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An insight into medicinal and ethnopharmacological potential of *Crotalaria burhia*

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ABSTRACT

Crotalaria burhia Buch.-Ham. (*C. burhia*) (Fabaceae), is an undershrub found distributed in arid parts of the world. It extensively grows in Pakistan, India and Afghanistan. It is a highly medicinal plant. The leaves, branches and roots can be used as a cooling medicine. Plant juice is useful for treatments of gout, eczema, hydrophobia, pain and swellings, wounds and cuts, infection, kidney pain, abdominal problems, rheumatism and joint pain in traditional medicine system. The medicinal activity is the result of the presence of various important phytochemicals like alkaloids, flavonoids, phenols, polyphenols, tannins, steroids, triterpenoids, anthraquinones, crotalarine, monocrotaline, croburhine, crosemperine, quercetins and β -sitosterol. *C. burhia* is also known to possess antimicrobial, anti-inflammatory and antinociceptive activities, which supports its traditional uses. In this article, a comprehensive account of phytochemical constituents and pharmacological activities is presented along with traditional uses of *C. burhia*.

1. Introduction

Crotalaria genus belongs to family Fabaceae. It comprises approximately 700 species that are distributed in tropical and subtropical regions of the world[1]. The genus exhibits great diversity in terms of habit and habitat. They chiefly colonizes on cut slopes, open grasslands, and forest edges. However, some species like *Crotalaria burhia* Buch.-Ham. ex Benth. (*C. burhia*) are adapted to arid conditions[2,3]. *C. burhia*, is an undershrub as well as fibrous plant found in all over the arid part of the world extensively growing on sand dunes[4]. It belongs to the family Fabaceae, subfamily Papilionaceae and genus *Crotalaria*[5]. It is distributed in Pakistan (Punjab, Sind and Baluchistan), India (Punjab, Rajasthan and Gujarat) and Afghanistan. It is known as Chagg in Sindh[6], Shinio in Rajasthan, and it is named as Khip in Hindi place[7], in Punjab as Bhata, in Gujarat as Ghughato, in Marathi as Ghagri and in Bengal

as Ban sutra[4]. Among these *Crotalaria* species, approximately 500 species are endemic to eastern and southern tropical Africa and Madagascar[8]. In India, *Crotalaria* genus is represented by 92 species and considered as the largest legume genus[9-11]. It occurs in the southwestern and northeastern regions[10]. In ancient Indian medical system of Ayurveda, *C. burhia* has been used as a medicinal plant and various parts of the plant are used for this purpose[12]. It is a good soil binder and used to make ropes and sheds for animals in the desert and also used to make desert huts; in some areas of Pakistan, the plant is used for making *moi* which is used for cleaning pots. It is also used as a fodder for desert animals[4-7,12-14].

2. Morphological aspects

The plant is a low undershrub, 30-60 cm tall, with numerous greyish-white branches covered by dense appressed pubescence. The plant stem epidermis was one-layer made up of barrel shaped cells. From the epidermal cells emerged trichomes of ordinary and glandular type. With 0.6-2.5 cm long and 3-10 mm broad, the leaves are few, deciduous, simple, oblong, obtuse, and pubescent on both sides.

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The leaf lamina is dorsiventral, hyperstomatic and mesomorphic. It has a thick adaxial epidermis, and abaxial epidermis has a number of stomata. The stomata are anisocytic type. Each stoma is surrounded by 3 subsidiary cells. In certain regions of the epidermis, sessile glandular trichomes are embedded in wide and shallow pits. These glandular trichomes have short, one celled stalk[13]. Inflorescence is of 6-12 flowers, with elongated raceme. Pedicels are very short, and bracteoles are of 2 Calyx size, 8-9 mm long, pubescent, teeth lanceolate. Corolla is yellow and slightly exerted. Style is slightly bearded at the top. Fruit is 8-9 mm long and hairy, and 3-4 seeds are in each fruit[15]. The flowering and fruiting seasons are from March to August[4] (Figure 1).



Figure 1. Plant images of *C. burhia*.

A: General plant body at flowering stage; B: Plant appearance in desert environment.

