

INTERNATIONAL JOURNAL OF UNANI AND INTEGRATIVE MEDICINE



E-ISSN: 2616-4558
P-ISSN: 2616-454X
IJUM 2020; 4(2): 09-14
Impact Factor (RJIF): 6.3
Peer Reviewed Journal
Received: 09-05-2020
Accepted: 11-06-2020

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Badam shireen (*Prunus dulcis* Mill): A ghiza-e-dawaae and immunomodulator: A latest review

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Abstract

Badam Shireen (Meetha Badam) commonly known as Badam is one of the famous dry fruits known to everyone. There are two types of almonds, one is sweet and the second one is bitter. Generally we use sweet almond and this article is mainly about sweet almond. This is also one of the classical Unani drugs prescribed by Hakeems and Vaidyas in different body ailments. In Unani literature, it is mainly described as *Muqawwi-e-Dimagh* (Brain tonic), *Murattib-e-Dimagh* (Brain demulcent), *Mulayyan* (Laxative), *Muqawwi-e-Bah* (Aphrodisiac) and *Mughazzi* (Nutritious) etc. Its nutritional values are very high, most of the essential nutrients are present in sufficient amount which are necessary for the body development and immunity boosting against the diseases and so it is one of the best Immuno-boosters which is needed by a person to remain healthy. In Epidemic and Pandemic infections people need such type of nutritional Immuno-enhancers which strengthen their body to fight against the diseases.

Keywords: *Badam shireen, prunus dulcis, muqawwi-e-dimagh, laxative, muqawwi-e-bah*

Introduction

According to therapeutic guidelines of Unani System of Medicine the disease can be treated in three ways:

1. *Ilaj Bil Tadbeer wa Bil Taghzia* (Regimenal and dieto-therapy)
2. *Ilaj Bil Advia* (Pharmacotherapy)
3. *Ilaj Bil Yad* (Surgical intervention) ^[1].

As such the treatment of a disease is initially started with non-pharmacological approach, either with diet or regimental therapies. Since ancient period, numerous food items are being used as medicine for the prevention and treatment of diseases, among which almond is an important nutritious medicinal plant. Nuts are known as a source of nutritious food with high lipid content. Replacing half of the daily fat intake with nuts has been known to lower total and LDL cholesterol levels significantly in humans ^[2] and almond is one of the important nuts which are used in diet. It is a seed of *Prunus amygdalus* Batsch. var. *dulces*. There are two types of almonds based on taste, sweet almond and bitter almond. The sweet almond is edible and bitter almond is non-edible or poisonous. The bitter almond is slightly broader and shorter than sweet almond. Sweet almond contains 50% of fixed oil. Bitter almond yields hydrogen cyanide. Almond consists of three parts: Kernel or meat, mid shell and outer green shell. There is a thin leathery layer known as brown skin or kernel or seed coat. Its kernel part is of high nutritional value. Almonds are packed with vitamins, minerals, protein and fiber. They are eaten in raw or roasted form. They are a drupe and not considered as true nut ^[3]. The cultivated sweet almond (*Prunus dulcis* Mill.) is a very important and valuable specialty product both for domestic consumption and trade and it grows in the temperate and sub-tropical areas of the world. Almond belongs to the genus *Prunus*, with in the Rosaceae family. The cultivated almond is designated as *Prunus dulcis* (Miller) D.A. Webb. Listed synonyms include *Prunus amygdalus* Batsch and *Prunus communis* L. as well as the early designation *Amygdalus communis* L ^[4]. Sweet almond have been cultivated for thousands of years and used for food and medicinal purposes. In the ancient medical and scientific texts of the Greeks and then the Persians, and later in traditional Chinese, and Indian Ayurvedic medicine, almost same properties, such as hot, heating, cleansing, nourishing, strengthening mental functions, are attributed to almonds. In addition it has been reported that the almonds were introduced from western and eastern Asia ^[5].

