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A review on ethno-medicinal uses, phyto-chemical constituents and pharmacological evidence of *Psoralea Corylifolia* Linn. (Babchi)

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Abstract
Psoralea corylifolia Linn. belongs to family Leguminosae is commonly known as Babchi or Bakuchi, used in Unani and other traditional medicines such as Ayurveda and Siddha. It is also officially listed in Chinese Pharmacopoeia. Babchi seeds are the ingredients of various Unani formulations such as *Safoof Bars*, *Zamad e Bars*, *Roghan Babchi*. It has been used by Unani physicians since antiquity for the treatment of various ailments such as *Bars* (Leucoderma), *Daussadaf* (Psoriasis), *Juzam* (Leprosy), *Bahaq* (Pityriasis), *Tap-e- Balghamiya* (Phlegmatic Fever) and *Deedan-e-Am'aa* (Intestinal worms). Different phytochemical studies reported that psoralen and isopsoralen are therapeutically active constituents found in it. Diverse pharmacological studies of Babchi have been reported such as antipsoriatic, antifungal, antibacterial, antidermatophytic, cytotoxic, antioxidant activity etc. This review summarizes the information described in classical Unani text and scientific research conducted on different parts of Babchi plant.

Keywords: antipsoriatic, babchi, isopsoralen, *Psoralea corylifolia* Linn, psoralen

1. Introduction
Psoralea corylifolia Linn belongs to the family Leguminosae. It is one of the most popular Traditional Unani Medicine officially listed in Unani Pharmacopoeia [1]. It has been described by the name of Babchi in unani classical literature. *P. corylifolia* is widely distributed in the tropical and subtropical regions of the world, especially China and Southern Africa [2]. It is an annual herb grows through the plains of India. It has been used since many years for its effect against several skin diseases, such as psoriasis, leukoderma, and leprosy [3]. It also possesses many pharmacological activities [4, 8].

Fig 1: (a) Seeds of *Psoralea corylifolia;* (b) Plant of *Psoralea corylifolia*

1.1 Taxonomical Classification
The plant classification details are [9]
Kingdom: Plantae
Division: Angiospermae
Class: Dicotyledoneae
Order: Rosales
Family: Leguminosae
Subfamily: Papilionaceae
Genus: *Psoralea*
Species: *corylifolia* Linn.

1.2 Vernaculars (Muheet. Azam) [1, 4, 7]
Arabic: Loelab el abid, Mahalep
Bengali: Bavachi
Bangladesh: Buckidana
Chinese: Ku Tzu, Pu Ku Chih, Bu Ku Zhi, Cot Chu
English: Babchi
Gujrati: Babchi
German: Bawchan
Hindi: Babachi, Bavanchi, Bhavanj, Bukchi
Kannada: Bavanchigida, Karbekhiga
Malyalam: Kapokkari, Kaurkoalari
Marathi: Babachi, Bavachya
Nepalese: Bakuchi
Oriya: Bakuchi
Persian: Waghchi, Vabkuchi
Panjabi: Babchi
Sanskrit: Aindavi, Avalguja, Bakuchi, Chanderlekha, Chanderprabha, Kushthahantri, Sashilekha, Shulotkha, Sitavari, Soma, Vejani
Srilanka: Ravoli
Tamil: Karpokarishi
Telgu: Bavanchalu, Bhavanchi-vittulu, Bogi-vittulu, Karu-bogi
Urdu: Bebechi

1.3 Parts used
Seeds, seed oil, roots, and leaves [10]

1.4 Temperament (*Mizaj*)
Hot 2º Dry 2º [11, 12]
Hot Dry 2º-3º [13, 14]

1.5 Taste (*Maza*'a)
Tasteless, Unpleasant (Bustanul mufradat)

1.6 Dosage (*Miqdar e Khurak*) [14]
Seeds Powder: 3.5-10 gm seeds (depending upon *mizaj*) (MA); 1-3 masha (MM)
Seeds Infusion: 1.25 Tola

1.7 Method of Uses (*Tarkeeb-e-Istemalat*)
Babchi seeds are prescribed both for oral administration (*Brah-e-Dahn*) and for external topical application in the form of a paste (*Zamad*) and ointment (*Marham*) [4, 15]

