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Value Addition, Sensory and Evaluation of Jujube Products

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ABSTRACT

The Chinese jujube (Ziziphus jujuba Mill.) is a drupe, varying from round to elongate shape and from cherry-size to plum size depending on the cultivar. Chinese jujube fruits are eaten fresh, dried or processed, as "Chinese dates" which have been included in confectionery recipes such as Graham bread, cake, candy, compote, seraph etc. Seven different products of jujube were used for evaluation. Processed fruits and different way of processing like cloying of jujube fruits with honey (½ green - ½ brown and full brown), preservation in jujube fruits in sweet sour infusion vinegar (½ green - ½brown and full brown), conservation of jujube fruit in sweet infusion like compote (cultivars and seedlings) and dry jujube fruits. These processed products were evaluated on the basis of appearance, aroma, consistency, taste and overall acceptability by a panel of 11 judges by Hedonic Rating Test (0 - 10 scale and averaged). Two years evaluation of different products has revealed that Compote (cultivar) is the best product of jujube. Jujube with vinegar (½ green - ½ brown) gave poor results.

Highlight

- *Chinese date (Ziziphus jujube) is a promising new fruit species for Czech Republic*
- *Jujube is both a delicious fruit with high nutritional value and an effective herbal remedy*
- *Compote (cultivar) is the best product of jujube with evaluators of young ,middle and old age groups*

***Keywords*:** Jujube, Sensory Evaluation, Aroma, Consistency, Vinegar, Honey.

INTRODUCTION

Chinese jujube (Rhamnaceae), is one of the two most important cultivated jujubes of the world, the other being Indian (Ber), *Ziziphus mauritiana* Lam. The chinese jujube. is a deciduous tree, has a chilling requirement, and is very cold hardy; the Indian jujube is evergreen and does not tolerate freezing temperatures about 170 Fº other *Ziziphus* species exist worldwide, some of local importance, but none rival the importance of the two main cultivated species.

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Although Chinese and Indian jujubes are very different, it is not always easy to tell from the literature which of the two is being discussed, because *Ziziphus mauritiana* has often been discussed under the name *Ziziphus jujube*, a proposal was made to suppress the name *Ziziphus zizyphus* in favour of *Ziziphus jujube*, and this proposal was accepted in 2011[1]. The general concept underlying the preservation of foods aims to prevent the development of micro-organisms (bacteria, yeasts and mould), to avoid food spoilage during storage. At the same time, the chemical and biochemical changes that bring about the deterioration process must be controlled. This way, it will be possible to obtain a food whose typical organoleptic characteristics will have remained unchanged (colour, flavour and aroma), and which can be safely consumed within a certain period of time (at least a year).

Jujube has plenty of advantages. Freshly plucked jujube fruits and dried and candied jujubes are eaten as snacks or at tea time. These are available in black or red colour, the former being smoked for enhancing the flavour. Sweet tea syrup made of jujube fruits is popularly available in Korea, Taiwan and China. Jujube teabags and canned tea is also widely available. Jujube fruits are also used in the preparation of jujube vinegar. However, this is not common. In some parts of the world, people also drink Jujube juice. This fruit is also used to prepare sweet wines in China. Pickled jujubes can be preserved and stored in Chinese liquor to be kept fresh during winter months. These are called 'Spirited Jujubes' or 'jiuzao'. Moreover, many Chinese delicacies use stoned jujubes for additional sweetened flavourings. The use of jujubes in Persian cuisine is not unknown either. The dried jujubes are called 'annab'. In India, the ripe jujube fruit is mostly consumed raw. However, candied version of this fruit is also eaten by pricking and immersing the unripe jujube it in a salt or sugar solution and marinating it for a few weeks. Candied jujubes can last in jars for around 3 months. In south-east Asia, people eat raw unripe jujubes with salt. They are even font of drinking a cold drink made of crushed jujubes and cold water. Jujubes are also sun-dried and powdered for off-season use in day to day cooking and for preparation of sweet dishes. Sometimes they are also used to prepare chutneys and pickles. In Africa, these fruits are made to pulp and eaten with cakes. Jujube liquor known as 'Crema de ponsigue' is made in Venezuela[4].

The fruits of many *Ziziphus* species are edible and are prepared for consumption in many ways. The fruit has a date-like taste and the seeds taste like walnuts. Fruits are eaten mostly fresh but may be pickled, dried and made into confectionery, or drinks can be made from the juice. A juice can be made by soaking overnight.