The Central and Western Asia is said to be the native of Almond [6, 7]. It has been cultivated in China since 10th century B.C. and in Greece since 5th century B.C. In India, Almond is mainly cultivated in Kashmir and is supposed to be one of the chief crops of this region. The United States is the largest almond producer in the world and most of the US almonds are grown in California [8]. Almonds are considered highly nutritious due to rich source of fat and proteins [9]. According to US department of Agriculture Nutrient Database, almonds have high protein content (21.2 g/100 g of raw almond) and the TRP content of this nut is about 214 mg/100g. These nuts provide 5.79 kcal/g of energy and are low in saturated fat (<8% of total fats) but rich in unsaturated fats (92% of total fats), mainly of which are monounsaturated (66.15%). Almonds are one of the most important source of plant protein, and good source of dietary fiber, minerals, antioxidants, vitamins and numerous bioactive substances, such as phytosterols and flavonoids. These nutrients may possess health benefits by producing synergistic effects and/or interactions with each other [10]. According to Unani literature, it is used alone or in combination with other medicine as compound formulation like *Laoq-e-Badam*, *Luboob-e-Kabir*, and *Luboob-e-Sagheer* etc [11]. It possesses many important pharmacological activities like *Muqawwi-e-Dimagh* (Brain tonic), *Taqwiat-e-Hifz* (Memory enhancing), *Mulattif* (Demulcent), *Jali* (Detergent) etc [12]. Almonds are also *Mughazzi* (Nutritious) and Stimulant nervine tonic and valuable in diets for peptic ulcer. Unripe fruits are astringent applied to gums. Almond oil is nutritive, demulcent and slightly laxative [13]. The unripe fruit is used as vegetable in certain parts of country.

Mutradifat (Vernacular Names)

Arabic-*Lauz-ul-Hulu* [14, 15, 16]
 Persian-*Badam-e-Shireen* [15, 16]
 Urdu-Badam Shireen [15]
 English-Sweet Almond [15]
 Hindi-Badam [15]
 Sanskrit-Badama [15]
 Malayalam-Badam [15]
 Marathi-Badam [15]
 Kannada-Badami [15]
 Tamil-Vadumai [15]
 Telugu-Badamu [15]
 Bengali-Bilaiti Badam [15], Kaath Badam [16]
 Gujrati-Badam [15]
 Punjabi-Badam [15]

Habitat

Almond is a large deciduous or evergreen tree and shrubs mostly unarmed [6, 17]. It is said to be originally a native of central and western Asia and have been cultivated in China as early as the 10th century B.C. and in Greece in 5th century B.C. At present it is cultivated throughout Southern Europe, in U.S.A. (California), Australia and South Africa [6]. In India the almond is cultivated in Punjab, Kashmir and Himachal Pardesh [17, 18] also in Afghanistan, Baluchistan, Persia and the Mediterranean region [17]. The almond is said to have been extensively planted in some of the hilly areas of Uttar Pradesh also, but the fruiting has not been very encouraging due to heavy rainfall [6].

Description

Macroscopic: The seeds are found enclosed in stony shell.

The seeds are about 2-2.5 cm long and 1-1.5 cm wide, laterally flattened rounded at one end and tapering at micropylar end, almost exalbuminous. The outer most covering of seed is a thin membranous rough brown colour seed coat. The seed coat is easily removed when soaked in water. The embryo is made of two large slightly elongated plano-convex cotyledons, hinged together by a small axis and radical lies at the narrow end of seed. One seed varies from 0.67 to 1.53 g [15].

Microscopic: Transverse section of seed reveals that the seed coat has epidermis, the outer most layer of testa is represented by greatly enlarged, thick walled papilli form cells. The lower half of which appears to be pitted. The cells of middle region and tagmen are almost crushed. The inner epidermis of tagmen persist as a single layer of small thick walled compactly arranged tubular cells. The single layered endosperm consisting of thin walled larger parenchymatous cells is often found persisting in mature seeds. The two cotyledons are made up of thin walled parenchymatous cells filled with proteins in the form of aleurone grains [15].

Powder: As the seeds are oily, a coarse powder is produced on grinding. It is creamy white in colour, sweet in taste and devoid of any characteristic odour [15].