1.8 Adverse Effects (*Muzir Asraat*) *Nafakh* (Flatulence) [12]

1.9 Correctives (*Musleh*) Curd and Oils, Fennel [8, 12]

1.10 Substitutes (*Badal*) *Tukhm-e-Panwad* (*Cassia tora* seeds) [12]

2. Botanical Description
2.1 Habitat
It grows throughout the plains of India, especially in the semi-arid regions of Rajasthan and Eastern districts of Punjab, adjoining Uttar Pradesh. It is also found throughout India in Himalayas, Dehra Dun, Oudh, Bundelkhand, Bengal, and Bombay, some valley in Bihar, Deccan, and Karnataka [16]. The plant thrives well in areas with low to medium rainfall during the summer months and on a variety of soils ranging from sandy, medium loam to black cotton in dry tropical regions of India. The germination percentage can be considerably increased by sowing the seeds during summer, that is, March–April and leaving them in the heat of the soil.
For breaking the dormancy of the seeds methods like presowing treatment with concentrated sulfuric acid for 60 min or mechanical puncturing of the seed coverings has been found effective in considerably increasing the germination percentage. The crop takes 7–8 months to reach maturity. As seeds continue to mature continuously, 4–5 pickings are usually taken between December and March. Clonal propagation of *P. corylifolia* through axillary bud and shoot tip culture is done. Survival rate on transfer to field was 95%.

2.2 Macroscopic Description
It is a small, erect, annual herb growing up to 60–120 cm in height throughout sandy, loamy plains of Central and East India. Seeds are brownish black in color, oblong, and flattened. Das, described the seeds as kidney shaped, 2–4 mm long, 2–3 mm broad, and 1–1.5 mm thick, hard, smooth, exalbuminous with straw-colored testa, with an agreeable aromatic odor and a pungent-bitter taste [6]. They have grooved and gland-dotted stems. Leaves are simple, broadly elliptic, rounded, and mucronate at apex, clothed with white hairs on both surfaces, covered with numerous black dots, 5 main nerves springing from the base. Flowers are dense, corolla yellow or bluish purple [17], axillary, 10–30 flowered racemes [16]. Flowering time is from August to December. Fruit is small, 5 mm long, subglobular, slightly compressed, pitted black, beaked without hairs, indehiscent, one-seeded pod, which is adhering to the pericarp [17].

2.3 Microscopic Description
Transverse section of the fruit shows pericarp with prominent ridges and depressions, consisting of collapsed parenchyma and large secretory glands containing oleo-resinous matter; testa, an outer layer of palisade epidermis, layer of bearer cells, and 2–3 layers of parenchyma; cotyledons of polyhedral parenchyma an 3 layers of palisade cells on the adaxial side [18].

Phytochemistry
The fruits of *P. corylifolia* consist of a sticky oily pericarp (12% of the seed), a hard seed coat and kernel [2]. The seeds are found to contain an essential oil (0.05%), nonvolatile terpenoid oil, a dark brown resin (8.6%), and traces of alkaloidal substance. Seeds are also found to contain 13.2% of extractive matter, albumin, sugar, ash 7.4%, and traces of manganese [6]. A monoterpenoid phenol or hydroxyl flavones, namely bakuchiol ($C_{18}H_{24}O$, b.p. 145–147°C), raffinose, coumarin and a brown fixed oil (10%) compounds were also found in the seeds [2]. The essential oil contains α-elemene, β-caryophylenoxide, γ-elemene, limonene, linalool, 4-terpineol, geranylacetate [19], psoralen (similar to that of ficusin; $C_{11}H_6O_3$, m.p. 161–162°C) [20], bakuchiol and angelicin [21]. Siddhiqui isolated psoralidin ($C_{16}H_{14}O_4$; m.p. 315°C) and isopsoralen, along with the above constituents [6]. Two new benzofuran derivatives—corylifonol and isocorylifonol—were isolated from the seeds [22]. The seeds also contained flavonoids, such as corylifolin, corylifolean, corylifolinin [17], psoralidin, isopsoralidin, bakuchicin, bavachin, bavachinin, isobavachin, bavachalcone, isobavachalcone [23], bavachromanol, corylidin, corylin, corylinal, 7-O-methyl bavachin, 4-O-methyl bavachalcone, neobavachalcone isoneobavachalcone, neobavaisoflavone, bavachromene [24], bakuchalcone, psoralenol, isopsoralone, psoralone, and psoralidin-2,3-oxide diacetate [25]. Also, astragalin, *p*-hydroxybenzoic acid [2], stigmasterol, triaconate, and β-sitosterol-D-glucoside [24], were present in the seeds. Fixed oil of the seeds is viscous, bitter in taste, and on keeping deposits psoralen [2].