3. Traditional medicinal uses

C. burhia is a highly medicinal plant used by local community for many purposes, for example, after the root is boiled in water, the filtrate has a good cooling effect and can be taken orally[6,12,16,17], the leaves can be applied externally on wounds and cuts[12,18], and the root juice with sugar can be given to cure kidney pain[14,19,20]. In Thal Desert Punjab, the plant is well known for treatment of general infections[21]. The root of the plant is used for rheumatism[20]. Some researchers also mentioned its anti-cancer activity[12,22,23]. Dried plants material is ground, mixed with water and filtered, and can be used for diarrhoea and other abdominal troubles[24]. Root decoction in combination with other plants is given for typhoid[14], while fresh plant juice is applied on eczema[12,25]. The plant is also useful in gout, hydrophobia, pain, swellings and inflammation[12,23]. In some areas of Pakistan, the whole plant is boiled in water and

the decoction is used for leukoderma, fever, arthritis and skin diseases[18,25,26]. The plant is also used for stomachache, and the powdered plant material is orally taken with water[27]. The plant is also utilized as veterinary medicine, for example, the whole plant is crushed with water and given to the animal to expel placenta after delivery and it is also used for urinary problems[28-30].

4. Phytochemical and pharmacognostic evaluations

Pharmacognostic investigation was undertaken to determine the pharmacognostical standards for standardization of the plant material. For this purpose, various investigations like organoleptic characters, microscopic study, physicochemical standards, fluorescence analysis, preliminary phytochemical screening and chromatographic study of the plant were carried out. These studies helped to provide referential information for correct identification and standardization of plant material and high performance thin layer chromatography profiling revealed the presence of an anticancer component, monocrotaline, in this plant species[13].

Four extracts of the whole plant *C. burhia* i.e. methanol, chloroform, petroleum-ether and aqueous, were investigated for their phytochemical analysis. Petroleum-ether extract showed the presence of carbohydrates and glycosides. Chloroform extract showed the presences of saponins and carbohydrates. Methanol extract showed the presence of alkaloid, flavonoid, glycoside and carbohydrates, and the aqueous extract showed the presence of carbohydrates, saponins and glycosides[31]. The leaves of *C. burhia* were also investigated for phytochemicals. Phytochemical screening of aqueous extract showed the presence of alkaloids, tannins, amino acid, steroids, triterpenoids, mucilage and gum. Methanolic extract showed the presence of alkaloids, glycosides, tannins, protein, amino acid, flavanoids, steroids, triterpenoids, mucilage and gum[32]. The whole plant was also tested in four extracts for phytochemical screening. The petroleum-ether and chloroform showed positive response only for steroid. Methanol extract has showed response for alkaloid, flavonoid, glycoside, saponins and phenolic compounds. Water extract showed response for alkaloid, glycoside, saponins and phenolic compounds[13]. The root of plant was also analysed for phytochemicals and evidenced to contain alkaloids, flavonoid, phenol, polyphenol, tannins, steroids, triterpenoids and anthraquinones[33]. In another study, phytochemical screening showed that the root of *C. burhia* was rich in alkaloids, flavonoids, steroids, terpenes and phenolic compounds[34]. Some phytochemical studies also revealed the presence of many alkaloids like crotalarine[35], monocrotaline, croburhine, crosemperine[36-38]. In addition to alkaloids, some flavonoids like quercetin and steroids like β -sitosterol have also been isolated[37].

5. Physicochemical analysis

The plant of *C. burhia* was evaluated for physical parameters

which showed moisture content (14%), total ash value (4.8%), acid-insoluble ash value (4.5%), water-soluble ash value (3.66%), and sulphated ash value (3.33%). In another study, the leaves were investigated and showed total ash value (5.67%), water-soluble ash value (3.1%), acid-insoluble ash value (0.8%), moisture content (6.3%), and foreign organic matters (2.9%) [32]. Physico-chemical investigation of the whole plant showed to contain foreign organic matters (1%), total ash (6.7%), acid-insoluble ash (1.6%), water-soluble ash (2.3%), sulphated ash (10.5%), loss on drying (0.6%), swelling index (7.5 mL/g), foaming index (less than 100%), and crude fibre content (35.28%) [13].

