration of nutrients on the percent of solid soluble materials in 1% probability level was significant. Also the interaction between time and concentration on wet weight in 5% probability level was significant. Considering the diagram of comparing, the most and least percent of solid soluble materials was seen in 2*ppm*concentration of Putrescine and control, respectively.

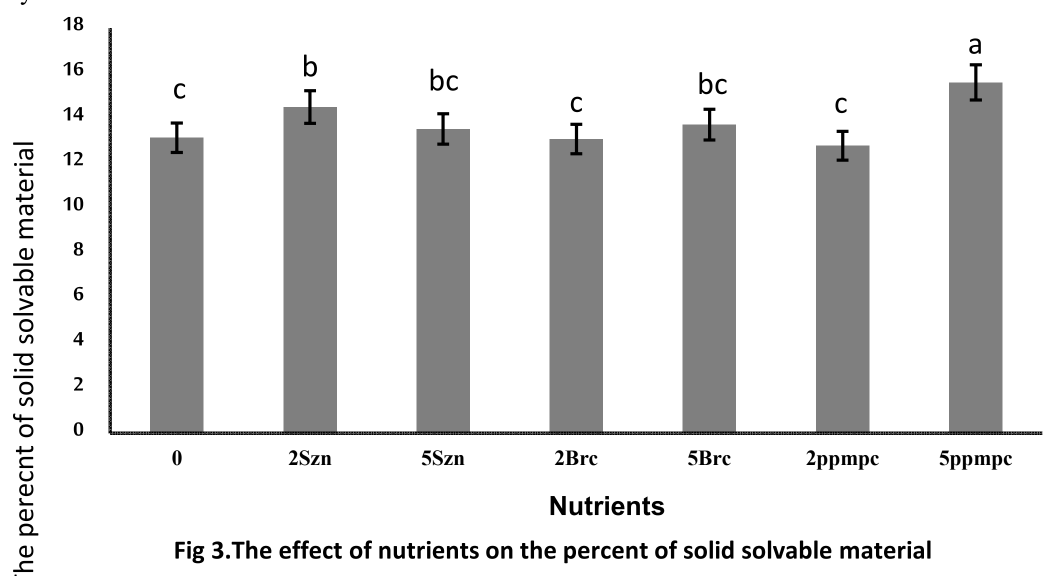

Fig 3.The effect of nutrients on the percent of solid solvable material

The Effect of Nutrient son Fruit Firmness

Based on the variance analysis table, effect of storage duration on fruit firmness was significant at the 1%level. While different concentration of nutrients and the interaction between time and concentration had no significant effect on tissue firmness. In addition, there was no significant difference between different concentration of nutrients in fruit firmness.

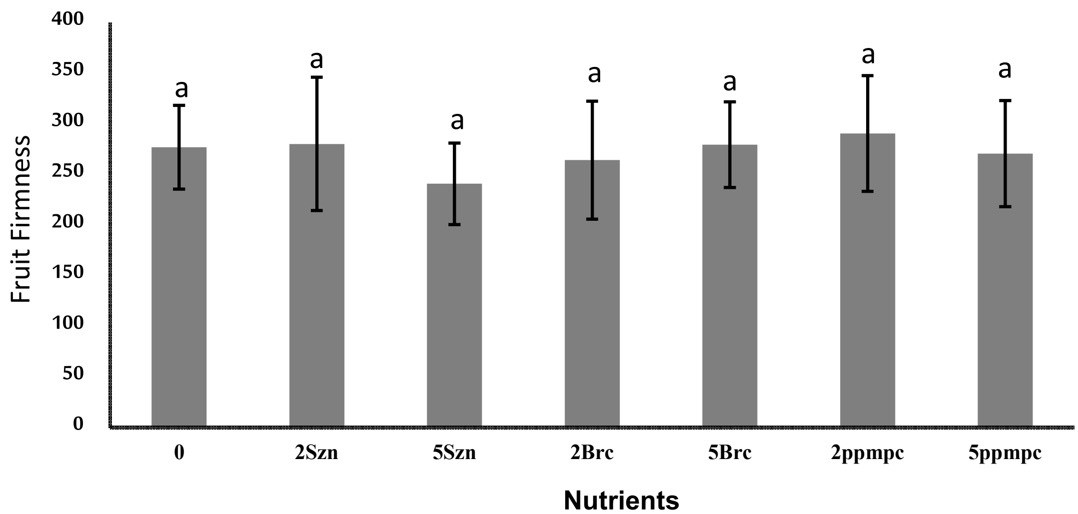

Fig. 4 The effect of nutrients on fruit firmness

The effect of Nutrients on the rate of Flavonoid

The results of variance analysis table indicate a significant difference of time at the level of 1%and concentration at the level of 5%.Mean comparing of the effect of different concentration of nutrients showed that the most amount of flavonoid in control, 2gr./liter zinc, 5gr./liter boron and the least amount of flavonoid in 2gr./liter boron (diagram 7).

