INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 7, p. 59-63, 2014

RESEARCH PAPER OPEN ACCESS

# Effect of processing and concentration method on physicochemical and sensory characteristics of jujube

**Mehdi Ghiafeh Davoodi[2], Reihaneh Ahmadzadeh Ghavidel[1*], Fereshteh Ghannad Toosi[1], Ahmad Fahim Adib Asl[1]**

[1]*Department of Food Science and Technology, Quchan Branch, Islamic Azad University, Quchan, Iran*

[2]*Technical and Engineering Research Section, Agricultural and Natural Resources Research Center of Khorasan Razavi, Iran*

**Key words:** Jujube concentrate, Functional food, Physicochemical and organoleptic properties, Rotary evaporator.

http://dx.doi.org/10.12692/ijb/4.7.59-63 Article published on April 01, 2014

**Abstract**

Jujube is used as an herbal remedy to treat various diseases because of its associated health effects such as antimicrobial activity and its bioactive phenolic and flavonoid compounds. In addition to biologically active substances, jujube also contains nutrients and micronutrients and can be used as a food additive. Jujube concentrate, a combination of relatively "transparent contains the qualitative and quantitative properties of jujube and has particular applicability in the food industry as a flavorant, nutritional and pharmaceutical additive, natural color and sweetener. In this study, we researched the formulation of concentrates on four processing methods of fresh and dried jujube by using methods of doping concentration under vacuum rotary evaporator and atmospheric pressure. To investigate its physicochemical properties, tests including the measurement of pH, ash, total solids, sugar, colorimetric and sensor tests based on a completely randomized factorial design were performed. Based on the results of the organoleptic analysis, the total sugar of dried concentrated jujube under vacuum was considered the best treatment. On the other hand samples of fresh jujube concentrated under vacuum recovery only in terms of flavor and sugar and high pH located in lower level. Adding citric acid was necessary in this case. All treatments were ranked higher when they were vacuum-condensed.

* **Corresponding Author:** Reihaneh Ahmadzadeh Ghavidel ✉ reahmadzadeh2@yahoo.com

## Introduction

Jujube, also known as ber (*Ziziphus spp.*), is described as the "fruit of life" and is a key member of the Chinese herb family. It is mainly distributed in the subtropical and tropical regions of Asia and America and is a tree of the *rhamnaceae* family (Dongying Wang *et al.,* 2012). Jujube fruits in the Mediterranean region come in various shapes, sizes, colors, and tastes and have been reported to possess unique nutritional and organoleptic characteristics (Akbolat *et al.*, 2008). Chinese jujube (*Ziziphus jujube Miller*) is indigenous to China and has a history of over 4000 years. It has been widely planted in reforested areas within the Yellow River valley and has been chosen as a variety compatible with the present ecology and economy (Yan and Gao, 2002). The fruit of the Chinese jujube is a favored and profitable fruit and is much admired for its high nutritional value (Wi Li *et al.,* 2007 and 2011).

Jujube has been commonly used as a crude drug in traditional Chinese medicine for analeptic, palliative, hypoglycemic and anti-hyper glycemic treatments (wei Li *et al.,* 2011), and it has also been used as an additive and flavorant for thousands of years (Wi Li *et al.*, 2007). Much of the annual Chinese jujube production is consumed in fresh and dried forms; therefore, there are numerous studies and experiments as well as simulations dealing with the preservation and drying of jujube to enhance its quality (Wu *et al.,* 2001; Wang *et al.*, 2003; Jiang *et al.*, 2004). Fresh mature ber fruits contain 81% to 97% pulp (Hovatia *et al.*, 1993; Ghosh and Mathew, 2002). Ber pulp contains 12-23% T.S.S., 0.13-1.42% acidity, 3.1-14.5% total sugars, and 1.4-9.7% reducing sugars (Ghosh and Mathew, 2002). Ber pulp is a rich source of vitamin C, and the ascorbic acid content in different ber cultivars has been measured as ranging from 39-166 mg/g pulp. The DPPH radical and total phenolic mg GAE/gm content in some cultivars of Chinese jujube fruits have been measured as ranging between 33.60-98.60% and between 5.18-8.53 mg GAE/gm, respectively.

The natural phenolic compounds present in ber have received much attention, because they may help the human body cope with oxidative stress. Epidemiological evidence shows that the consumption of fruits and vegetables can decrease the risk of heart disease and cancer. It should be noted, however, that the health effects of phenolics are critically determined by their bioavailability. Phenolic compounds are generally consumed in foods along with other macronutrients such as proteins and fat. These dietary components may have an impact on the bioavailability and bio efficacy of phenolics (Hao zhang *et al.,* 2012). The jujube fruit tastes like a mixture of dates and apples. Highly prized by the Bedouins, it was found to have a very high energy value (Gultekin, 2007). The food from this plant is an important source of energy, protein, and minerals (Li *et al.,* 2007).