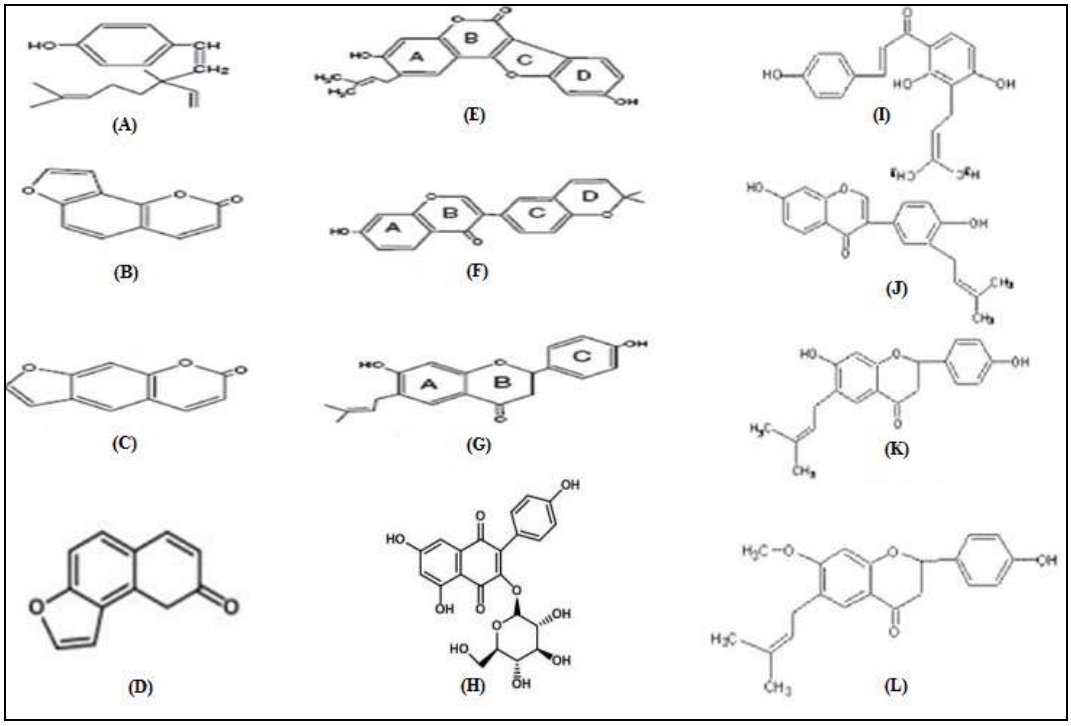

Fig 2: Structures of few important chemical constituents present in *Psoralea corylifolia: (A)Bakuchiol; (B)Isopsoralen; (C)Psoralen; (D)Angelicin; (E)Psoralidin; (F)Corylin; (G)Coryfolin; (H)Astragalin; (I)Isobavachalcone (J)Neobavaisoflavone; (K)Bavachin; (L)Bavachinin*

Chopra obtained considerable resin acids (21.5%) along with glycerides of oleic, stearic, palmitic, myristic, myristolic, linoleic, and linolenic acids from the petroleum ether extract of the seeds [6]. Two new coumestans—bavacoumestans A and B along with sophoracoumestan A were isolated from the seeds of *P. corylifolia* [22]. Two new benzofuran glycosides, namely, psoralenoside and isopsoralenoside, isolated from the seeds, which could be easily converted into psoralen and isopsoralen on hydrolysis [26]. 6-(-3-Methylbut-2-enyl)-6'-7-dihydroxycoumestan was obtained from the crude chloroform extract of the seeds of *P. corylifolia* [27]. New isoflavone, corylinin, was also isolated from the plant [28].

