



Medicinal and Nutritional Properties of *Ziziphus jujuba* Mill. in Traditional Persian Medicine and Modern Phytotherapy

Ali Ghobadi^{1,2}, Farshad Amini-Behbahani^{1,2}, Azizollah Yousefi³, Maryam Taghavi Shirazi^{1,2,4}, Nasim Behnoud^{1,2,4*}

Abstract

Objectives: *Ziziphus jujuba* (jujube) is a plant with a long history of consumption as a fruit and a medicinal plant, which has various pharmacological effects. This plant has been widely used in traditional Persian medicine (TPM) and modern phytotherapy. Therefore, the overarching goal of this research was to review the nutritional and pharmacological properties of this valuable plant.

Materials and Methods: The relevant keywords were used to search different databases containing the new findings as well as the old textbooks, and several articles on *Z. jujuba*, its effects, and its benefits were extracted.

Results: First, the descriptions of *Z. jujuba* in the books on traditional medicine were reviewed with regard to the experiences of past physicians. Next, the new findings reported by scientists about the pharmacological effects of *Z. jujuba* and its active ingredients were presented. *Z. jujuba* has had numerous uses in the course of history. Considering the definitions provided in the traditional medical books and the modern applications of *Ziziphus jujuba*, there were close relationships among some of the findings, while for some of the effects described in traditional books there is no similar account in the classical medical books.

Conclusions: Jujube has been used for the treatment of some diseases throughout the history. Hence, since this plant is native to different parts of Iran, research centers are recommended to use the state-of-the-art technology to summarize the effects of jujube and its socioeconomic benefits.

Keywords: *Ziziphus jujuba* Mill., Jujube, Traditional Persian medicine, Onnab

Introduction

The instructions provided in traditional Persian medicine suggest that Iranians have been among the founders of medicine and have had a major role in the development of the science of medicine. Besides, the scientific transfer of traditional medical findings to modern medicine as part of a fully empirical-scientific process is one of the substantially important duties of the heirs of the medical history of Iran. Hence, since medicinal plants have been used by the public for a long time (1), the number of studies on the traditional applications of plants in the world, especially in the Mediterranean countries, has increased (2). According to the WHO report, the global sale of medicinal plants is currently about 62 billion dollars, which will increase to 5 trillion dollars by 2050 (3). Therefore, the examination of plants prevalently used in the traditional and classical medicine can be useful. For example, jujube is a plant with a long history of consumption as a fruit and a medicinal plant. It has, in fact, been deemed a medicinal plant with various pharmacological effects in the traditional Persian medicine (TPM) and phytotherapy. Therefore, reviewing the nutritional and pharmacological values and properties of this precious plant is the pivot of this paper.

Scientifically known as *Ziziphus jujuba* Mill, jujube is a plant in the Rhamnaceae family, which includes 45 genera and 550 species. It grows as a wild plant in tropical and subtropical regions (4). The height of the jujube trees varies from 2 to 8 m (and sometimes 12 m). This plant is also highly drought-tolerant and its fruit is called jujube, which is an edible olive-shaped bright red fruit (when it ripens). This fruit looks like an irregular wrinkled pulp but its exterior surface is smooth and shiny. It has a diameter of 2 mm (the diameter of the fruit core or pulp), and it is crispy and brittle. It has a faint smell and a slightly sweet, mucilaginous, and pleasant taste. It is also available in the fresh, dried, and processed forms around the globe (5). A plant in the buckthorn family (Rhamnaceae), *Z. jujuba* Mill is a fruit of the *Ziziphus* genus that has a pleasant taste and serves as a medicinal plant (6). This plant, which is the native wild plant of many countries, delivers significant nutritional and medicinal values. It is, however, a native Asian and South European plant that mainly grows in the tropical and subtropical regions (5). This plant is also known as *Ziziphus vulgaris* Lam., *Rhamnus ziziphus* L., *Ziziphus sativa* Gaertn., and *Ziziphus zizyphus* (L.) Karsten around the globe. Besides, lageniformis, inermis,

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¹School of Persian Medicine, Iran University of Medical Sciences, Tehran, Iran. ²Research Institute for Islamic and Complementary Medicine, Iran University of Medical Sciences, Tehran, Iran. ³Pediatric Growth and Development Research Center, Institute of Endocrinology and Metabolism, Iran University of Medical Sciences, Tehran, Iran. ⁴Student Research Committee, Iran University of Medical Sciences, Tehran, Iran.