Scientific Classification [19]

Kingdom: Plantae

Division: Tracheophytes

Class: Angiosperms

Order: Rosales

Family: Rosaceae

Genus: *Prunus*

Subgenus: *Prunus* subg. *Amygdalus*

Species: *P. dulcis*

Binomial name: *Prunus dulcis* (Mill.) D. A. Webb

Synonyms: *Amygdalus amara* Duhamel, *Amygdalus communis* L., *Amygdalus dulcis* Mill.

Prunus amygdalus Batsch, *Amygdalus sativa* Mill.

Mizaj (Temperament)

Hot 1 & Moist 1 [12, 14, 15, 20]

Hot & Cold [14]

Cold 1 & Dry 2 [21, 22]

Ajza-e-Mustamla (Parts Used)

Seeds and seed oil [14]

Fruit and Root [17], Seed, Almond shell [23]

Miqdar Khurak (Dose)

7 Badam seeds [14]

7-11 Badam seeds [15, 17]

1.5 Tola or Not more than 2.5 Tola in one time, Badam seed oil [14]

Muzir Asar (Adverse effect)

Delayed Digestion [14, 16]

Badal (Substitute)

Maghz Finduq, Pista [14]

Maghz Akhrot [16]

Musleh (Correctives)

Sugar, Honey water, Mastaghi [14, 20]

Murakkabat (Compound Formulations)

Laoq-e-Badam, Laoq-e-Sapistan, Raughan-e-Badam Shireen, Raughan-e-Luboob-e-Saba, Luboob-e-Kabir, Luboob-e-Sagheer, Majoon-e-Aarad Khurma, Majoon-e-Mughalliz [15].

Af'āl (Pharmacological Actions)

Muqawwi-e-Dimagh (Brain Tonic) [14, 15, 16]
Taqwiyat-e-Hifz (Memory Enhancer) [12]
Mughazzi (Nutritious) [13, 14]
Muqawwi-e-Bah (Aphrodisiac) [14, 15, 16]
Muwallid-e-Mani (Semen Productive) [12]
Musammin-e-Badan (Body Fattening) [14]
Mulaiyyen (Laxative) [14, 15, 16]
Muqawwi-e-Chasm (Eye Tonic) [14]
Mulattif (Demulcent) [13, 18, 24]
Muharrik-e-Aasab (Nervine Stimulant) [6, 13, 18, 23]
Jali (Detergent) [16, 12]
Mudirr-e-Baul (Diuretic) [17, 23, 24]
Suda (Headache) [17, 23]
SualYabis (Antitussive) [12, 17]
Muqawwi-e-Meda (Stomach Tonic) [12]
Muqawwi-e-Ama (Intestinal Tonic) [17]
Kasir-e-Riyah (Carminative) [12]
Mufatteh (Deobstruent) [12]

Ist'emalat (Therapeutic Uses)

Zof-e-Dimagh (Brain Weakness) [12, 15, 16, 20]
Zof-e-Qalb (Heart weakness) [12]
Khafqan (Palpitation) [12]
Nisyan (Amnesia) [12]
Muqawwi-e-Mana t (Immunity Enhancer) [16]
Zof-e-Aam (General Weakness) [12, 20]
Zof-e-Bah (Sexual Debility) [15, 20]
Qabz (Constipation) [12]
Zof-e-Basar (Weak Eyesight) [12, 14, 17]
Sual (Cough) [14, 15, 17, 21, 23]
ZeequnNafas (Asthma) [14]
ZatulJanab (Pleuricy) [14]
Nafsuddam (Haemoptysis) [14]
Nakseer (Epistaxis) [12]
Khushunat-e-Halaq (Sore Throat) [14]
Qarh-e-Medi (Peptic ulcer) [6, 13, 24]
Humuzat-e-Medi (Hyperacidity) [12]
Ishaal (Diarrhoea) [12]
Zaheer (Dysentery) [14, 23]
Bawasir (Piles) [12]
Yarqaan (Jaundice) [12]
Istisqa (Ascites) [17]
Waja-e-Asab (Neuralgia) [17, 23]
Ushr-e-Tams (Dysmenorrhoea) [14, 17, 23]
KasratBaul (Polyuria) [23]
Suzaak (Gonorrhoea) [14]
Sozish-e-Baul (Burning Micturition) [12, 14]
Waram-e-Masana (Cystitis) [14]