Leaves contain raffinose, psoralen, and isopsoralen. From the petroleum ether extract of *P. corylifolia* roots, daidzein [28], trilaurin, and coumesterol [25] were isolated along with angelicin, psoralen, and sitosterol. Fruit contains corylinal and neobavaisoflavone, including the methyl esters of the 2 compounds, psoralenol, 5'-formyl-2',4-dihydroxy-4'-methoxychalcone, and bavachromanol [16].

Table 1: Studies depicting identification or isolation of different chemical constituents present in different parts of *Psoralea corylifolia* along with their time points.

S. No.	Author Name	Year of Study	Chemical Constituent Identified or Isolated	
			Category or Class	Name of Compound(s)
(A)In Seeds				
1.	Chopra and Chopra	1958a	Furanocoumarins	Psoralidin and Isopsoralen
2.	Chopra and Chopra	1958b	Resin Acids (21.5%)	Glycerides of Oleic, Stearic, Palmitic, Myristic, Myristolic, Linoleic, and Linolenic acids
3.	Khastgir *et al*.,	1959	Furanocoumarins	Psoralen
4.	Krishnamurthi *et al*.,	1969	Monoterpenoid Phenol, Hydroxy Flavone	Bakuchiol (10%), Raffinose, Coumarin
5.	Rastogi & Mehra	1998	Benzofuran Derivatives	Corylifonol and Isocorylifonol
6.	Rastogi & Mehra	1998	Two new Coumestans	Bavacoumestans A and B along with Sophoracoumestan A
7.	Rastogi & Mehra	1999	Flavonoids	7-O-Methyl bavachin, Bavachromanol, Corylin, Corylidin, Corylinal, 4-O-Methyl bavachalcone, Neobavaisoflavone, Bavachromene, Neobavachalcone, Stigmasterol, Triaconate, and β-sitosterol-D-glucoside
8.	L.D. Kapoor	2001	Essential Oils (0.05%)	Limonene, α-Elemene, γ-Elemene, β-Caryophylenoxide, 4-Terpineol, Linalool, Geranylacetate
9.	Rastogi & Mehra	2001	Flavonoids	Bakuchalcone, Isoneobavachalcone, Psoralone, Isopsoralone, Psoralenol, and Psoralidin-2,3-oxide diacetate
10.	Khatune *et al*.,	2002	Coumestant	6-(-3-Methylbut-2-enyl)-6'-7-dihydroxycoumestan
11.	Rastogi & Mehra	2004	Flavonoids	Bakuchicin, Psoralidin, Isopsoralidin, Bavachin, Isobavachin, Bavachinin, Bavachalcone, Isobavachalcone

12.	Gupta *et al*.,	2005	Hydroxy Flavone	Angelicin and Bakuchiol
13.	V. Rajpal	2005	Flavonoids	Corylifolean, Corylifolin, Corylifolinin
14.	Qiao *et al*.,	2006	Two new Benzofuran glycosides	Psoralenoside and Isopsoralenoside,
(B)In Plants				
15.	Ruan *et al*.,	2007	Isoflavone	Corylinin along with Raffinose, Psoralen, and Isopsoralen.
(B)In Roots				
16.	Rastogi & Mehra	2001	Flavonoids	Trilaurin, Coumesterol, Angelicin, Psoralen, and Sitosterol
17.	Ruan *et al*.,	2007	Flavone	Diadzein
(B)In Fruits				
18.	Krishnamurthi *et al*.,	1969	Essential oil, Hydroxy Flavone	Sticky Oily Pericarp (12% of the seed)
19.	Sharma *et al*.,	2001	Corylinal and Neobavaisoflavone,	Methyl esters of the 2 compounds, Psoralenol, 5'-formyl-2',4-Dihydroxy-4'-methoxychalcone, and Bavachromanol