*Corresponding Author: Nasim Behnoud, Tel: +989125121659, Email: Nasim_sahary5@yahoo.com



jujuba, and spinosa are among the different species of this plant, and *Ziziphus mauritiana* is another name for *Z. jujube* Mill. This plant is known as Ennab and Annab in the Arabic and Persian languages, respectively. It is also referred to asbedara, ber (i.e. other names for *Ziziphus mauritiana*), beri, bidara, bor, Chinese date, Chinese jujube, French jujube, kankole, ilantai, ma-tan, masan, onnab, taotau, tsao, and zao (7). The use of the jujube fruit in traditional medicine has a long history due to some of its pharmacological properties and benefits for blood purification and digestion. It also slows down the process of aging in women (8). Carbohydrates, sugar, organic acids, proteins, minerals, vitamins, and carotenoids are also abundant in this nutrient-dense fruit (9).

Traditional Persian Medicine

The 4 temperaments, which form the pillars of TPM, are based on four elements, namely soil, water, air, and fire. Each element delivers a certain quality. For example, soil, air, and fire are cold/dry, hot/humid, and hot/dry, respectively. These 4 elements were introduced as the constituents of the universe by the fathers of the TPM, and different combinations of these elements account for all the diversities and differences in the world. According to this belief, the elements dominating every creature account for the qualities of that creature, which are known as the temperaments. However, TPM is not the only advocate of the 4 temperaments theory because many other traditional schools such as the Greek, Arabic, Roman, Indian, European, and traditional Chinese medicine also believe in this theory (10). In this theory, the temperaments also determine the plant qualities (11). For instance, in the books about TPM, *Z. jujuba* Mill. is described as a hot and cold plant with mild moisture (12).

Materials and Methods

Web-based databases such as Google Scholar, PubMed, Medline, and Elsevier were searched using the related keywords and articles published from May 2000 to September 2018 were extracted. Thereafter, the articles were assessed using the following keywords: Unnab, *Ziziphus jujuba* Mill., Jujube, Ennab, Annab, Masan, Onnab, Taotau, Tsao, Bedara, Ber, Beri, Bidara, Bor, Chinese jujube, French jujube, Bankole, Blantai, Matanzao and traditional Persian medicine. The books on TPM were also reviewed for the descriptions of this plant.

Results

Pharmacologic Properties

In Traditional Persian Medicine

Jujube is introduced as a blood purifier, facilitator of hematopoiesis, facilitator of the viscous temperament, expectorant, cough suppressant, anti-asthmatic, laxative, wound healer, anaphrodisiac, semen suppressant, blood and bile refrigerant, anti-pruritus, and tranquilizer for renal and bladder pains. It also contributes to the

treatment of rectal and intestinal ulcers/diseases as well as liver diseases. Ripe jujube fruit has laxative properties, but unripe jujube heals diarrhea.

This plant is difficult to digest, and thus it might inhibit digestion in people suffering from digestive system problems. Flatulence is also a side effect of the excessive intake of jujube. However, according to TPM, these side effects can be eased with the aid of sugar and currant.

Depending on the patient's physical condition, honey and libido-enhancing medicines are prescribed to avoid the decrease in libido following the consumption of jujube (13, 14).

In Modern Phytotherapy

Nutritional Value

The active ingredients of jujube fruit, which is considered as a healthy food choice, are vitamin C, phenolics, flavonoids, triterpenic acids, and polysaccharides (6).