Phytochemistry

Almond contains carbohydrates, fat, proteins. It also contains many important and essential minerals and vitamins like calcium, phosphorous, iron, potassium, magnesium, manganese, zinc, copper, sulphur, chlorine, iodine, thiamine, riboflavin, nicotinic acid and folic acid [6, 25]. Almond is a very good source of vitamin E, Monounsaturated fatty acid, polyunsaturated fatty acid and

Arginine [26]. The active constituents of almonds are globulins such as amandine and albumin; amino acids such as arginine, histidine, lysine, phenylalanine, leucine, valine, tryptophan, methionine and cystine [6, 25, 26]. The oil has been estimated to consist principally of diolein and triolein [6]. Almond contains approximately 49% oil, of which 62% is monounsaturated oleic acid (omega 9 fatty acid), 24% is linoleic acid (a poly unsaturated omega 6 essential fatty acid), and 6% is palmitic acid (saturated fatty acid) [26, 27]. Many phenolic compounds have been extracted from almond byproducts which were identified as 3-O-methylquercetin, 3-O-β-D-glucopyranoside, 3-O-methylquercetin 3-O-β-D-galactopyranoside, 3-O-methylquercetin 3-O-α-L-rhamnopyranosyl (1→6)-β-D-glucopyranoside, catechin, protocatechuic acid, vanillic acid, and phydroxybenzoic acid [28]. Four different flavonol glycosides-isorhamnetin, rutinose, isorhamnetin glucoside, kaempferol, rutinose, and kaempferol glucoside have been reported in almond seed coats [29].

Nutritional Value of Almonds (Per 100g/3.5 oz) [30]

Energy-579 kcal (2,423 kJ)
 Carbohydrates-21.6g
 Starch-0.7g
 Sugars-4.4g
 Dietary fiber-12.5g
 Fat-49.9g
 Saturated-3.8g
 Monounsaturated-31.6g
 Polyunsaturated-12.3g
 Proteins-21.2g
 VitB1 (Thiamine)-211mg (18 % DV)
 Vit B2 (Riboflavin)-1.014mg (85 % DV)
 Vit B3 (Niacine)-3.385mg (23 % DV)
 Vit B5 (Pantothenic acid) – 0.469 mg (9 % DV)
 Vit B6-0.143mg (11 % DV)
 Folate (B9)-50 micro g (13 % DV)
 Vit E-25.6mg (171 % DV)
 Calcium-264mg (26 % DV)
 Copper-0.99mg (50 % DV)
 Iron-3.72mg (29 % DV)
 Magnesium-268mg (75 % DV)
 Manganese-2.285mg (109 % DV)
 Phosphorus-484mg (69 % DV)
 Potassium-705mg (15 % DV)
 Zinc-3.08mg (32 % DV)
 Water-4.4g

Pharmacological Studies**The Cholesterol Lowering Action**

- A study published in the Journal of the American Heart Association, showed that snacking on almonds daily for six weeks not only reduced LDL and total cholesterol, but also reduced abdominal fat and waist circumference in study participants [31].
- CE Berryman *et al* have found that almonds have a consistent LDL cholesterol lowering effect in healthy individuals and in individuals with high cholesterol and diabetes, in the controlled and free-living settings. Almonds are low in saturated fatty acids and rich in unsaturated fatty acids and contain fiber, phytosterols, plant protein, α-tocopherol, arginine, magnesium, copper, manganese, calcium and potassium. The nutrients which are present in almonds regulate the

enzymes which are involved in cholesterol synthesis and bile acid production [32].

- c) Another study conducted by David J.A. *et al* showed that almonds reduced the biomarkers of lipid peroxidation in hyper lipidaemic patients [33].