The fresh jujube fruit has a mild sub-acidic flavor and crisp firm flesh. Jujube can also be eaten boiled as an addition to rice or millet, stewed, or baked. Other culinary uses include pickles, jams, candied fruits, beverages, ber butter, and cheese–like pastes (Pareek, 2001, 2002; Azam Ali *et al.,* 2006). Investigated various processing methods for Z. jujube fruits. Based on sensory evaluation and chemical analysis, it was found that dried fruits, nectar, jam, fruit extracts, and a powdered tea were the most promising products. A jujube concentrate product has been successfully prepared by our group. In this study, we researched the formulation of concentrates on four processing methods of fresh and dried jujube by using methods of doping concentration under vacuum rotary evaporator and atmospheric pressure to investigate its physicochemical and sensory properties.

## Materials and methods

*Material*

Chemical materials were purchased from Merck (Pharmaceutical and Chemical Co., Germany).

Fresh ripe jujube and dried jujube were purchased from a local market in Birjand, Iran. Both dried and fresh jujube were preserved at an ambient temperature and -20˚C, respectively.

*Characterization studies of jujube concentrate*

Jujube concentrates were analyzed for pH, total acidity, ash, total sugars, reducing sugar, sucrose, and total soluble solids (TSS%).

*Sensory evaluation*

Sensory evaluation was carried out according to A.O.A.C. methods (2005) consisting of 5 points (1-5), where 5=excellent, 4=very good, 3=good, 2=fair, and 1=poor. An internal panel of ten expert members of the Technical and Engineering Research Section, Agricultural and Natural Resources Research Center, Mashhad, Iran evaluated the products for color, odor, texture, taste/flavor, and overall acceptability.

*Colorimetric measurements*

The color characterization of different treatments in this study was carried out using a Hunter Lab Color Flex 45/0 spectrophotometer and measured by describing L*, a* and b* indexes. L* value showed lightness of the product and ranged from 0 (pure black) to 100 (pure white). A* value showed red and green and ranged from -120 (pure green) to +120(pure red), while b* value was blue and yellow and ranged from -120 (pure blue) to +120 (pure yellow). 26 gr of raisin spread was placed in a glass plate to form a thin layer. Images were taken by a HP Scanjet G3010 and measured by Image J (Sun, 2008).

*Statistical analysis*

The samples were prepared in three replicates, and the results were analyzed by Mstat–C, 1.42 version. Using a 2 x 2 element factorial design, samples included ber in four types **(**fresh ber, dried ber, dried ber powder (microwave), and dried ber powder (oven)**)** and 2 concentration methods (ambient pressure and vacuum pressure). A multiple comparison procedure of the treatment means was performed using Duncan's New Multiple Range Test. Significance of the differences was defined as $P<0.05$. All diagrams were drawn by Excel.

**Result and discussion**

*Characterization of ber concentrate*

The changes in pH and acidity of the jujube concentrate were not statistically significant in any of the treatments. Results showed that processing and concentration methods had no significant effects on pH and acidity. Similar observations with respect to the changes in pH and acidity have been previously made (Helmy I. M. F., Wafaa, M. Abozied and Nader A., 2012). Processing and concentration methods caused no significant changes in ash content. Results indicated that dried ber, fresh ber, and oven-dried powder had the most total sugar content, but the concentration method had no significant effect on total sugar. The interaction of processing and concentration method showed that the highest total sugar contents belonged to the dried ber concentrate at ambient pressure, microwave powder at vacuum pressure, oven-dried and fresh ber concentrate at ambient pressure. The least total sugar belonged to microwave-dried powder concentrate at ambient pressure. Results showed that dried ber had the highest reducing sugar content, and the interaction between processing and concentration method indicated that fresh ber concentrate at vacuum pressure had the least reducing sugar content. The Millard reaction reduced 24% of the sucrose content of jujube during drying and processing. According to this information and the results, fresh ber concentrate at ambient pressure had the highest sucrose content. TSS (°Brix) of the treatments was stable throughout the processing and concentration, and the interaction between processing and concentration method had no effect on it (Table 1).

*Sensory evaluation*

Dried treatments had the best texture, because these treatments had low sucrose contents. Dried ber concentrate at vacuum pressure had the most odor in comparison with the other treatments. When the concentration temperature was increased, the odor decreased. Similarly, dried ber concentrate at vacuum pressure had the best taste as indicated by panelists. Color analysis showed that the highest score belonged to fresh ber concentrate, however, results showed that dried ber concentrate received the highest overall acceptance score from the panelist team (Table 2).