Recently, there have been many innovations in industrial food processing. The techniques employed today to preserve foods are characterized by different levels of complexity compared to ancient fermentation and sun drying methods. These include irradiation and freeze-drying. However, when considering relevant food preservation techniques in small-scale industrial systems, the discussion should be limited to the simplest methods. Investigatedvarious 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. The processing of damaged or defective *Z. Jujube* fruit was investigated. This is useful if mechanical harvesters increase the percentage of damaged fruits. They looked at the processing technology and parameters required for fermenting vinegar. Alcohol fermentation of vinegar was carried out using *Z. Jujube* fruits fermented with 8-10 % sugars and *Saccharomyces ellipsodieus*. Ethane acid fermentation was achieved using 5 % *Acetobacter rancens*. The optimum conditions for clarifying the resultant Chinese jujube vinegar involved heating at 95° C for two minutes, and filtering with diatomite after cooling.

Different kinds of jujube Products are available in the market for example Candy

fruit is the product of jujube, which is conserved by sugar, which enters into the fruit from the sugar solution (the fruit is inside this solution for a long time). The content of natural sugar in the fruit should be minimal 65%, to avoid microbial infestation. The fruit, however, lost its original characteristics and becomes material, which can be used very often in confectionery as a high caloric delicacy. Drying (dehydration) is the process when moisture is removed from the fruit, vegetable or other food in the warm, air environment. Working process of drying fruit is chosen according to the type of materials. Drying is a creative way to preserve foods and use home-grown fruit, extra products (e.g., ripe bananas) and roadside market specialities. Like all methods of preservation, drying causes some nutrient loss .Compote is a sterilized product from the fresh fruit, mixed with sugar or other solution, e.g. honey or only with water. Concentration of the sugar in the solution depends on the kind of fruit and necessity. If fruit has lower concentration of acids, citric acid can be used for acidification of the compote.

Medicinal Uses of *Ziziphus jujuba*

There are a large number of traditional medicinal uses that are not necessarily based on knowledge of the constituents, especially in Ayurveda medicine, traditional medicines in India, Japan, China and Africa. Jujube is both a delicious fruit and an effective herbal remedy. It aids weight gain, improves muscular strength and increases stamina. The fruit and its seeds are used in Chinese and Korean traditional medicine, where they are believed to alleviate stress, and traditionally for anti-fungal, anti-bacterial, anti-ulcer, anti-inflammatory purposes and sedation, antispastic, antifertility/ contraception hypotensive and antinephritic, cardiotonic, antioxidant, immunostimulant, and wound healing properties[5]. The dried ripe fruit is a mild laxative. The seeds are sedative and are taken, sometimes with buttermilk, to halt nausea, vomiting, and abdominal pains in pregnancy. They check diarrhea, and are poulticed on wounds. Mixed with oil, they are rubbed on rheumatic areas. In another clinical trial, jujube was proved to be effective against neonatal jaundice[3]. Research suggests jujube fruit has nootropic and neuroprotective properties[6,7,8].

Table 1: Food value per 100 g of edible portion in *Ziziphus jujuba*

***Fruits, Fresh:**

Calories	473/lb (1,041/kg)
Moisture	68.10 g
Protein	1.44 g
Fat	0.21 g
Carbohydrates	2.47 g
Sugar	21.66 g
Fiber	1.28 g

****Fruits, Dried:**

Moisture	81.6g
Protein	0.8g
Carbohydrate	17.0g
Total sugar	5.4-10.5g – 21.66g
Calcium	25.6mg
Phosphorus	26.8mg
Iron	0.76-1.8mg
Ascorbic acid	65.8-75.0mg
Riboflavin	0.02-0.03mg

*Analyses made in India and Honduras.

**Analyses made in the Philippines.

MATERIALS AND METHODS

This work is part of my Ph.D. work. The investigation on are being carried out at the Department of Pomology, Faculty of Horticulture in Led nice, Mendel University of Agriculture and Forestry in Brno, in the Czech Republic. Seven different products of jujube were used for evaluation. Processed fruits and different way of processing like cloying of jujube fruits with honey (½ green - ½ brown and full brown), preservation in jujube fruits in sweet sour infusion vinegar (½ green - ½ brown and full brown), conservation of jujube fruit in sweet infusion like compote (cultivars and seedlings) and dry jujube fruits. These processed products evaluated on the basis of appearance, aroma, consistency, taste and overall acceptability by a panel of 11 judges by Hedonic Rating Test, where 0 is poor and 5 is excellent in 2007 and 0 is poor and 10 is excellent in 2008 (0 – 5 in 2007 and 0 – 10 in 2008 scale and averaged).