Immunostimulant Properties

- a) A recent study conducted by Adriana Arena, *et al.* has suggested that almonds, specifically the skin of almonds, may support immune system function. In this study they have evaluated that with almonds, high levels of cytokine production were observed i.e., interferon- α (INF- α), interleukins (IL-12), INF-gamma and tumour necrosis factor (TNF- α). Their data suggested that almonds improved the immune surveillance of the peripheral blood mono nuclear cells towards viral infections. Almonds also were found to induce a significant decrease in the Herpes simplex virus (HSV-2) replication. Thus the study indicates that (natural) almond skins (may) stimulate the immune response and thus contribute to an antiviral immune defense [34].
- b) Dr. Giuseppina Mandalari from the Institute of Food Research, Norwich, UK, reported that almonds have a helpful impact on the treatment of infective and chronic diseases. She has also reported that almond skins can modulate an immunological response "and positively act as novel antiviral agents. Their team evaluated the effects of natural and blanched almond skins on the release of immunological compounds in cells either infected or not infected with the genital herpes virus HSV-2 [35].

Anti-oxidant Action

A study conducted by Ali Jahanban Isfahan, and others demonstrates that the methanolic extracts of almonds possessed anti-oxidant and anti radical activities and that their phenolic extract may be helpful in preventing or slowing the processes of various oxidative stress related diseases. The results showed that the anti-oxidant and the anti-radical activities of the almond hull (green outmost layer of almond) were higher than those of its shell [29].

Hypoglycemic Action

- a) David J.A. Jenkins *et al* conducted a study, it shows that almonds lowered post-prandial glycaemia, insulinaemia and oxidative stress. The nut consumption in the Seventh Day Adventists study, the Nurses' Health study, the Physicians Health study, the Health Professionals study and the Iowa Women's Health study were all associated with the same actions which are mentioned above. Almonds decrease post-prandial glycaemia and oxidative damage in healthy individuals [36].
- b) Another study conducted by Shah KH, *et al* showed that the ethanolic extract (250 and 500mg/kg) of the leaves, flowers and seeds of almonds was taken up to evaluate its anti-diabetic activity against normal and streptozotocin induced diabetic mice. The oral administration of the extract for 21 days resulted in a significant reduction in the blood glucose levels. At the end of the experiment (15th day), the blood glucose levels were 80.6 ± 1.8 and 77.6 ± 1.4 mg/dl in the diabetic mice which were treated with 250 and 500

mg/kg b. w. of the leaf extract respectively. The flower and seed extracts, at a dose of 500mg/kg b. w., also showed significant reduction ($P < 0.001$) in the blood glucose levels of the diabetic mice on the 15th day of the study [37].

- c) A number of randomized, controlled studies of the effects of almonds on measures related to blood glucose control have been conducted in subjects with T2D, evaluating both post-meal effects and longer-term (over at least four weeks) measures. In three of the four longer-term studies, eating an almond-enriched diet resulted in significant reductions in fasting glucose and insulin levels control, when compared to an almond-free diet. A randomized trial in 19 U.S. adults (including 7 with T2D) reported a 30% reduction in post-prandial glycemia in participants with T2D following the consumption of a test meal containing one ounce (28 grams) of almonds compared to an almond-free test meal similar in calories, fat and available carbohydrate, although the effect was not significant in those without T2D [38].

Aphrodisiac Action

Gopu Madhavan *et al*, in their study with a polyherbal formulation (Tentex Royal) which contained *Prunus amygdalus* along with other herbal preparations, showed a significant improvement in all the parameters of the sexual indices. Parameters such as total sexual behaviour, mounting frequency, ejaculation frequency, ejaculation latency, and serum testosterone levels and sperm count were carefully monitored. A significant improvement in all the parameters of the sexual indices was observed in the Tentex royal group. The treatment with Tentex royal also showed an increase in the sperm count and the testosterone levels. Histological evaluation of the anterior pituitary revealed an increase in the FSH-LH producing basophils and a decrease in the ACTH producing cells. The study revealed that Tentex royal improved the erectile capacity. Considering the limitations of sildenafil citrate in clinical practice, Tentex royal may be considered a safe and alternative treatment for the correction of erectile dysfunction [39].