*Color analysis*

Fresh ber concentrate under atmospheric pressure had the highest L* value. Other treatments, because of enzymatic and no enzymatic browning reactions, had lower L* values and were not statistically significant. Similarly, fresh ber concentrate under atmospheric pressure had the highest a* and b* values. Temperature and the Millard reaction had significant effects on the darkness of samples (Table 3).

**Table 1.** Interaction of processing and concentration method on physicochemical properties of jujube concentrate.

| Treatments | Brix | sucrose | Reducing sugar | Whole sugar | Ash | Acidity | pH |
|---|---|---|---|---|---|---|---|
| Dry Jujube+ At ambient pressure | 62.37$^{a}$ | 14.27$^{f}$ | 44.07$^{b}$ | 59.14$^{a}$ | 1.007$^{a}$ | 0.819$^{a}$ | 4.293$^{ab}$ |
| Dry Jujube+ At vacuum pressure | 62.47$^{a}$ | 12.13$^{g}$ | 45.73$^{a}$ | 58.54$^{b}$ | 1.267$^{a}$ | 0.837$^{a}$ | 4.213$^{bc}$ |
| Dried jujube(microwave)+ At ambient pressure | 62.23$^{a}$ | 11.65h | 41.95$^{c}$ | 54.25$^{e}$ | 1.4$^{a}$ | 0.802$^{a}$ | 4.173$^{bc}$ |
| Dried jujube(microwave)+ At vacuum pressure | 62.4$^{a}$ | 16.14$^{d}$ | 42.23$^{c}$ | 59.13$^{a}$ | 1.15$^{a}$ | 0.827$^{a}$ | 4.213$^{bc}$ |
| Dried jujube(oven)+ At ambient pressure | 62.47$^{a}$ | 19.11$^{c}$ | 38.97$^{e}$ | 59.15$^{a}$ | 1.173$^{a}$ | 0.863$^{a}$ | 4.15$^{c}$ |
| Dried jujube(oven)+ At vacuum pressure | 62.57$^{a}$ | 15.33$^{e}$ | 41.41$^{d}$ | 57.42$^{c}$ | 1.27$^{a}$ | 0.893$^{a}$ | 4.21$^{bc}$ |
| Fresh Jujube+ At ambient pressure | 62.47$^{a}$ | 26.92$^{a}$ | 31.06$^{f}$ | 59.13$^{a}$ | 2.14$^{a}$ | 0.868$^{a}$ | 4.39$^{a}$ |
| Fresh Jujube+ At vacuum pressure | 62.33$^{a}$ | 25.68$^{b}$ | 29.78$^{g}$ | 56.81$^{d}$ | 1.543$^{a}$ | 0.805$^{a}$ | 4.4$^{a}$ |

**Table 2.** Interaction of processing and concentration method on sensory properties of jujube concentrate.

| Treatments | color | taste | Aroma | texture | Total acceptance |
|---|---|---|---|---|---|
| Dry Jujube+ At ambient pressure | 4.17$^{abc}$ | 4.17$^{ab}$ | 4.17$^{a}$ | 4.33$^{a}$ | 17$^{a}$ |
| Dry Jujube+ At vacuum pressure | 4.17$^{abc}$ | 4.5$^{a}$ | 4.17$^{a}$ | 4.33$^{a}$ | 17.17$^{a}$ |
| Dried jujube(microwave)+ At ambient pressure | 3.67$^{bcd}$ | 3$^{d}$ | 3.17$^{c}$ | 3.83$^{b}$ | 13.67$^{e}$ |
| Dried jujube(microwave)+ At vacuum pressure | 3.5$^{cd}$ | 3.17$^{cd}$ | 3.5$^{bc}$ | 3.5$^{b}$ | 13.67$^{e}$ |
| Dried jujube(oven)+ At ambient pressure | 3.33$^{d}$ | 3.33$^{cd}$ | 3.67$^{abc}$ | 4.33$^{a}$ | 14.67$^{d}$ |
| Dried jujube(oven)+ At vacuum pressure | 3.5$^{cd}$ | 3.33$^{cd}$ | 3.83$^{ab}$ | 4.33$^{a}$ | 15$^{cd}$ |
| Fresh Jujube+ At ambient pressure | 4.67$^{a}$ | 3.67$^{bcd}$ | 4$^{ab}$ | 3.83$^{b}$ | 15.83$^{bc}$ |
| Fresh Jujube+ At vacuum pressure | 4.33$^{ab}$ | 3.83$^{abc}$ | 4$^{ab}$ | 3.83$^{b}$ | 16.5$^{ab}$ |