6. Pharmacological activity

6.1. Antioxidant activity

The root of *C. burhia* was subjected for antioxidant assay in different concentrations (1-1280 µg/mL) and different systems *i.e.* 2,2'-diphenyl-1-picrylhydrazyl assay, superoxide radical assay and lipid peroxidation assay. Methanolic extract of concentration 1280 µg/mL showed significant scavenging activity and the maximum percentage inhibition was observed in superoxide anion (96.66%) which is followed by 2,2'-diphenyl-1-picrylhydrazyl (94.85%) and lipid peroxidation (89.68%) assay [39].

6.2. Antimicrobial activity

Antibacterial activity of *C. burhia* (whole plant) was investigated in four extracts of methanol, chloroform, petroleum-ether and water against *Staphylococcus aureus* by using cup plate agar diffusion method. Antibacterial screening showed that methanol extract has good antibacterial activity in the concentration of 150 µg/mL whereas the other extracts were found inactive [31]. For the same activity, ether and alcoholic leaf extracts of *C. burhia* were tested against bacterial pathogens *i.e.* *Staphylococcus aureus* (Gram-positive), *Escherichia coli* (Gram-negative) and a fungal pathogen *Candida albicans*. Both extracts showed positive reactions against all test organisms [40]. The root of plant also exhibited certain medicinal properties, so it was screened for antimicrobial activity against different strains of bacteria and fungi. For this purpose, four different extracts of plant which were aqueous, petroleum-ether, chloroform and methanol extract were used. Tests were carried out by using agar disc diffusion method. All extracts showed growth inhibition of Gram-positive and Gram-negative bacteria but Gram-positive bacteria appeared to be more susceptible than the Gram-negative bacteria. The same extract also showed significant antifungal activity [33].

6.3. Anti-inflammatory activity

The anti-inflammatory activities of four fractions of ethanolic

extract of *C. burhia* root in Wistar albino rats were tested. The animals were divided into different groups in which two were taken as control groups, and two groups were treated with anti-inflammatory drugs while the other groups were treated with four fractions of hexane, chloroform, ethyl acetate and water with oral administration. Result shows that ethyl acetate was found more effective than hexane and chloroform but water had shown negligible anti-inflammatory activity [34]. In another investigation, methanolic extract of the whole plant is assessed for anti-inflammatory activity and showed significant result in test organism [41].

6.4. Antinociceptive activities

Methanolic extract of the whole plant of *C. burhia* was tested against the inflammation-induced pain in mice and the extract at concentrations of 100, 200 and 400 mg/kg showed significant antinociceptive activity in test organism [41].

7. Conclusion

The medicinal properties of *C. burhia* discussed in this review have highlighted significant traditional and pharmacological activities of this plant. The pharmacological studies reported in this review support its traditional use and may prove to be useful in the development of some commercial drugs in future. However, critical evaluation reveals that pharmacological studies are deficient in the identification of active constituents which are responsible for pharmacological activities. Therefore, more emphasis towards identification and isolation of active constituents in future studies is suggested. A serious limitation in the scientific knowledge is the lack of clinical data and it is not yet apparent to what extent the findings about pharmacological activities are of potential clinical relevance.

Conflict of interest statement

We declare that we have no conflict of interest.

References

- [1] Lewis G, Schrire B, Mackinder B, Lock M, editors. *Legumes of the world*. Surrey: Royal Botanic Gardens Kew; 2005, p. 577.
- [2] Nayar MP, Sastry ARK. *Red data book on Indian plants*. Vol I. Kolkata: Botanical Survey of India; 1987.
- [3] Wanjala CCW, Majinda RRT. Flavonoid glycosides from *Crotalaria podocarp*. *Phytochemistry* 1999; **51**(5): 705-7.
- [4] Kirtikar KR, Basu BD. *Indian medicinal plants*. Vol 3. 2nd ed. Dehradun: International Book Distributors; 1994, p. 2061-2.
- [5] Van Wyk BE, Schutte AL. Phylogenetic relationships in the tribes Podalyriaceae, Liparicieae, and Crotalariaeae. In: Crisp MD, Doyle JJ, editors. *Advances in legume systematics (part 7). Phylogeny*. Surrey:

- Royal Botanic Gardens Kew; 1995, p. 283-308.
- [6] Bhatti GR, Qureshi R, Shah M. Ethnobotany of Qadan Wari of Nara Desert. *Pak J Bot* 2001; **33**: 801-12.
- [7] Kumar S, Parveen F, Goyal S, Chauhan A. Indigenous herbal coolants for combating heat stress in the hot Indian Arid Zone. *Indian J Tradit Knowl* 2008; **7**(4): 679-82.
- [8] Polhill RM. *Crotalaria in Africa and Madagascar*. London: CRC Press; 1982.
- [9] Polhill RM. Miscellaneous notes on African species of *Crotalaria* L. II. *Kew Bull* 1968; **22**(2): 169-348.
- [10] Ansari AA. *Crotalaria L. in India*. Dehradun: Bishen Singh Mahendra Pal Singh; 2008.
- [11] Sibichen MT, Nampy S. [*Crotalaria kurisumalayana* Sibichen & Nampy (Fabaceae), a new species from India]. *Candollea* 2007; **62**(1): 105-8. French.
- [12] Kirtikar KR, Basu BD. *Indian medicinal plants. Vol 2*. Allahabad: Lalit Mohan Basu; 2003.
- [13] Sandeep K, Birendra S, Khajuria RK, Suri KA, Sharma P. Pharmacognostic evaluation of *Crotalaria burhia* Buch.-Ham. *Indian J Tradit Knowl* 2011; **10**(4): 629-35.
- [14] Katewa SS, Galav PK. Additions to the traditional folk herbal medicines from Shekhawati region of Rajasthan. *Indian J Tradit Knowl* 2006; **5**(4): 494-500.
- [15] www.efloras.org. *Crotalaria burhia*. Flora of Pakistan. [Online] Available from: http://www.efloras.org/florataxon.aspx?flora_id=5&taxon_id=250064748 [Accessed on February 10th, 2015]
- [16] Qureshi R, Bhatti GR, Memon ARA. Ethnomedicinal uses of herbs from northern part of Nara Desert, Pakistan. *Pak J Bot* 2010; **42**(2): 839-51.
- [17] Panhwar AQ, Abro H. Ethnobotanical studies of Mahal Kohistan (Khirthar national park). *Pak J Bot* 2007; **39**(7): 2301-15.
- [18] Patel RM, Dabgar YB, Joshi PN. Some noteworthy ethno medicinal plants of Western Kachchh, Gujarat. *Life Sci Leaft* 2010; **9**: 244-50.
- [19] Ram S, Kumar N, Vats A. Traditional uses of some medicinal plants used in district Sriganganagar of Rajasthan for the treatment of various health problems. *Int J Adv Res* 2014; **2**(5): 1068-75.
- [20] Bhardwaj R, Dutta S, Sharma KC. Conserving biodiversity of medicinal plants from central Aravallis of Rajasthan, India. *J Environ Res Dev* 2011; **6**(1): 69-75.
- [21] Niaz S, Bokhari TZ, Sherwani SK, Younis U, Dasti AA. Ethnobotanical study of some medicinal plants of Thal Desert Punjab Pakistan. *Int J Pharm Res Bio-Sci* 2013; **2**(6): 31-41.
- [22] Rastogi RP, Dhawan BN. Anticancer and antiviral activities in Indian medicinal plants: a review. *Drug Dev Res* 1990; **19**(1): 1-12.
- [23] Nisar MF, Jaleel F, Waseem M, Ismail S, Toor Y, Haider SM, et al. Ethno-medicinal uses of plants from district Bahawalpur, Pakistan. *Curr Res J Biol Sci* 2014; **6**(5): 183-90.
- [24] Marwat SK, Rehman FU, Khan MA, Ahmad M, Zafar M, Ghulam S. Medicinal folk recipes used as traditional phytotherapies in district Dera Ismail Khan, KPK, Pakistan. *Pak J Bot* 2011; **43**(3): 1453-62.