Hepatoprotective Action

A study conducted by Manoj Soni *et al* reported the hepatoprotective activity of the Prunus extract against Paracetamol and CCl4 induced hepatitis in rats. The extract of methanol: ethanol (70:30) of Prunus was prepared and tested for its hepatoprotective effect against Paracetamol and CCl4 induced hepatitis in rats. An alteration in the levels of the biochemical markers of hepatic damage like SGPT, SGOT, ALP, total bilirubin, direct bilirubin and tissue LPO, GSH, catalase and SOD were tested in both the treated and untreated groups. Paracetamol (2g/kg) and CCl4 (1.5ml/kg) enhanced the SGPT, SGOT, ALP, total bilirubin, direct bilirubin and the tissue levels of GSH. The treatment with the extract of the Prunus fruits (150mg/kg and 300mg/kg) brought back the altered levels of the biochemical markers to near normal levels in a dose dependent manner [40].

In Amnesia

Kulkarni, *et al*, in their study, suggested that almonds possess a memory enhancing activity in view of its facilitatory effect on the retention of special memory in scopolamine induced amnesia. They concluded that almonds

lowered the serum cholesterol in rats. They were also found to elevate the Ach level in the brain and ultimately improve the memory (special and avoidance) of rats. In the light of the above findings, it may be worthwhile to explore the potential of this plant in the management of cognitive dysfunction. They concluded that because the diminished cholinergic transmission and an increase in the cholesterol levels appeared to be responsible for the development of the amyloid plaques and the dementia in Alzheimer's patients, PA could be a useful memory restorative agent. It would be worthwhile to explore the potential of this plant in the management of Alzheimer's disease [41].

Pre-Biotic Potential

A study conducted by G. Mandalari *et al* that demonstrates the prebiotic activity of almond seeds. It has been shown that almonds altered the composition of gut bacteria by stimulating the growth of bifid bacteria and Eubacterium rectale [42]. Pre-biotics are non-digestible-food ingredients that stimulate the growth and activity of bacteria in the digestive system, in ways which are claimed to be beneficial to health. Typically, pre-biotics are carbohydrates (such as oligosaccharides). The most prevalent forms of pre biotics are nutritionally classified as soluble fibers. To some extent, many forms of dietary fibers exhibit some level of pre-biotic effects [43].

Anti-aging Activity

In a scientific study, skin extract of *Prunus amygdalus* was used in herbal cosmetic formulation and evaluated for the protection of skin from solar ultraviolet induced photo-aging. The skin of treated mice groups showed stronger antioxidant activity by significantly decreased and increased MDA and GSH level respectively as compared to irradiated control groups [44].

Conclusion

In this review article we have discussed in detail about the nutritional value, biochemical ingredients and pharmacological actions, therapeutic uses and also the pharmacological studies conducted so far of the commonly used almond that is sweet almond (*Prunus dulcis*). Its nutritional value is very high and is full of all the essential ingredients of a healthy diet. This makes it healthy snack/diet that protects our body in fight against the diseases, it boosts our immunity and this is proved by the study, this is the reason for choosing almonds for article being an excellent food/drug. Dietary changes are often the first and one of the most effective ways to reduce the risk of cardiovascular disease, and the research studies suggest that eating almonds can help in maintaining a healthy heart. The prevalence of type 2 diabetes is rapidly increasing. Diabetes is also a contributing risk factor for other chronic diseases, such as heart disease and stroke. Dietary and lifestyle interventions are a critical component of diabetes management, and evidence continues to mount supporting the role of almonds and other tree nuts as part of an overall dietary pattern that is beneficial for those with type 2 diabetes. Almonds are low-glycemic index and provide a satisfying combination of protein (6 grams per ounce), fiber (4 grams per ounce), and monounsaturated fats makes them an ideal snack and addition to meals for individuals with impaired glucose tolerance or type 2 diabetes. In last few years many studies were conducted and they showed its

hypolipidaemic, immunostimulant, antioxidant, hypoglycaemic, hepato-protective, aphrodisiac and nootropic activities etc. The pharmacological and medicinal significance of *Prunus dulcis* is gradually increasing, more and more research studies are needed to explore its therapeutic efficacy.

Acknowledgement

The authors are highly thankful to Director General, CCRUM, New Delhi for generating enthusiasm amongst the research workers for publishing more and more data available at the peripheral centers.

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