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Full Length Research Paper

Effect of different methods harvesting, drying and harvest time on losses seedless barberry *(Berberis vulgaris L.)*

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Barberry (Berberis vulgaris) is one of the most important minor fruits especially in arid and semi-arid regions in east of Iran. Especially in south- Khorasan Province as a major pole and axis of this valuable fruit. Barberry has various usages in local foods, traditional medicines, and protection of soil and prevention of erosion. Seedless barberry is a native medicinal shrub that has been cultivated in Iran for more than two centuries. In order to study the effects of harvest dates, drying and harvest methods on quantity of seedless barberry fruits, three separate experiments were conducted in Qayenat, Southern Khorasan province, Iran in 2011 and 2012. In the first experiment the effects of different harvest dates (7October, 22 October and 7 November) the effect of picking methods (branch cutting, Impact and berry picking) and drying methods (sun drying, Industrial Drying and shade drying) were studied on quantitative indices of seedless barberry. Results showed that the highest fresh and dry fruit yields were obtained at the final. Generally, results of these experiments showed that berry picking in berry picking and sun drying method are effective ways for improving barberry quantitative indices.

Keywords: barberry, Berry-picking, Branch cutting, Shade dring, Sun dring, losses

INTRODUCTION

Barberry (Berberis vulgaris L., Var. asperma Don, family Berberidaceae) grows in Asia and Europe; In Iran more than 5,000 tones of barberries are produced each year (Aghbashlo, M., Kianmehr, M.H., Samimi-Akhijahani, H., 2008). Barberry has been used extensively as a medicinal plant in traditional medicine. The fruit of the plant has been used as food additive. South Khorasan, located at the northeastern Iran, is the production center with about 6,000 hectares of field Growing barberry. Each year, more than 4,500 tones are harvested in South Khorasan region alone. Barberry cultivation in South Khorasan is concentrated in the south of the province, especially around Birjand and Qayenat where environmental condition (i.e. hot weather, low relative humidity, and water shortage and soil condition) are unfavorable for the growing of other horticultural crops. Mean yearly precipitation is 190.3 and 173.5 mm in Qayenat and Birjand, respectively (figure 1). Minimum and maximum temperatures are -38, +41℃ in Qayenat and -15, +44℃ in Birjand. About 85% of production is in Qayenat and about 15% in Birjand (table 1).

Barberry (Berberis vulgaris) is a dicotyledon and perennial species belonging to the Berberidaceae family (Figure 1). Barberry is a well-known medicinal plant in Iran

Table 1. Chemical analysis of soil

Sample	Tissue type	pH	EC (ds/m)	N (%)	P (mg/kg)	K (mg/kg)
soil	***Loam-clay***	**6.86**	**6.62**	**0.3**	**52**	**265**

Source: Agricultural Statistics, Ministry of Agriculture, Islamic Republic of Iran

(A)

(B)

Figure 1: Plant of barberry (A) before fruit maturity stage (B) fruit maturity stage

Table 2. Regional Climate Information

Annual average Relative humidity (%)	*Annual average evaporation– transpiration (mm/year)*)	*Annual average precipitation (mm/year)*)	*Annual average maximum temperature* (o*C)*	*Annual average Minimum temperature* (o*C)*	Average temperature (o^C)
34.7	***1892.7***	**251.4**	**35.8**	**-8**	**17.8**

Source: Agricultural Statistics, Ministry of Agriculture, Islamic Republic of Iran.

and has also been used as a food product. Seedless barberry (Berberis vulgaris var. asperma) is cultivated as a domestic plant for many years in southern parts of Khorasan province.

There is evidence that the barberry was domesticated about 200 years ago in this region (Kafi and Balandari, 2004). Higher price in the internal markets encouraged growers to establish new orchards of this crop. Cultivation area increased from 704 ha in 1981 to 8082 ha in 2005 and barberry production increased from 941 t to more than 8540 t in recent years (Table 1). The province of Khorasan with a production of more than 90% of the total production is the main region of barberry production in Iran (Kafi and Balandari, 2004).

