BITTER ALMOND (PRUNUS AMYGDALUS VAR. AMARA): A REVIEW ON TRADITIONAL USES, NUTRITIONAL VALUE AND THERAPEUTIC APPLICATIONS

Salma¹, Yasmeen Shamsi², Sadia Nikhat³ and Mateen Ahmad⁴*

¹MD Scholar, ³, ⁴Asst. Professor,
¹, ³Department of Moalajat, SUMER, Jamia Hamdard.
²Professor & HOD Department of Moalajat, SUMER, Jamia Hamdard.
⁴Asst. Professor, Department of Ilmul Saidla, AIUMC, Muzaffarnagar.

ABSTRACT

Bitter almond is the kernel of a popular medicinal plant Prunus amygdalus var amara, which has been used to prevent and cure diseases since many centuries. Bitter almond essential oil is used in cosmetics for various skin issues. Bitter Almond has been traditionally used for melasma, dark spots of skin, and some other skin problems like fungal infections, urticaria, dry itching, dandruff, acne, hair loss, for healing wounds, haemorrhoids and as analgesic in joint pains. The kernel is rich in antioxidants, flavonoids and phenolic acids. Major pharmacological properties of bitter almond include antioxidant, anti-tumour, anti-microbial, and use for prevention of stretch marks during and after pregnancy. Anti-cancer activity of bitter almond is due to presence of amygdalin compound. However, in high doses, bitter almond, especially its oil can cause cyanide poisoning and which may lead to various complications such as sudden headache, dizziness, vomiting, bradycardia, seizure, and even coma. This article reviews its traditional uses, phytochemical compounds, and therapeutic actions of bitter almond.

KEYWORDS: Bitter almond, Prunus amygdalus var. amara, amygdalin, traditional uses, antioxidant, Melasma.
INTRODUCTION
Bitter Almond is a fruit kernel obtained from *Prunus amygdalus var. amara*, which belongs to the family Rosaceae (rose family). Almond has two varieties, bitter and non-bitter. *Prunus amygdalus var. dulcis* is a tree which produces sweet almond (non-bitter) that has very low amount of toxic phytochemicals such as cyanides. *Prunus amygdalus var. amara* produces bitter almond that has comparably greater amount of toxic phytochemicals called glycoside amygdalin.\(^1\)\(^,\)\(^2\) Sweet almond and Bitter almond producing plants can be recognised on the basis of the colour of their flowers. Flowers of bitter almonds are of pinkish colour, while flowers of sweet almonds are white in colour. Bitter almond comprises high levels of amygdalin (3-5\%) and develops a specific cyanide smell when it comes in contact of moisture. Its bitter taste is due to the presence of content of cyanogenic glycoside amygdalin which decomposes into cyanuric acid. Excessive use of such toxins (more than the permissible/ tolerable dose for humans) can lead to poisoning and even death also. The amygdalin are only found in kernels of almonds. Additionally, amygdalin concentration increases as the fruit matures. Bitter almond have approximately 40 times higher hydrocyanic acid concentration than non-bitter almond. Prunasin is a cyanogenic monoglucoside which is present in leaves, roots and kernels of almonds.\(^2\) Even though bitter almond has numerous health benefits, it has some adverse and toxic effects on the body because of presence of hydrocyanic acid. There are so many benefits of bitter almond which is used to prevent and treat various diseases.

HABITAT
Almond tree is a native of central and western Asia. They are widely cultivated in the countries that border on the Mediterranean. In hotter regions of the world like California, Spain, Persia, Australia, Morocco, Italy, Armenia, India, Kashmir, Pakistan and Afghanistan, having long summers almond trees are usually cultivated.\(^3\)\(^,\)\(^4\) California (USA) is the topmost producer of almonds (*Prunus dulcis*) globally, with an estimated annual production of 1 million tons and accounting for 80\% of world almond production.\(^12\) Another countries producing almond are Australia (7\%), Spain (4\%), Tunisia and Iran (1\%).\(^4\)

BOTANICAL DESCRIPTION
The almond tree is a small deciduous species about 6-8 m tall. Trees of Almond are not immediately productive, and only bear fruit after 5 years. The fruit becomes mature after 7 to 8 months of flowering, in autumn season. The fruit of almond tree is a drupe, which splits
open as it ripens, disclosing the hard endocarp, within which almond is to be found.\[2\] The fruit of bitter almond tree has pink shoots and comparatively flatter and tinier than the non-bitter almond that has white shoots. Lanceolate, type leaves which are 3 to 5cm wide, and 4-13 cm long, with serrated tips. White or pale pink flowers of diameter (3-5cm), which are formed singly or in form of groups, in early spring. The fruit of almond is 3.5 to 6.0 cm long drupe, with soft outer cover.