- [25] Wariss HM, Ahmad S, Anjum S, Alam K. Ethnobotanical studies of dicotyledonous plants of Lal Suhanra national park, Bahawalpur, Pakistan. *Int J Sci Res* 2014; **3**(6): 2452-60.
- [26] Ahmad S, Wariss HM, Alam K, Anjum S, Mukhtar M. Ethnobotanical studies of plant resources of Cholistan Desert, Pakistan. *Int J Sci Res* 2012; **3**(6): 1782-8.
- [27] Kumar S, Goyal S, Parveen F. Ethno-medico-botany of household remedies of Kolayat tehsil in Bikaner district, Gajasthan. *Indian J Tradit Knowl* 2003; **2**(4): 357-65.
- [28] Mistry N, Silori CS, Gupta L, Dixit AM. Indigenous knowledge on animal healthcare practices in district Kachchh, Gujarat. *Indian J Tradit Knowl* 2003; **2**(3): 240-54.
- [29] Meena KL. Some traditional ethno-veterinary plants of district Pratapgarh, Rajasthan, India. *Am J Ethnomed* 2014; **1**(6): 393-401.
- [30] Galav P, Jain A, Katewa SS. Traditional veterinary medicines used by livestock owner of Rajasthan, India. *Indian J Tradit Knowl* 2013; **12**(1): 47-55.
- [31] Soni B. Preliminary phytochemical screening and antimicrobial activity of methanol extract of *Crotalaria burhia*. *Pharm Tutor* 2014; **2**(9): 115-8.
- [32] Kumar GG, Gali V, Dwivedi SC. Phytochemical investigation of *Crotalaria burhia* Hamilt. *Int J Res Pharm Biomed Sci* 2011; **2**(4): 1721-4.
- [33] Kataria S, Shrivastava B, Khajuria RK, Suri KA, Sharma P. Antimicrobial activity of *Crotalaria burhia* Buch.-Ham. root. *Indian J Nat Prod Resour* 2010; **1**(4): 481-4.
- [34] Talaviya PA, Vyas BM, Sharma D, Indoria SP, Suman RK. Anti-inflammatory activity of four fractions of ethanolic extract of *Crotalaria burhia* Buch.-Ham. roots in rats. *Natl J Physiol Pharm Pharmacol* 2014; **4**(3): 213-7.
- [35] *The wealth of India: a dictionary of raw materials and industrial products, raw materials*. Vol 2. New Delhi: National Institute of Science Communication and Information Resources; 1992, p. 243.
- [36] Ali MA, Adil GA. Isolation and structure of crotalarine, a new alkaloid from *Crotalaria burhia* Buch.-Ham. *Pak J Sci Industr Res* 1973; **16**(6): 227-9.
- [37] Rao PG, Sawhney RS, Atal CK. Genus *Crotalaria*. XXIII. Croburhine, a novel pyrrolizidine alkaloid from *Crotalaria burhia* Buch.-Ham. *Indian J Chem* 1975; **13**(8): 835-6.
- [38] Ahmad VU, Fatima I. Isolation and carbon-13 NMR of crosemperine from *Crotalaria burhia* Buch.-Ham. *J Chem Soc Pak* 1986; **8**(1): 89-90.
- [39] Alang G, Kaur R, Singh A, Budhlakoti P, Singh A. Free radical scavenging activity of methanolic root extract of the plant *Crotalaria burhia*. Linn. *Pharmacologyonline* 2010; **1**: 78-85.
- [40] Kapoor BBS, Raksha M, Sanjay A, Swati L, Veena P. Antimicrobial screening of some herbal plants of the Rajasthan desert: an overview. *Unique J Engin Adv Sci* 2013; **1**(1): 38-40.
- [41] Kataria S, Shrivastava B, Kaur D, Sharma P. Anti-inflammatory and antinociceptive activities of *Crotalaria burhia* Buch.-Ham. whole plant. *Indian J Nat Prod Resour* 2012; **3**(2): 189-96.