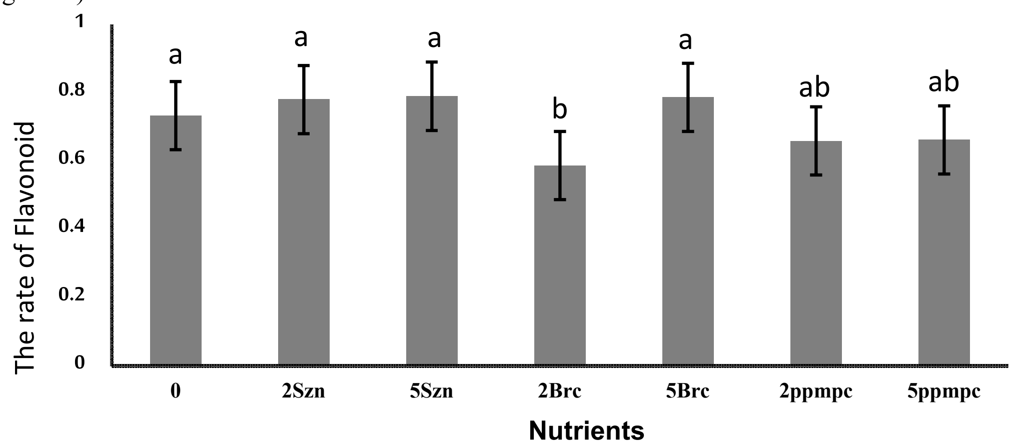

Fig.5 The effect of nutrients on the rate of Flavonoid

4. DISCUSSION

Since organic acids are used as substrate for enzymatic reactions, the fruit acidity decreased in the post harvest period. As the amount of breathing has reduced during this time, organic acid consumption has been delayed. Some of nutrients, specially zinc synthesis in photosynthesis and they have an important role in photosynthesis enzymes. So using these nutrients (zinc) causes the increase in yield and photosynthesis efficiency and then increases in sugar. Also, regarding the effect of different time at the rate of wet weight, it showed that there is a significant difference between different times of a storage among the fruits. This means that the wettest weight was for the fruits that were placed in the storeroom in the first days and also in the last day. By the lengthening of storage period, the wet weight of the fruits first increased, then decreased and after that increased in the last stage of storage. In fact, the pattern of change in the weight of the fruit can be attributed to the production of ethylene. Although this study did not consider ethylene changes. Other research was conducted on mango and plum ethylene production showed that the ethylene amount decreased at the beginning of the storage period and gradually increased. After that ethylene production decreased at the end of storage. The suppression in ethylene production with putrescence treatment and subsequent weight increasing may be attributed to competition among the pas and ethylene biosynthesis for a common intermediate S-adenosyl methionine (SAM). It has been proposed that internal levels of both Polyamines and ethylene may be tightly regulated by this substrate **[17]**. Previously, Polyamine application that suppression in ethylene production in putrescine -treated fruit may also be ascribed to the reduction in the activities of 1-aminocyclopropane-1-carboxylic acid synthase (ACS) and 1-aminocyclopropane-1-carboxylic acid oxidase (ACO) enzymes, as reported by Khan et al. (2007) in plum fruit. Application of putrescine reduced fruit weight during ripening as well as cold storage, which may be ascribed to consolidation or stabilization of both cell integrity and tissue permeability **[15]**.On the other hand, the water of fruit cells inside is evaporated and the fruit's wet weight decreases. From the first days of preserving the fruit, the amount of solid soluble materials increases. This can be due to polysaccharide sugars conversion (like starch)to simpler sugars like glucose and fructose. However, the coefficient of polysaccharide sugars conversion to simple sugars decreases due to reduction in polysaccharide at the final of storage time. As a result, monosaccharide decreases and subsequently the percent of solid soluble materials decreases. The effect of B element application on increasing the amount of carbohydrates in the plants has been proved. The reason for that is an increasing in photosynthesis yield by an increase in B application, which also increases to assimilate sugars. As the time passes, the amount of polysaccharide sugars decrease because of the cells storage decreasing. The reduction in polysaccharides like (starch)causes a reduction in simpler sugars like fructose. Consequently, it leads to reduction in the percent of solid soluble materials**[7].