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FULL LENGTH ARTICLE

Effect of harvesting and drying methods of seedless barberry on some fruit quality

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Abstract Barberry species (*Berberis vulgaris* L. var. asperma) is cultivated in arid and semi arid areas of Iran (Southern Khorasan) and it is widely used as a food additive. Harvesting time awareness and proper drying and harvesting methods can cause higher production quality and enhance the position of this fruit in internal and global markets. Barberry trees were harvested at different methods (branch-cutting, cluster picking and impact force) and times (mid September-late October-mid November) as well as barberry fruits were dried with different methods (shade-drying, sun-drying and industrial-drying) in order to study their effect on achieve optimal production conditions and production quality. The results showed that the bulk density of dried barberry as the criteria for puffy barberry fruits was affected by harvesting and drying methods. Branch-cut harvesting method led to yield production with the lowest bulk density (rate of 214.86 kg/m^3) and thus causing more puffy fruits. Colorimetric parameter A that shows the redness of barberry fruits had the lowest rate in sun-drying method and first harvest date, and the highest rate in shade-drying method and third harvest date. The result also, shows that the sun-drying and industrial method caused damage to barberry pigments (color quality of production is reduced). This also was confirmed via the results of sensory tests, and the Panelists gave the most points to the taken samples during the second harvest date in cluster-picking approach and the shade-drying method. The lowest scores of the Panelists were belonged to the samples taken with impact force and the first harvest date in sun-drying approach.

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1. Introduction

Barberry contains more than 660 species. One species of barberry (*Berberis vulgaris* L. var. asperma) is cultivated in arid and semi arid areas of Iran (Southern Khorasan). It is widely used as a food additive. Fruits of this species are seedless, while wild type barberries produce seeds in the same area (Kafi and Balandri, 2002).

The seedless barberry fruit has been used by various ethnic populations as food. Barberry fruits consumed in the form of jams and other preserves, sirups and wines were commonly

eaten during the Medieval times in England and western Europe (Batmanglij, 2007). Barberries were, and still are, a popular food product in the Middle East and is a major crop in Iran (Ebadi, Rezaei, and Fatahi, 2010). In Iranian and Persian cooking whole dried berries, traditionally named ''Zereshk'', are commonly added to stews (Polow) and festive rice dishes (Basan, 2006). Typically in Iran, the approximate amount of dried barberries consumed per week ranges from 0.5 to 1 g (Fatehi et al., 2005). Barberries of *B. vulgaris* L. are also preserved as jams and jellies while barberry juice is consumed for its cleansing properties and blood pressure lowering effects (Batmanglij, 2007). Dried barberries are also a popular food item in Georgia. In this country the fruits from *B. vulgaris*, locally known as ''kotsakhuri'', are added to meat dishes and used as a spice in this region (Rodov et al., 2010).

Barberry fruits are harvested by three methods: branch-cutting, cluster-picking and impact force (Anonymous, 2009). In the branch-cutting approach, branches carrying fruit are being cut by a garden scissor from the junction of the main branches. In the impact force approach, a thick cloth (fabric) is being expanded under the shrub and by waving the branches and successive strikes with a stick, barberries are scattering on the cloth and for drying the products, they are being carried to the special stacks or heaps. In the cluster picking approach, the workers separate the clusters one by one from the branches by hand. This method is time consuming and due to the sharp thorns within the branches, the harvest time for the workers is severely increased. This method is used for consuming as fresh fruits. Also drying the barberry is being done in three ways: shade-drying, sun-drying and industrial-drying. In the shade-drying approach, the fruits after the harvest are distributed or scattered on the wooden or metal scaffolds. Sun-drying approach is often used for the harvested barberries by impact force method. The fresh barberry fruits are being exposed to the sunlight around the gardens or on the house's roofs. This method contaminates the products and reduces its quality such as color and appearance. Recently, industrial dryers (cabinet) for shortening the drying time and also increasing the quality of the products were developed in the region. But most producers yet believe that the crops produced by shade-drying have the highest quality.

More than 70% of the barberry fruit is harvested using impact force method and being exposed to the sunlight for drying in which both types are the worst methods of harvesting and drying. The reason is high labor expenses of barberry harvesting using branch-cutting and also lack of places for shade and industrial drying. Although studying the sources in relation to the effects of harvest date and barberry fruits drying methods was not productive, but the results of some studies showed the effects of these two variables on other agricultural products. Effect of harvest date and drying method on jujube fruits showed that these two variables had significant effects on dried fruit quality (Azarpajooh and Mokhtarian, 2007). Duration of 120 days after flowering was more suitable than 100 days for harvesting. At this time the jujube fruit's weight, length, soluble solids and acidity are the highest. Ash drying method compared to other drying methods (on the tree and industrial) in terms of texture, color and taste of dried product was more favorable (Azarpajooh and Mokhtarian, 2007).

Comparison of different methods of harvesting and drying the figs with the experimental treatments such as (drying in the open air without a plastic cover, in glass boxes and industrial dryer at temperatures 60, 55 and 65 °C) showed a temperature of 50 °C is not enough to dry figs. The 60 °C for a period less than a day is the same as three days of drying at free air. Drying temperature of 60 °C for 12 h and at a temperature of 65 °C for 9 h yielded optimum results (Rezaee et al., 2005). Barberry products in global markets is still not known so more attention and effort to harvest and post harvest problems is needed in order to produce the highest quality product, and this product can become as a high income export product to offer to the world. For this purpose, the product must be provided for exports when it is in the best and most suitable harvesting and processing conditions Knowledge of time and proper harvesting and drying methods could help farmers to produce a global quality product. So in this research to achieve the optimum production conditions, effects of three important factors (harvest time, harvest method, drying method) on the product quality were investigated.

2. Material and methods

The study was performed using factorial statistical design with the following experimental treatments and three replications for each experiment.

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). Three times of harvest date (mid September-late October-mid November). Three methods of barberry fruits drying; shade-drying, sun-drying and industrial-drying. Finally, the effect of experimental treatments on pigment properties, bulk density and also the sensory characteristics of barberry fruits were evaluated as follows:

2.1. Measurement of barberry pigment

First color image of barberry mass was prepared using a scanner HP G3010 model. Then the barberry pigment was measured using classified image method and Image J software. Now the more common way to measure the food color is the use of LAB. LAB is an international standard where L indicates brightness range (0–100), A (redness) and B (yellow) indicates colored compound from 0 to 120 (Leon et al., 2006).

2.2. Barberry bulk density

Puffy seedless barberry is favorite for the market so to evaluate this characteristic, the mass density of barberry fruits was measured. Measurements were done by pouring some of the barberry mass inside the scaled container, and then weighed using a laboratory scale. Dividing the mass by volume, barberry mass density of the sample was calculated. Lower mass density indicates that it is more puffier.

2.3. 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 a temperature range of 55–60 °C for 20 h.