During the process of candy fruit preparation, cells juice is replaced by dense sugar solution, which penetrates through the cell walls. It is very important to reach optimal concentration of sugar solution because, when sugar concentration is higher, it cannot be penetrated through the cell wall and consequently the cell juice secrets from the fruit because of osmosis process. The fruit will be squeezed and dry. Because of this reason, the concentration of the first honey solution has to be set according to refraction and structure of the fruit to reach the favourable difference between the refraction of the fruit and the solution. It should be 5 – 10 % higher as the dry weight of fruit. Penetration of sugar solutions can be accelerated with using of alternate heating. To ensure optimal shape and texture of fruit, the refraction of the solution has to be gradually increased.

Drying of jujube fruit

For drying of jujube fruit, fresh and fully ripened fruit was selected. Immature produce lacks flavour and colour. Over mature product can be tough and fibrous or soft and mushy. Drying does not improve food quality. Dirt or spray had to be removed by thoroughly washing and cleaning of the fruit. Fruit that shows decay, bruises, or mold were sorted and discarded. Such defects can affect all foods being dried. Fruit was dried at 140°F (60°C) in an oven or dehydrator. The length of time needed to dry fruits will depend on the size of the pieces being dried, humidity and the amount of air circulation in the dehydrator or oven. At a drying temperature of 60°C, jujube was dried about 12 to 24 hours depends upon kinds of fruit and quality of fruits. Fruit was stirred and large pieces turned over every 3 to 4 hours during the drying period. Fruits scorch easily toward the end of drying. Therefore, the power was turned off when drying was almost completed and the door was wide-opened for an additional hour before removing pieces. Fruit had to be well-dried to prevent microbial growth and subsequent spoilage. To test fruit for dryness, a few pieces were removed and let cool to room temperature. When warm or hot, fruits seem more soft, moist and pliable than they actually are. The fruit was handful squeezed. If no moisture was left on the hand and pieces sprang apart when released, fruit was dry.

Conservation of jujube fruit with sugar and acid solution (vinegar)

The solution makes 30 – 40 % of the total weight of the product. Its composition has an important impact for the taste and usefulness of the crude material of jujube. According to composition, there are different solutions:

1. Sour, which contains 2% of acid, 2.5% of salt and 10% of sugar
2. Medium sour, which contains 1.6% of acid, 2% of salt and 8% of sugar
3. Mild sour, which contains 1.2% of acid, 1.5% of salt and 6% of sugar

To acidification of the solution, vinegar with the content of 8% of vinegar acid was used. The solution contained 2% of vinegar, 2% of salt and 10% of sugar. Fruits were saved in 700 ml glass and the solution was added. For the improvement of the flavor, leaf of *laurusnobilis* /thruelauler/ and the whole black spice were added to the each jar. After the closing of the jars, the product has been sterilized at 80° C for 20 minutes.

Preparation of compote

First of all, jujubes were cleaned; unwanted parts of the fruits were discarded. The natural sugar in jujube fruits was calculated. When the fruits had low natural sugar, more sugar was added to the solution. According to necessity the sweet solution for fruits was calculated. Final concentration of sugar was 18 – 20 °Rf. Glasses were filled with fruits and solution together, then sterilized in 90 °C for 15 minutes.

RESULT AND DISCUSSION

Seven different products were prepared from jujube fruit (**Fig. 1**). In 2007, the compote (cultivar) scored highest value (204) on the basis of hedonic scale (0 – 5) followed by cloying with Honey (½ green and ½ brown) having the score value of 195. The least score (153) was with sweet sour infusion vinegar (½ green and ½ brown). Results are available in the **table 2**.

Fig. 1 Different product of *Ziziphus jujuba* Mill.