According to evidence the cultivation of seedless barberry in south of province backs to two hundred years ago. Other studies described detailed information about cultivation, taxonomy, propagation, utilization and processing of seedless barberry cultivated in the southern parts of South Khorasan, Iran.

The plant is a shrub, 1-3mtall, spiny, with yellow wood and **Obovate** (obovata): leaves, bearing pendulous yellow flowers succeeded by oblong red berries (Zargari, 1983; Amin, 1991). Medicinal properties for all parts of the plant have been reported, including tonic, anti-microbial, anti-emetic, antipyretic, anti-pruritic and cholagogue actions, and it has been used in some cases like cholecystitis, cholelithiasis, jaundice, dysentery, leishmaniasis, malaria and gall stones (Aynehchi, 1986; Nafissi, 1990; Zargari, 1983). In spite of extensive applications and numerous properties, the mechanism of action in most of its effects is not exactly clear. Some of these properties may occur due to antihistaminic or anticholinergic effects.

The climatic condition of this crop production area is mostly desert and semi-desert types with hot summer, cold winter, low relative humidity and high variable range of daily maximum and minimum temperatures (Table 2). Average precipitation in the region is 207 mm/year.

Results (Fallahi et al. 2010) on Berberi**s** vulgaris showed that the best harvest date was in mid-November that

improved its fruit quality and yield. In addition, Rezvani Moghaddam et al. (2011) in studies on seedless barberry were reported that fruit quality was influenced by the harvest and drying methods. They emphasized that berry picking and sun drying methods are suitable for fruit quality improving. In addition, it is well documented that quantity and quality of barberry fruits are affected by harvest date and drying and harvest methods (Chandra and Todaria, 1983; Balandari, 1992; Arena and Curvetto, 2008; Fallahi et al., 2010; Rezvani Moghaddam et al., 2011). Because of limited cultivation of seedless barberry to a small area around the world, there are a few studies conducted on this medicinal shrub. Therefore, the aims of this study were determining the Effect of different methods harvesting, drying and harvest time on quantity of fruit, for seedless barberry.

MATERIALS AND METHODS

In order to study the effects of different harvest dates (7 October ,22 October and 7 November) Barberry fruits harvesting methods at three types; branch cutting (cutting all the fruit branches), cluster-cutting and the Impact force method (striking the branches with a stick). On quantitative indices of seedless barberry, an experiment was conducted in a Complete Randomized Block Design with three replications in Qayenat, Southern Khorasan province, Iran, in 2011 and 2012.Finally, the effects of experimental treatments on barberry fruits were evaluated as follows:

Drying methods

This study was conducted as a factorial experiment based on Complete Randomized Block Design with three replications in Qayenat, Southern Khorasan province, Iran, in 2011-2012. Experimental factors included drying methods (sun drying, Industrial drying and shade drying). The indices such as Wet and dry yield, Length and width of Berry, Seed weight, Losses, Moisture Berry Number of Berry were determined in berry samples. In the experiments, data analysis was carried out using spss17 and means were compared by the Duncan multiple ranges at the 5% level to distinguish the different treatments.

Harvest methods

This study was conducted as a factorial experiment based on Complete Randomized Block Design with three replications in Qayenat, Southern Khorasan province, Iran, in 2011-2012. Experimental factors included picking methods (branch cutting, Impact and berry picking) .The indices such as Wet and dry yield, Length and width of Berry, Seed weight, Losses, Moisture Berry Number of Berry were determined in berry samples. In the experiments, data analysis was carried out using spss17 and means were compared by the Duncan multiple ranges at the 5% level to distinguish the different treatments.

Harvest time

This study was conducted as a factorial experiment based on Complete Randomized Block Design with three replications in Qayenat, Southern Khorasan province, Iran, in 2011-2012. Experimental factors included Three times of harvest date (7 October, 22 October and 7 November). The indices such as Wet and dry yield, Length and width of Berry, Seed weight, Losses, Moisture Berry Number of Berry were determined in berry samples. In the experiments, data analysis was carried out using Spss17 and means were compared by the Duncan multiple ranges at the 5% level to distinguish the different treatments.