This fruit has a moisture content of 68.0%, and its pulp consists of acids (3.92%), total sugars (8.68%), reducing sugars (1.85%), non-reducing sugars (1.85%), pectin (1.72%), and tannins (1.32%). In addition, there is 2.56 mg of vitamin C per 100 grams of its pulp, and the total mineral content of the pulp which is manifested in the form of ash equals 1.38%. Proteins also make up 2.56% of the jujube pulp, while minerals, namely phosphorus, potassium, calcium, magnesium, and iron also make up 0.069%, 0.583%, 0.083%, 0.065%, and 0.006% of the pulp, respectively. Jujube fruit is also considered as a secondary source of vitamins such as thiamin, riboflavin, niacin, vitamin B-6, and vitamin A (15) (Table 1).

Table 1. Nutritional Value of Jujube

Contents	Unit	Value per 100 g
Water	g	20.19
Energy	kcal	281
Protein	g	4.72
Total lipid (fat)	g	0.5
Carbohydrate, by difference	g	72.52
Fiber, total dietary	g	6
Minerals		
Calcium, Ca	mg	63
Iron, Fe	mg	5.09
Phosphorus, P	mg	68
Potassium, K	mg	217
Sodium, Na	mg	5
Zinc, Zn	mg	0.39
Vitamins		
Vitamin C, total ascorbic acid	mg	217.6
Thiamin	mg	0.047
Riboflavin	mg	0.053
Vitamin B-12	µg	0
Lipids		
Cholesterol	mg	0

Source: USDA Food Composition Databases, 2017.

Antioxidant and Anti-Inflammatory Effects

According to research findings, phenolics and ascorbic acid are more abundant in jujube than in the other types of common fruits. Moreover, the assessments of the antioxidant capacity of jujube extract were carried out based on a decrease in power using scavenging methods to unveil the differences in the antioxidant capacity and free radical scavenging capacity of different jujube cultivars. However, rutin was not a measure in these assessments. It was found that the physicochemical properties and antioxidant capacity of jujube are cultivar-driven (15). Research findings have also proven the antioxidant and antilisterial properties of the oil from the seeds of *Z. jujube* (16), while the edible parts of jujube carry phytochemicals, phenolics, flavonoids, alkaloids, and glycosides (17). Having anti-inflammatory effects (16), jujube extract also prevents inflammations caused by 5HT and histamine (18). Finally, through the inhibition of T-cell proliferation, it modulates the anti-oxidant activity and immune responses (19,20).

Antimicrobial Activity

The therapeutic properties of *Z. jujuba*, as a medicinal plant, have been proven through research, and there have been reports of the positive antibacterial effects of jujube essential oils in different studies on its antimicrobial properties (16, 21). Therefore, jujube essential oils have antimicrobial properties while different parts of this plant such as its leaves deliver therapeutic values. In fact, jujube fruit owes its biological properties to its antibacterial and antifungal effects (21-23). For example, the crude extract of jujube fruit had a positive antimicrobial effect on the gram-negative and gram-positive bacteria and fungi in a study, demonstrating the greater antimicrobial properties of this fruit than the conventional antibiotics such as vancomycin. Therefore, this study proved the antimicrobial effect of jujube extract on fungi and the gram-positive and gram-negative bacteria and demonstrated its effectiveness in treating infectious diseases especially pediatric infections (24-28).

Sedative Activity

In China, jujube (*Z. jujuba*) has been traditionally used for the treatment of sleep disorders and anxiety. As mentioned, phenolics, flavonoids, and triterpenic acids are also the active ingredients of jujube (6). Moreover, sleep disorders can be alleviated through the modulation of the monoaminergic system, which is linked to in vitro activity of triterpenic saponins and might be the primary bioactive factor involved in these disorders (29). Finally, according to the results from the in vivo experiments, the hypnotic effect of saponins may influence the serotonergic system (30, 31).