**TAXONOMICAL CLASSIFICATION**

<table>
<thead>
<tr>
<th>Family</th>
<th>Rosaceae</th>
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<tr>
<td>Genus</td>
<td>Prunus</td>
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<tr>
<td>Subgenes</td>
<td>Prunus subsp. amygdalus</td>
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<td>Species</td>
<td><em>P. amara</em></td>
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**VERNACULAR NAMES**\[3,4,5\]

- **English:** Bitter almond
- **Persian:** *Badam Talkh*
- **Arabic:** *Lauzul Murr*
- **Spanish:** Almedro
- **Tamil:** Vadamkottai
- **Telugu:** Badamvittulu
- **Urdu:** Kadwa badam
- **Hindi:** Kadwa badam
- **Punjabi:** Kadwa badam

**Plant of Bitter and Sweet Almond**
TEMPERAMENT
Temperament of Bitter almond is hot in third degree and dry in third degree. Hot and dry in 3rd degree\(^5,6\); Hot and dry in 2nd degree\(^7\); Hot in 3rd degree and dry in 1st degree.\(^8\)

PARTS USED
- Seeds
- Oil expressed from bitter almond,
- Roots
- Gum.\(^3,9\)

ACTIONS DESCRIBED IN UNANI MEDICINE
- Emollient
- Demulcent
- Laxative
- Attenuent
- Astringent
- Lithotropic
- Diuretic
- Detergent
- Antihelmenthic
- Emmenagogue
- Carminative
- Expectorant
- Styptic
- Calorific

**Roots**
- Discutient
- Alterative\[^3\]

**Traditional uses of bitter almond**
- Bitter almond is very much valued in traditional system of medicine and modern medicine. In Iranian medicine, bitter almond essential oil is used to treat wounds and burns and to protect stomach, and ointment is used in to treat joint pain, hair loss, acne and to strengthen condition hairs. Haemorrhoids are also treated with the extract of bitter almond.\[^2\]

**Therapeutic uses** – It is a drug of choice for melasma and headache for local application.\[^7\]

**Other uses**\[^5,7,8,9,10\]
- *Amraz e jild* (Skin disease)
- *Jhaiyyan* (Melasma)
- *Namsh* (Freckels, lentigo)
- *Sharaa* (urticaria)
- *Qurooh saa’iya* (ulcers)
- *Busoor ratba* (Acne vulgaris)
- *Qooba* (dermatophytosis)
- *Huzaaz* (dandruff)
- *Namla* (Herpes)
- *Jarab* (Scabies)
- *Hikkah* (Dry itching)

- Ear disease
- *Sudaa* (Headache)
- *Waja ul uzn* (Ear ache)
- *Taneen wa Dawi* (Loss of hearing)
Respiratory diseases
- Su’al (Chronic Cough)
- Rabu (Asthma)
- Seene ka waram (Chest inflammation)
- Phephdo ka waram (lungs inflammation)
- Nafas-ud-dam (Haemoptysis)

Gastrointestinal disease
- Waram e jigar (Liver inflammation)
- Waram e tihal (Spleen inflammation)
- Qoolanj (Colitis)
- Yarqan (jaundice)

Genito-urinary disorders
- Waja-ur rehem (uterine pain)
- Usrul baul (Painful urination)

Toxicity and Adverse/Side effects: Harmful for Intestine. Badam Talkh is mainly used for external application for various diseases, but also used internally with precaution and in less quantity.\textsuperscript{[10]} In \textit{P. amygdalus var. amara}, the amounts of cyanide compounds are much higher than other varieties. Cyanide-induced poisoning due to high doses of bitter almond may cause certain difficulties such as, dizziness, sudden headache, bradycardia, vomiting, lactic acidosis, fever, liver damage, hypotension, seizure, and coma.

Correctives: Sugar, Khashkhash, Baddam Shireen are used to counter its toxic and adverse effects.

Substitutes: Habbul muhlab (\textit{Prunus mehalba}) is used as substitute
Dose: $\frac{1}{2}$ to 1 seed, 2-2-1/2 gm per day.

SCIENTIFIC STUDIES
1. PHYTOCHEMISTRY
Bitter almond kernel contains several nutrients such as fatty acids, minerals, and vitamins\textsuperscript{[11]}, fixed oil 45%, proteins 25%, sugar 3%, amygdalin 3%, and phytosterols, flavonoids and phenolic compounds. The fruit has also contain emulsin, mucilage 3%, and ash 3 to 5%, hydrocyanic acid (glucoside)-0.025 mg in 100 g. Amygdalin is a crystalline substance, a
glucoside which is found in bitter almond only. In the presence of water amygdalin produces benzoic aldehyde, prussic acid and glucose. The most important bioactive components of bitter almond are amygdalin, prunasin, phenolic acids and flavonoids (Flavonoid - kaempferol, myricetin, naringenin are found in extract; Phenolic acids - caffeic acid, vanillic acid, hydroxycinnamic acid, rosmarinic acid, ferulic acid, are found in the extract of bitter almond), which exert antioxidant and anticancer effects.[3,11] Bitter almond is a good natural source of phytosterols like, stigmasterol, βsitosterol, ergosterol, αtocopherol, δ-tocopherol and retinol. Bitter almond is used for cosmetic, pharmaceutical and pastry production flavouring extracts and also for manufacture of prussic acid and also used in.[2,11]