4. Pharmacological Actions (*AF'AAL*)

Daf-e-Bars (Anti-leucodermic) [1, 7, 11, 22]
Daf-e-Jozam (Anti-leprosy) [4, 7, 15, 22, 29, 30]
Daf-e-Daussadaf (Anti-psoriatic) [2, 7, 22, 29]
Daf-e-Kharish (Anti-pruritic) [7, 8, 14, 15, 30]
Daf-e-Damah (Anti-asthmatic) [5, 8]
Daf-e-Waja-ul-Meda (Anti-stomacache) [7, 30]
Daf-e-Tap-e-Balghamiya (Anti-phlegmetic Fever) [4], [7], [8]
Jali (Detergent) [1, 8, 11, 13, 15]
Kasir-e-Riyah (Carminative) [8, 11–14]
Musaffi-e-Khoon (Blood Purifier) [1, 7, 12, 13]
Maney-Sauda (Anti-souda) [31]
Mulayyan-e-Am'aa (Laxative) [4, 7, 12–15, 29, 31]
Mushtahi (Appetizer) [7, 14, 15]
Muqavvi-e-Meda (Gastro tonic) [11, 12, 14]
Mu'arriq wa Mudirr-e-Baul (Diaphoretic and Diuretic) [4, 29, 31]
Muhallil-e-Waram (Anti-inflammatory) [14, 15, 30]
Muharrik wa Muqavvi-e-Bah (Stimulant and Aphrodiasiac) [4, 7, 22, 29–31]
Muqavvi-e-Qalb (Cardiac Tonic) [7, 14, 15]
Mus'hil (Purgative) [1, 7, 30]
Musakkin (Sedative) [30, 31]
Maney-e-Jarasim (Antibacterial) [4, 29, 30]
Mukharrish (Irritant) [1]
Qatil-e-Deedan-e-Amaa (Antihelminthic) [4, 6, 7, 13, 30]

4.1 Pharmacological Activities

4.1.1 Anti-depressant activity

Y. Chen *et al*, 2005 studied the behavioral and biochemical effects of total furocoumarins from seeds of *Psoralea corylifolia* were investigated in the forced swimming test (FST) in mice in comparison with amitriptyline and fluoxetine. These results suggest that Total furanocoumarins in Psoralea corylifolia possesses potent antidepressant properties that are mediated via MAO activity, HPA axis action and oxidative stress in the FST in mice [32].

Li-Tao Yi *et al*., 2008 reported the antidepressant-like effects of psoralidin isolated from the seeds of *Psoralea Corylifolia* in the forced swimming test in mice. These results suggested that psoralidin possessed potent antidepressant-like properties that were mediated via the monoamine neurotransmitter and the hypothalamic-pituitary-adrenal (HPA) axis systems [33].

4.1.2 Cytotoxic activity

Ketaki Bapat *et al*., 2005 reported the Preparation and in vitro evaluation of radio-iodinated bakuchiol as an anti-tumor agent. Viability studies showed that the radio-iodinated compound showed greater cytotoxic effect than bakuchiol [34].

4.1.3 Anti-dermatophytic activity

Rajendra Prasad N *et al*., 2004 studied the Antidermatophytic activity of extracts from Psoralea corylifolia (Fabaceae) correlated with the presence of a flavonoid compound. The active compound isolated was found to be flavonoid, 4'-methoxy flavone by spectral studies. MIC of the active compound along with standard miconazole was carried out using tube dilution technique [35].

4.1.4 Antibacterial activity

S Chanda *et al*., 2011 studied the anti-bacterial effect of Psoralea corylifolia seed extracts. The aqueous and methanolic extracts of the plants was used to determine the antibacterial activity by agar well diffusion method against five species of microorganisms. The present findings suggest that the doixan extracts of seed of Psoralea corylifolia can be used as a novel antibacterial agent in the near future [36].

4.1.5 Antifungal activity

B. Kiran *et al*., 2011 studied the effect of petroleum ether extract of seeds of Psoralea corylifolia on antifungal activity on Aspergillus flavus oryzae and Aspergillus tamarii. Results indicated that the plant shows significant activity [37].

4.1.6 Antioxidant activity

Bhawya D *et al*., 2011 reported the antioxidant, DNA damage protection and anti-bacterial effect of Psoralea corylifolia seeds. The results suggested that the seeds of Psoralea corylifolia have potential application in food systems as an anti-oxidant in biological systems [38].