Anticancer Activity

The anticancer effects of jujube fruit have been reported

by many researchers. For instance, there are reports of the contribution of jujube extract to the reduced cell viability through the concentration-dependent alteration of apoptosis and differential cell cycle arrest in HepG2 cells (32-34). Jujube also exerts selective anti-tumor effects via inhibiting cell growth and inducing apoptosis. It could be a promising strategy to develop a successful treatment for cancer therapy. In addition, inhibited cell growth and induced apoptosis are the causes of the selective anti-tumor contribution of jujube, which can form the basis for a winning strategy for cancer therapy (35-37).

Gastrointestinal Protective Activity

In a study, the intestinal conditions of hamsters were improved using the water-soluble carbohydrate concentrate of jujube fruit, which contained glucose, fructose, pectin polysaccharide, and hemicellulose. This effect can be attributed to a decrease in the exposure of intestinal mucosa to harmful substances such as ammonia, which is toxic (37, 38).

Balancing Lipid and Obesity

According to the findings from an experimental study on rats, *Ziziphus jujuba* inhibits the alcohol-induced increase in the serum cholesterol and triglyceride and glucose levels (39-41). It was reported that jujube extract could potentially prevent obesity in rats, while it can also inhibit the accumulation of lipids and glycerol-3-phosphate dehydrogenase activity without undermining cell viability (42).

Wound-Healing Effect

There are reports of the positive effects of the jujube fruit on the treatment of burns and wounds. It is also known as the fruit of life (43,44).

Discussion

In this research, after reviewing the articles on modern and traditional medicine, a comparison was drawn between the descriptions of the nature and uses of this plant according to the traditional and modern medical texts. It was found that jujube is considered as a rich nourishing fruit in both modern and traditional medicine. In modern medicine, the antioxidant and anti-inflammatory effects of jujube are stressed, and it is described as a cough suppressant, a wound healer, a cure for liver diseases, and a blood purifier. These descriptions reveal the similarities between the stands of the modern and traditional medicine on jujube. As regards the classical medical viewpoint on its antimicrobial effect, it could be stated that old physicians referred to the treatment of cohesive sputum or wounds by dint of this fruit. Besides, there are references to its sedative effects. In traditional medicine, this plant is not described as a sedative, but perhaps the blood purification and sputum treatment besides its wet temperament mirror its sedative effects. The positive effect of jujube

on the digestive system and the liver has been proven in many studies. Its contribution to the treatment of hyperlipidemia has also been proven. In the traditional medical books, jujube is explicitly introduced as a laxative and an anti-diabetic as well as a cure for intestinal ulcer and the liver conditions. In both traditional and modern medical sources, the positive effect of jujube on wound healing has been asserted. Our review of the classical studies revealed no study on the effect of jujube on sexual desire and seminal fluid or its effect on renal and bladder pains and blood purification, which is probably about reducing abnormal blood factors or proteins. There are, however, references to its other effects on suppression of coughing and treatment of asthma and other conditions in the traditional medicine, yet there is a lack of experimental and clinical studies on these effects of jujube.

In any case, the assessment of the pharmacological properties and values of jujube entails ethnobotanical analyses, pharmacological and experimental studies, and clinical research for its effectiveness and safety.

Conclusions

According to our findings, the traditional Persian medical texts present instructions on different types of medicinal plants including jujube. Therefore, it is possible to achieve economic, social, and mental efficiency by comparing these books to the new sciences and conducting research in this subject area. For instance, jujube is a well-known medicinal plant with various nutritional values and pharmacological properties. There is no report of the toxicity or serious side effects of the oral intake of jujube. This fruit has a pleasant taste and is good for the human body. It has been recommended in several centuries in the old and recent Persian references. Besides, its pharmacological properties, phytochemical compounds, and pharmacological reports reflect its importance.

Competing Interests

The authors declare that they have no competing interests.

Ethical Issues

This manuscript is a part of a PhD thesis. The study protocol was approved by the Ethics Committee of Iran University of Medical Sciences (code number: IR.IUMS.REC 2018.9421309003).

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