1.1 NUTRITIONAL VALUE
In addition to many amino acids and fat, bitter almond has various minerals, such as K, Ca, Fe, Mg and Zn, and vitamins, predominantly vitamin E. The kernels contain approximately carbohydrates (60%), fat (48%), proteins, (30%), 3% amygdalin, and some other nutrients. Fatty acids found in kernels mostly were unsaturated, and the major fatty acids are oleic acid (70.61%) and linoleic acid (20.68%). It also considered a rich source of lipid soluble vitamins like vitamin D, vitamin K, saturated fatty acids and unsaturated fatty acids. However use of excessive amount (toxic tolerable dose) of it causes various cyanide induced hazardous health issues.[2,11]

2. PHARMACOLOGICAL ACTIVITIES

2.1 Antioxidant properties
Behzad Moradi et.al. Mentioned in his review article that mean antioxidant capacity of aqueous, ethanolic and methanolic, extracts was derived 56.72, 33.05 and 44.86, mg/g dry extract, respectively. Additionally, the highest amount of flavonoid compounds and lycopene are found in the ethanolic extract and the highest amount of phenolic compounds was found in aqueous extract of bitter almond kernels. Vit E is considered as maximal antioxidant effect, and it presents abundantly in bitter almond kernels. By numerous studies, it proved that it contains phenols and flavonoids which exhibits great antioxidant properties as well.[2]

2.2 Anti-tumour activity / Anti cancerous activity
Eman Zakaria Gomaa et.al. mentioned in his study that that bitter almond kernels have higher content of flavonoids and this is in accord with their higher cytotoxicity on HepG2 cell lines. In prevention or treatment of many different types of cancer, that is: colon, lung, laryngeal, prostate, breast, leukemia, and hepatocellular carcinoma, flavonoids have been
reported to exert a positive effect.[13] Amygdalin found in bitter almond was well thought-out an unconventional but desired anticancer agent in 1970s. It was referred to as B17 or laetrile in the last eras and has been known to be an exclusive substance to treat cancer for over 100 years.

In addition, anticancer effects of amygdalin have been investigated on bladder, cervical, colon cancer and hepatocarcinoma. Moreover, it has also been found that it can also can be used as a chemopreventive agent to prevent progress of cancers. FDA has banned amygdalin use since 1980 and its sale is prohibited in European countries. However, in some regions amygdalin is still being used as an anticancer agent worldwide. Therefore, it is necessary to explore the effect of amygdalin on normal cells death and then in laboratory animals to find a dose with anticancer effects but without fatal effects on normal cells.[2]

2.3 Antimicrobial properties
In a review article, Behzad Moradi et.al. Mentioned that aqueous, extract, Methnolic extract and ethanolic extracts of bitter almond have different antimicrobial effects. Of these methanolic extract have more effect on Bacillus subtilis and Staphylococcus aureus.[2] Hamid Abtahi et.al mentioned in his study that the greatest synergistic effect of bitter almond extracts is detected in methanol and aqueous extracts. Among the bacterial strains tested, Staphylococcus aureus was most susceptible.[14]

2.4 Antifungal activity
Huiling Geng et.al mentioned in his study that, in vivo antifungal activity of BAEO (Bitter almond essential oil) against Gloeosporium orbiculare was much higher than Blumeria graminis. The protective efficacy for the former was up to 98.07% at 10 mg/mL and the treatment efficacy was 93.41% at 12 mg/mL. The above results indicated that BAEO has the great potential to be developed as a botanical and agricultural fungicide.[15]

2.5 Protective effect on Biochemical parameters of brain tissue in diabetic rats
MDA (lipid peroxides) level was not changed, GSH (glutathione) level is protected, Fatty acid composition, lipid-soluble vitamins and cholesterol levels were protected or prevented in the bitter almond oil given group as compared to the control group. These positive results can be accredited to bitter almond oil, because it contains phytochemical compounds which have antioxidative properties, such as phenolics, flavonoids, sterols, vitamins.[16]
2.6 Prevention of stretch marks

Behzad Moradi et al. Mentioned in his review article that bitter almond essential oil can be used to prevent stretch marks. This may perhaps be described by the fact that almond kernel comprises large amounts of fat soluble vitamins like vitamin E, which is a strong antioxidant, Which reducing the severity of skin pathological condition.[17]

CONCLUSION

Bitter almond (Prunus amygdalus var amara) is an important medicinal plant which was used from traditionally unani system of medicine. It is commonly used as medicine in non-toxic tolerable dose. From ancient times, it is never used as food, due to its toxicity because of presence of amygdalin. It is a good source of fatty acids, minerals, and vitamins, phytosterols, flavonoid and phenolic compounds. As it contains flavonoids and phenolic acids which is having a good antioxidant property. Therefore, bitter almond is used as an anti-cancerous in desirable dose and it is good for skin health for local application. Bitter almond is basically used for external application for skin diseases like melasma, and having great anti-ageing properties, it helps in removing dark spots, improving complexion and texture of skin. Bitter almond essential oil is used mostly in cosmetics and in pharmaceutics. No randomized clinical trials have yet been conducted because of potential cyanide-induced poisoning due to amygdalin. But due to valued compounds present in bitter almond then future studies should be done to find out the action mechanisms of amygdalin which is important compound and having anti-cancerous effects.

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