4.1.7 Antipsoriatic activity

Anusha S. *et al*., 2013 studied the effect of seed extracts of Pongamia pinnata and Psoralea corylifolia seed extracts showed synergistic effects on Psoriasis. It was concluded by measuring mean thickness of epidermis and histopathological reports and anti-bacterial studies by zones of inhibition and Minimum Inhibitory Concentration when compared with the individual extracts [39].

5. USES

Well-marked contraction of the arterioles of the frog was seen on perfusion of oil [6]. The furanocoumarins, which

contain psoralens, promote pigmentation [40]. The powder is used by Vaidyas internally for leprosy and leukoderma and externally in the form of paste and ointment [41]. Oil has a powerful effect on the skin *Streptococci and also* stimulatory action on voluntary muscles in high dilutions (1 in 100,000) [17]. It is used in the inflammatory diseases, mucomembranous disorders, dermatitis, and edematous conditions of the skin [16]. It also alleviates boils and skin eruptions. The plant has blood purifying properties. It is used to treat itching red papules, itching eruptions, extensive eczema with thickened dermis, ringworm, rough and discolored dermatosis, dermatosis with fissures, and scabies [10]. Seeds are given in scorpion-sting and snake bite [41]. Seeds are useful in bilious disorders. Petroleum ether extract of seeds produced a rise in the blood pressure on anesthetized dogs and caused stimulation of the intestinal smooth muscle. *P. corylifolia* extracts have found to possess antitumor, antihyperglycemic, antidepressant, and antioxidant activities [42]. Its water extract possesses antibacterial property [43]. Seed and extract powder are used as diuretic, anthelminthic, laxative, and for healing wounds [9]. Seeds are used as stomachic, stimulant, aphrodisiac [9], and diaphoretic [16]. It is used in the treatment of various kinds of disorders, such as asthma, cough, nephritis, and others. The major active components isopsoralen and psoralen have antibacterial, antitumor and antiviral activities [44]. It is a good hair tonic and hence used in alopecia areata and hair loss [45]. It produces the contraction of isolated rectus abdominis muscle of frog [21]. It is an effective invigorant against impotence, menstruation disorder, and uterine hemorrhage [28]. It is a cure for gynecological bleeding [26].

6. Compound Formulations (*Murakkabat*) Available

Safoof-e-Bars, Zamad-e-Bars, Roghan-e-Babchi, Saafi, Habbe Bars, Zamad e Bars [1, 46, 48]

7. Acute Toxicity [5]

Psoralen:

LD_{50} oral in rat: 1330 mg/kg; LD_{50} s.c. in rat: 830 mg/kg

LD_{50} oral in mice: 625 mg/kg; LD_{50} s.c. in mice: 480 mg/kg

Isopsoralen:

LD_{50} i.p. in mice: 138± 10.9 mg/kg

LD_{50} i.m. in mice: 180 ± 29.6 mg/kg;

8. Precautions

In pregnancy used it with caution [40]. It is not suitable for patients having lupus erythematosus, liver diseases, hydroaporphyria, or other diseases. Spicy diet, late night's foods and salt should be avoided during babchi therapy. Ghee, milk, and butter should be consumed in the diet. Seed oil should mixed with coconut oil and then applied on eyes, since it is thermogenic [49].

9. Conclusion

This review reveals that the plant has potent pharmacological activities. The plant was found to have promising Antipsoriatic, Antioxidant, Antifungal, Antibacterial, Antidermatophytic, Cytotoxic and Anti-depressant activities etc. The plant is traditionally claimed to be useful in the treatment of various disorders such as gynecological bleeding, extensive eczema, Psoriasis, Leprosy, Leucoderma etc. Babchi plant extracts have found to possess antitumor, antihyperglycemic, antidepressant, and antioxidant activities which may be due to the presence of pharmacologically active psoralen and isopsoralen. Its water extract possesses antibacterial property. Further investigations are needed to isolate the various phytoconstituents present to get a clear idea of the mechanism of action of the plant and utility of Babchi in clinical practice.

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