Table 1: Results of degustation of different products of *Ziziphus jujuba* Mill. In 2007 (scale 0 – 5conduced by 11 judges)

2007	Appearance	Aroma	Consistency	Taste	Overall Acceptability	Total No.
Compot (cultivar)	47	33	40	43	41	204
With Honey (1/2 green, 1/2 brown)	41	34	38	42	40	195
Compot (seedling)	41	28	41	40	39	189
With Honey (full brown)	40	35	35	38	36	184
Dry Fruit (Cultivar)	37	34	31	42	37	181
With Vinegar (full brown)	50	25	42	27	30	174
With Vinegar (1/2 green, 1/2 brown)	45	22	36	23	27	153

In 2008 the experiment was repeated; in which maximum hedonic score (367.5) on 0 – 10 scale was found to be associated with cloying with Honey (full brown) followed by both compote (cultivar, seedling). The minimum score (285) was found with sweet sour infusion vinegar (½ green and ½ brown). Results are available in the **table 2**. Evaluation of different product of jujube for improving quality standard and evaluating processed product of jujube has given good result. Compote (cultivar) is the best product of jujube.

Table 2: Results of degustation of different products of *Ziziphus jujuba* Mill. in 2008 (scale 0 – 10conducted by 11 judges)

2008	Appearance	Aroma	Consistency	Taste	Overall Acceptability	Total No.
With Honey (full brown)	73	72.5	71	74	77	367.5
Compote (seedling)	71.5	65	73	72.5	73	355
Dry Fruit (cultivar)	71	70.5	69	74	67	351.5
With Vinegar (full brown)	78	53.5	58	61.5	56	327
With Honey (1/2 green,1/2 brown)	69	66.5	58	66.5	61	321
Compote (cultivar)	77.5	61	63	62	57	320.5
With Vinegar (1/2 green,1/2 brown)	73	50.5	52	57.5	52	285

On the basis of average hedonic score value, the maximum score (279.5) was with compote (cultivar) followed by cloying with Honey (full brown) whereas least score was gain with sweet sour infusion vinegar (½ green and ½ brown). Therefore it was concluded from the investigation that the jujube product compote (cultivar) is the best. Results are available in the **table 3**.

Table 3: Average hedonic score (2007 – 2008) of different products of *Ziziphus jujuba* Mill.

Serial No.	Products	Hedonic score (Scale 0 – 5) 2007	Hedonic score (Scale 0 – 10) 2008	Average Hedonic score 2007 - 2008
1	Compote (cultivar)	204	355	279.5
2	Honey (full brown)	184	367.5	275.75
3	Compote (seedling)	189	355	272
4	Dry fruits (cultivar)	181	351.5	266.25
5	Honey (½ green, ½ brown)	195	321	258
6	Vinegar (full brown)	174	327	250.5
7	Vinegar (½ green, ½ brown)	153	285	219

Sensory evaluation is a key factor for determine the acceptability of processed products of jujube. Under the present studies, the attempt was made for ascertain the most acceptable processed products of jujube by comparing seven different treatments. Studies revealed that the Compote (Cultivar) is the most acceptable product in all evaluators representing different age groups viz., young, middle age and old age. It was also observed that fruits processed in vinegar (½ green - ½ brown) was the least preferred produce among all the evaluators of these age groups there by indicating that Compote can thus be exploited on commercial scale for Processing purpose. Shin *et al.* investigated various processing methods for 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. However, under present investigation Compote (cultivar) found to be the best processed product based on the sensory evaluation. All results presented in this work are based on two years of observations, and further observations over the next few years will lead to more precise conclusions.

CONCLUSION

Novelty of Research

The main aim of this research work is to introduce *Ziziphu sjujuba* Mill. in Czech agro climatic condition. Jujube is not very common in all Europe. Area under cultivation of jujube is almost negligible in Europe. On the basis of the present investigations, it can be concluded that in the southern Moravia part of Czech Republic there exists appropriate natural condition for Chinese date cultivation .Chinese date trees are extremely drought resistant, with few natural enemies, and the cultivation is simple.

Fruit appearance was attractive to the consumers and the taste was positively appreciated by the most part of them. The high content in soluble sugars, minerals and ascorbic acid makes the Chinese date as an attractive fresh market fruit with high nutritional value. Two years evaluation of different products of jujube for improving of has given good result. A comparative study on different processed products of jujube revealed that Compote (cultivar) is the best product of

jujube with evaluators of young ,middle and old age groups and vinegar (½ green - ½ brown) was the least preferred processed product.

GENERAL CONCLUSION

Taking into consideration our first experimental results, we underline that, Chinese date is a promising new fruit species for Czech Republic. Its cultivation should be extended in Czech Republic not only in integrated and organic farms, but also in small private gardens in the southern and western part of the country where low temperature is not a limiting factor.

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