Sensory test

Sensory testing using experienced Panelists based on Hdvnyk five-points test done and the features such as; texture, color, smell, taste and general appearance was evaluated (Moskowitz et al.,2006).For drying the sample to industrial-drying methods a laminated cabinet's drier was used. Barberry fruits were placed in the industrial dryer at temperature range of 55–60^{oC} for 20 h.

RESULTS AND DISCUSSION

The results of data variance analysis in Table 1 indicated that the harvest and drying method treatment, harvest date and the interaction between harvest time and drying method at 1% probability level had a significant effect on barberry bulk density. Also, the harvest date and drying method and the interaction between drying method and harvest date on one hand and between harvest method and harvest date on the other hand at 1% probability level had a significant. The effects of each variable on the studied traits are discussed separately as follow:

Drying method

Results showed that the effects of drying methods on most of qualitative indices of barberry fruit were significant ($p < 0.05$). All qualitative characteristics were superior in berry picking and sun drying treatments (Table 3).Our results showed that yield of barberry fruit can be improved by proper harvest and drying management.

The interaction results show that the lowest bulk density is obtained in the third harvest date with shade-drying

Table 3. Results of variance analysis (mean squares).

Change resources	Degree freedom	Mean squares									
		Number of berries per panicle	berries wide	Length berries	Dry weight of berries	Thousand berries weight	Loss (percent)	Secondary moisture	Primary moisture	Dry yield	Wet yield
Treatment	2	^{ns}0.01	6.05 ^{ns}	0.73**	9.83 ^{ns}	48.01 ^{ns}	^{ns}26.70	1.18 ^{ns}	0.96 ^{ns}	476.60 ^{ns}	1039.12 ^{ns}
Harvest method	2	1.77 ^{ns}	8.27 ^{ns}	0/13 ^{ns}	7.49 ^{ns}	66.23**	19479.82**	15.21 ^{ns}	12.24 ^{ns}	405.42 ^{ns}	164152.16**
Harvest time	2	216.77 ^{ns}	2.06**	**22.74	1552.73**	3363.80**	24.56 ^{ns}	0.43 ^{ns}	0.40 ^{ns}	694.75 ^{ns}	933.42 ^{ns}
Drying method	2	1.44 ^{ns}	0.05**	0.004 ^{ns}	15.25 ^{ns}	126.45**	4.83 ^{ns}	7.71 ^{ns}	7.43 ^{ns}	4712.49 ^{ns}	7706.16 ^{ns}
Harvest method * harvest time	4	0.77 ^{ns}	0.01 ^{ns}	0.007 ^{ns}	8.72 ^{ns}	73.88 ^{ns}	30.49 ^{ns}	7.11ns	8.96 ^{ns}	3323.16 ^{ns}	22159.54 ^{ns}
Harvest method * drying method	4	0.94 ^{ns}	9.75 ^{ns}	0.007 ^{ns}	2.04 ^{ns}	23.85 ^{ns}	3.13 ^{ns}	4.99 ^{ns}	5.57 ^{ns}	2732.95 ^{ns}	9458.17 ^{ns}
Harvest time * drying method	4	1.94 ^{ns}	0.01 ^{ns}	0.009 ^{ns}	28.61 ^{ns}	89.22**	8.48 ^{ns}	7.76 ^{ns}	6.62 ^{ns}	1799.34ns	19810.27 ^{ns}
Harvest method*drying*harvest time	12	4.44 ^{ns}	**8.27	0.003 ^{ns}	5.04 ^{ns}	32.03 ^{ns}	5.83 ^{ns}	**11.40	10.47 ^{ns}	2543.75 ^{ns}	19239.45 ^{ns}
Error	52	0.01	0.001	0.007	6.95	18.21	15.50	4.37	4.16	3042.30	23356.13
total	80										

Ns: no significant differences in 5% and 1% probability levels.

* Respectively, significant differences in 5% probability levels.

** Respectively, significant differences in 1% probability levels

methods and highest mass density is related to the industrial method and the second harvest date. Important point is that the incremental process of mass density in each three harvest date from shade drying method to industrial method is considerable.