**Table 3.** Interaction of processing and concentration method on color analysis of jujube concentrate.

| Treatments | b* value | a* value | L* value |
|---|---|---|---|
| Dry Jujube+ At ambient pressure | 1.8$^{e}$ | 1.7$^{d}$ | 5$^{e}$ |
| Dry Jujube+ At vacuum pressure | 1.7$^{f}$ | 1.4$^{e}$ | 4.5$^{g}$ |
| Dried jujube(microwave)+ At ambient pressure | 1.8$^{e}$ | 1.4$^{e}$ | 4.3$^{h}$ |
| Dried jujube(microwave)+ At vacuum pressure | 2$^{d}$ | 1.7$^{d}$ | 4.8$^{f}$ |
| Dried jujube(oven)+ At ambient pressure | 2.5$^{c}$ | 2.6$^{c}$ | 5.2$^{d}$ |
| Dried jujube(oven)+ At vacuum pressure | 2.5$^{c}$ | 2.5$^{c}$ | 5.33$^{c}$ |
| Fresh Jujube+ At ambient pressure | 6.6$^{a}$ | 4.5$^{a}$ | 13$^{a}$ |
| Fresh Jujube+ At vacuum pressure | 6.4$^{b}$ | 3$^{b}$ | 12$^{b}$ |

## Conclusion

Results showed that dried jujube concentrate under vacuum pressure was the best sample and had significant levels of excellence in total and reducing sugars and sensory properties compared with the other treatments. The addition of citric acid, however, was necessary. All treatments had higher scores in vacuum pressure concentration.

**References**

**Akbolat D, Ertekin C, Menges HO, Ekinci KErdal.** 2008. Physical and nutritional properties of jujube (Zizyphus jujube Mill.) growing in turkey. Asian journal of chemistry **20,** 757-766.

**Azam-Ali S, Bonkoungou E, Bowe C, Dekock C, Godara A, Williams J.** (2006). Harvesting post-harvest handling and processing in: Ber and other jujubes. international centre for underutilised crops, university of Southampton, Southampton, UK. 113-153.

**Dongying W.** 2012. Antioxidative and hepatoprotective effects of the polysaccharides from Zizyphus jujube cv. Shaanbeitanzao. Carbohydrate Polymers **88,** 1453– 1459.

**Gao QH.** 2012. Textural Characteristic, Antioxidant Activity, Sugar, Organic Acid, and Phenolic Profiles of 10 Promising Jujube (Ziziphus jujuba Mill.) Selections. Journal of Food Science **77(11),** 2012.

**Gultekin HC.** (2007). An unknown fruit (jujube). Popular Science journal **11,** 41-43.

**Ghosh SN, Mathew B.** (2002). Performance of nine ber (Zizphus mauritiiana Lamk) cultivars on topworking in the semi-dried region of west Bengal. J. Appl. Hort. **4(1),** 49-51.

**Hao Zhang.** 20012. Milk protein and fat play different roles in affecting the bioavailability and the antioxidant activity of jujube juice phenolics in rats. Mol. Nutr. Food Res. **(56),** 1511–1519.

**Hovatia RS, Patel DS, Patel GV.** (1993). Performance of ber (Zizphus mauritiiana Lamk) cultivars under dried conditions. Annals Arid Zone, **32(4),** 215-217.

**Pareek OP.** (2002). Ber-ziziphus Mauritania. Available by International centre for underutilized crops (on line). Available: http://www.civil.soton.ac.uk/icuc/cd-icuc-bertamarind/content/ber/ber-book-html via the INTERNET. Accesed 2004 Apr. 6.

**wei Li J, Fan L, Ding S.** 2011. Isolation, purification and structure of a new water-soluble polysaccharide from Zizyphus jujuba cv. Jinsixiaozao. Carbohydrate Polymers **83,** 477–482.

**wei Li J.** 2007. Nutritional composition of five cultivars of chinese jujube. Food Chemistry **103,** 454–460.

**Wang J, Li LT, Dan Y.** (2003). The correlation between freezing point and soluble Solids of fruits. Journal of Food Engineering **60,** 481–484.

**Wu CE, Wang WS, Kou XH.** (2001). Effect of cacl2 and 6-BA on postharvest respiratory intensity and storage quality of Chinese jujube. Scientia Agricultural Sinica **34(1),** 66-71.

**Yan YH, Gao ZP.** (2002). Industrialization of Chinese jujube. Journal of Northwest Science and Technology University of Agriculture and Forestry, **30,** 95–98 (in Chinese).