** The changes in the amount of solid soluble materials in treated fruit with 5*ppm*concentration as compared with other treatments can be related to decreasing in ethylene production and slowing down the rate of ripening of the fruits.**[23].**The increasing in TSS might be due to the alteration in cell wall structure and breakdown of complex carbohydrates into simple sugars during storage. This increase and decrease in TSS are directly correlated with hydrolytic changes in starch and conversion of starch to sugar which being an important index of ripening process in mango and other climacteric fruit and further hydrolysis decreased the TSS during storage **[4,10]**.The most amount of fruit firmness in the present study is related to the first days of storage and gradually as the time of storage lasts, it causes more reduction in fruit firmness. There was no significant difference between different concentrations of nutrients in fruit firmness. The penetration of nutrients inside the fruit causes the fast increasing in tissue firmness as well as a reduction in the fruits' softening in the storeroom. This effect as an increase in fruit firmness can be related to their bounding to peptic compounds of the cell wall. This binding leads to the stability of wall cell that can immediately be seen after treatment. The said binding also prevents the activity of wall analyzing enzymes, including pectin strase, pectin methyl esterase, polygalactronase. So this can be cause the fruit softening in the storage decreased**[21]**. Considering Zinc and Boron, it should be said that they have no role in the cell structure and wall. So they normally have no important effect on fruit firmness. As the time passes of food storage, the amount of types of polysaccharides like cellulose and hemicelluloses in the cell wall as well as galactronic acid compounds decreases. This leads to reduction in fruit firmness throughout the time, especially at the end of storage time. The results from the study showed thatthe amount of flavonoid is different in different periods. Studying the effect of different concentration of the nutrients showed that the most amount of flavonoid is in the concentrations of control, 2 gr/liter Zinc Sulphate, 5gr/liter Zinc Sulphate and 5 gr/liter B and the least amount of flavonoid was in 2 gr/liter B. Also, zinc is a powerful antioxidant which prevents the oxidation of flavonoid compounds in the fruits. So, the less fruits oxidation is observed when the fruit has more zinc content. Flavonoid is normally an antioxidant material which its synthesis increasing by polyamines increasing in the cell has been proved. One of these compounds is anthocyanin (water soluble pigments) that increase in polyamines accelerates the synthesis cycle of flavonoid **[8].**

Conclusion

According to the findings, it can be concluded that used nutrients and chemical treatments have been able to have an appropriate effect in storage of fruit under study. Thus, more complementary experiments of using nutrients can help improving the storage efficiency of other crops.

5. REFERENCES

1. Asna Asharie, M and M.R. Zuvkaee Khosro shahie, 2008. Postharvest physiology and technology. Bu-Ali Sina University Press, 92-145.
2. Jalili marandi, R., 1995. Check grapes kept in cold storage rooms. Olive magazine. Publications of the Ministry of Agriculture, Tehran., (21): 125-22.
3. Jazayerie, Gh AL D., 2009. Herbal Treatment. Janzadeh Tehran publishers, pp: 30-39.