Rapid transfer of moisture from the center of fruit to the membrane and from the membrane to the environment caused shortening the drying times in industrial dryers. This leaded to thermal stresses in texture and fruit membrane which caused a change in the fruit appearance (Rezaee et al., 2005). Other results also showed a significant influence of drying methods on the appearance of dried product (Chaji et al., 2008). In shade-drying due to long duration of three months for drying compared to industrial drying (20 h) and sun-drying (15 days), the product obtained is puffier and assigns higher market value.

Harvest method

Results showed that the effects of harvest methods on most of qualitative indices of barberry fruit were significant ($p<0.05$). All qualitative characteristics were superior in berry picking and sun drying treatments (Table 4). Our results showed that yield of barberry fruit can be improved by proper harvest and drying management.

Most of studies have evaluated the effects of light intensity and temperature in pre harvest stage of berries and there is no information on post harvest managements. Results in Table 2 shows that the effect of cluster-picking harvest method on increasing the bulk density compared to the other two methods of harvesting had a significant difference.

Branch-cutting harvesting method had a fruit production with the least amount of bulk density '209.44 kg/m3' and therefore had become puffier. Early harvesting of barberry in the first harvest date caused low redness grade of the product that gradually over time and completion of fruit growth physiology has increased and at the third harvest date reached to the value of 18.02. This result was also reported that early harvest date of jujube fruit had caused low redness grade of this product (Azarpajooh and Mokhtarian, 2007).

Table 4. Comparison of test results from the interaction of the barberry method of harvesting the drying method on weight loss

Harvesting methods	Data	Drying method		
		Industrial	dry shade	sun dried
branch	7 October	5.68fg	5.61g	5.61h
	22 October	5.57bc	5.59ab	5.58abc
	7 November	5.59ab	5.55de	5.65h
Cluster	7 October	7.96de	7.28ab	7.28h
	22 October	8.04efg	7.98a	8.06a
	7 November	7.94abc	8.08def	8.11ab
Impact	7 October	10.96i	10.92cd	10.94j
	22 October	10.91cf	10.87cd	10.97fg
	7 November	10.98 abc	10.98ab	11.02bc

Numbers with the same letters in each column suggest no significant difference in 5% probability level.

Harvest date

Results of combined analysis showed that year and harvest date had significant effect on quantitative indices of seedless barberry ($p < 0.01$). The lowest and highest berry length, 100 berries fresh and dry weights, fresh and dry fruit yield were obtained at the first and final harvest dates, respectively (Table 2).

CONCLUSION

The results showed that quantitative indices of seedless barberry were affected by harvest time (harvest date and harvest times-of-day) and harvest and drying methods. The fresh and dry fruit yields were increased by delaying in harvest date. The fresh and dry fruit yields on 13 November (forth harvest date) were 22 and 30% more than first harvest date (9 September), respectively. Barberry lesions affected the harvest, harvesting methods and drying procedures are. The method of weight loss 42% of the impact of the cluster approach is Chinese. Barberry also took second in the lowest 5/3 percent. Barberries in bunches harvested using waste Chinese and lowest in the second harvest and drying methods to dry in the sun, dry shade, 5/2 and 08/1 percent.

Bulk density was highest in industrial-drying method and lowest in shade-drying method. Rapid drying causes shrinkage of barberry seeds. On the other hand the product obtained in longer drying time, is more puffy posture and therefore are also expected to have lower mass density.

This result shows that in sun drying and industrial methods because of damage to barberry seed pigments, color quality of the product is reduced. The results of sensory tests also confirmed this issue and the Panelists gave the highest score to shade-drying samples.

Results showed that the Panelists gave the highest score to the samples of cluster-picking at second harvesting time and shade drying method. And the lowest score were given by The Panelists to the samples of impact force method at the first harvest time and dried in sunlight. The highest losses of 9% due to the impact of harvesting methods and drying in the sun first. In the most violent blow and cause the Berberis crushed grains and thus increase the impact waste has consequences.

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