4. Kays, S.J, 1991. Post harvest Phys: of Perishable Plant Products. Vas Nostrand Rein Hold Book, AVI Publishing Co, pp: 149-316.
5. Khan, A.S., Z. Singh, N.A. Abbasi, 2007. Pre-storage putrescine application suppresses ethylene biosynthesis and retards fruit softening during low temperature storage in 'Angelino' plum: Postharvest Biol. Technol., (46): 36–46.
6. Khan, A.S., Z. Singh, N.A. Abbasi, E.E. Swinny, 2008. Pre- or post-harvest applications of putrescine and low temperature storage affect fruit ripening and quality of Angelino' plum: J. Sci. Food Agric., (88): 1686–1695.
7. Khoshghalb, H.K., M.J. Arzani, V. Malakutie and M. Barzegar, 2008. Changes polysacarides and organic acids during storage and its effect on growth and survival, quality and condition of internal browning of Asian pear fruit in 2 cultivars (Pyvus Serothna Rehd) J. Agricultural Sciences and Natural Resources., (45): 1-9.
8. Khoshghalb, H.K., M.J. Arzani, V. Malakutie and M. Barzegar, 2013. Effect of foliar application of calcium, zinc and boron on growth before harvesting and content of sugars, nutrients and some quantitative and qualitative characteristics of varieties of Asian pear fruit (*Pyrus Serotina* Rehd), J. Agricultural Sciences and Natural Resources., (44): 149-159.
9. Khoshkhuye, M, 2005. Synergistic plant (plant propagation) Principles and Methods (Volume 1 and 2) (Translation). Shiraz University publishers, pp: 86-281.
10. Kittur,F.S., N. Saroja, Habibunnisa and R.N. Tharanathan, 2001. Polysaccharide-based composite coating formulations for shelf-life extension of fresh banana and mango: Eur. Food Res. Tec., (213): 306-311.
11. Lotfollahi, M., MR. Malakouti, and A. Rostami, 2007. Effect of zinc- fortified seed on tiller number and wheat grain yield, Improving crop production and human health Conference Zinc Crops, Istanbul, Turkey, pp: 20-23.
12. Malakou, A., and G.D. Nanos, 2005. A combination of hot water treatment and modified atmosphere packaging maintains quality of advanced maturity 'Caldesi 2000' nectarines and 'Royal Glory' peaches, Postharvest Biol. Tech., (38): 106-114.
13. Malik, A.U., Z. Singh and S.S. Dhaliwal, 2003. Exogenous application of putrescine affects mango fruit quality and shelf life: Acta Hortic., (628): 121–127.
14. Margossan, D.A., J.L. Smilanick and D.J. Henson, 1997. Combination of hot water and ethanol to control postharvest decay of peaches and nectarines, Plant Dis., (81): 1405-1409.
15. Mirdehghan, S.H., M. Rahemi, S. Castillo, D. Martínez-Romero, M. Serrano and D. Valero, 2007. Pre-storage application of polyamines by pressure or immersion improves shelf-life of pomegranate stored at chilling temperature by increasing endogenous polyamine levels: Postharvest Biol. Technol., (44): 26–33.
16. Nameless, 2010. The results of the survey sample of garden products, Ministry of Agriculture, Department of Planning and Economic Affairs, Office of Statistics and Information Technology.
17. Pandey, S., S.A. Ranade, P.K. Nagar and N. Kumar, 2000. Role of polyamines and ethylene as modulators of plant senescence: J. Biosci., (25): 291–299.
18. Perez-Vicente, A.D., A. Martinez-Romero, M. Carbonell, F. Serrano, F. Riquelma, A.Guillen and D. Valero, 2002. Role of polyamines in extending shelf life and reduction of mechanical damage during plum (*prunussalicina*-Lindl.) storage, Postharvest Biol. Technol., 25-32.
19. Rasulzadegan ,Y., 1996. Planting trees in temperate regions. Isfahan Industrial University publishers, pp:5-77.
20. Torrigiani, P., A.M. Bregoli, V. Ziosi, S. Scaramagli, T. Ciriaci, A. Rasoriand G. Costa, 2004. Pre-harvest polyamine and aminoethoxyvinylglycine (AVG) applications modulate fruit ripening in Stark Red Gold nectarines (Prunus persica L. Batsch): Postharvest Biol. Technol., (33): 293–308.
21. Valero, D.A., D. Perez-vicente, S. Martinez-romero, F. Castillo, M.Guillen and Serrano, 2002. Plum storability improved after calcium and heat postharvest treatments: role of polyamines. J. Food Science., (67): 2571-2575.
22. Veltman, R., Kho, RM. ACR. Venschaikand ASC. Andsanders, 2000. Rbic Acid and tissuebrowning in Pears (Pyrus commonisc. Cvs Rocha and Conference) Under Controlled Atmosphere Conditions. Post harvest Biology and Technology., (19): 189- 137.
23. Zuvkaee, M.R., 2006. Effect of putrescine on Postharvest four fruit peaches, apricots, strawberries and cherries. J. Agricultural Sciences and Natural Resources., (45): 219-228.