

BERBERIS ARISTATA: A REVIEW

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ABSTRACT

Berberis aristata commonly known as “Daru haldhi and Chitra” is spinous herb native to northern Himalaya region. The plant is widely distributed from Himalayas to Srilanka, Bhutan, and hilly areas of Nepal. *Berberis aristata* is used in ayurvedic medicines from very long time. The plant is used traditionally in inflammation, wound healing, skin disease, menorrhagia, diarrhea, jaundice and affection of eyes. Pharmacological studies on the plant reveals the proven activity of its as hypoglycemic, antibacterial, antifungal, antipyretic, anti-inflammatory, hepatoprotective, antioxidant, anticancer. The plant fruit is edible and it is rich in vit –c. A very valuable ayurvedic preparation ‘Rashut’ is prepared by this plant which is used in curing human ailment like ophthalmic, ulcer as a laxative and tonic and blood purifier. Phytochemical studies shows that plant *B. aristata* contains mainly yellow colored alkaloids Berberine, oxyberberine, berbamine, aromoline, a protoberberine alkaloid karachine, palmatine, oxycanthine and taxilamine and tannins, sugar, starch. The plant has effective pharmacological action and shows promising future for further researches.

KEYWORDS: antibacterial, anticancer, *Berberis aristata*, berberine, hepatoprotective, hypoglycemic

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INTRODUCTION

Berberis aristata commonly known as “Daru haldhi and chitra” is spinous shrub native to northern Himalaya region. The plant is widely distributed from Himalayas to Srilanka, Bhutan, and hilly areas of Nepal in Himalaya region.^{1,2} It is found in Himachal Pradesh. It grows at the height of 2000-3000m especially in Kumaon and Chammba region of Himachal Pradesh. It is also found in Nilgris hills in South India.^{3,4,5}

Berberis aristata is used in ayurvedic medicines from very long time. The plant is used traditionally in inflammation, wound healing, skin disease, menorrhagia, diarrhea, jaundice and affection of eyes. A very valuable ayurvedic preparation ‘Rashut’ is prepared by this plant.^{6,7,8}

Taxonomical classification

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Ranunculales

Family: Berberidaceae

Genus: *Berberis*

Species: *aristata*⁹

Vernacular Names

Sanskrit: Katamkateri, Dirvi

Bengali: Daruharidra

English: Indian Berberry

Gujrati: Daruharidra, Daruhuladur

Hindi: Daruhaldi, Darhald

Kannada: Maradarishana, Maradarishina, Daruhaladi

Malayalam: Maramannal, Maramanjil

Marathi: Daruhalad

Oriya: Daruharidra, Daruhalidi

Punjabi: Sumalu

Tamil: Gangeti, Varatiu manjal

Telugu: Manupasupu

Urdu: Darhald^{1,10}

Botanical description

It is an erect spiny shrub, ranging between 2 and 3 meters in height wood, hard and yellow; bark, yellow to brown from outside and deep yellow from inside, removable in longitudinal strips by hand; spines (which, in fact, are modified leaves), three-branched and 1.5 cm long.

Leaves

Leaves are in tufts of 5 to 8, phyllotaxy verticillate, simple spiny, lanceolate, toothed, leathery, sessile,

acuminate, with reticulate pinnate venation, 4.9 cm. long, 1.8 cm. broad, deep green on the dorsal surface and light green on the ventral surface.

Flower

Flowers are stalked, yellow, complete, hermaphrodite, cyclic, actinomorphic, perigynous, the average diameter of a fully opened flower being 12.5 mm; inflorescence, a simple to corymbose raceme, with 11 to 16 flowers per cluster. Calyx is yellow in color, polysepalous, with 6 sepals (3 small, 3 large), yellow, actinomorphic caducous, 4 to 5 mm long. Corolla is polypetalous, with 6 petals, yellow, actinomorphic, 4 to 5 mm long. Androecium is polyandrous, with 6 stamens, adnate, 5 to 6 mm long and gynoecium is one, 4 to 5 mm long, with a short style and a broad stigma.

Fruits

Fruits are globose to ovoid, usually covered with bloom as in plums. Fruits are 7 mm long, 4 mm in diameter, weighing 227 mg, 237 microlitres in volume. Fruit colour is aconite violet.

Seeds

Seeds are 2 to 5 in number, varying in colour from yellow to pink, each weighing 25 mg and being 29 microlitres in volume.^{7,8}

MICROSCOPIC DESCRIPTION

Stem

Stem shows rhytidoma with cork consisting of 3-45 rectangular and squarish, yellow colored, thin-walled cells which are arranged radially. Sieve elements are irregular in shape, thin walled, a few cells containing yellowish-brown contents. phloem fibers are arranged in tangential rows, consisting of 1-4 cells, each fiber short thick-walled, spindle-shaped, lignified having wide lumen; half inner portion of rhytidoma traversed by secondary phloem rays; phloem rays run obliquely consisting of radially elongated parenchymatous cells, almost all phloem ray cells having single prismatic crystals of calcium oxalate, a 34 few cells of rhytidoma also contain prismatic crystals of calcium oxalate; stone cells also found scattered in phloem ray cells in groups, rarely single, mostly elongated, a few rounded, arranged radially, some of which contain a single prism of calcium oxalate crystals. secondary phloem, consisting of sieve elements and phloem fibers, traversed by multi seriate phloem rays; sieve elements arranged in tangential bands and tangentially compressed cells alternating with single to five rows of phloem fibers, phloem fibers short, lignified, thick-walled having pointed ends. Secondary xylem is broad consisting of xylem vessels, tracheids, xylem fibers and traversed by multi seriate xylem rays. Xylem vessels are numerous, small to medium sized, distributed throughout xylem region in groups or in

singles, groups of vessels usually arranged radially; isolated vessels cylindrical with rounded or projected at one or both ends with spiral thickening. xylem fibers are numerous, lignified, large, thick-walled with wide lumen, and pointed tips; xylem rays quite distinct, straight, multiseriate, consisting of radially arranged rectangular cells, each ray 30-53 cells high, 8-12 cells wide, a few ray cells containing brown contents.

Stem powder

Powder is yellow in color; shows mostly fragments of cork cells, sieve elements, yellow colored phloem fibers entire or in pieces, stone cells in singles or in groups, numerous prismatic crystals of calcium oxalate, xylem vessels having spiral thickening, thick-walled, lignified xylem fibers and ray cells.^{1,10}

PHYTOCHEMICAL STUDIES

Berberis aristata contains protoberberine and bis isoquinoline type of alkaloid. Root of plant *B. aristata* contains alkaloid which are berbamine, Berberine, oxycanthine, epiberberine, palmatine, dehydrocaroline, jatrorhizine and columbamine,^{11,12} karachine,¹³ dihydrokarachine, taximaline,¹⁴ oxyberberine, aromoline.¹⁵ Four alkaloids, pakistanine, 1-O-methylpakistanine, pseudopalmatine chloride and pseudoberberine chloride were also isolated from *Berberis aristata*.^{12,16} A secobisbenzisoquinoline or simple isoquinoline alkaloid was isolated from *B. aristata*.¹⁷ The major alkaloid found in *B. aristata* is Berberine having yield of 2.23%¹⁸ followed by palamatine.¹⁹

Variation of Berberine content in root and stem of *B. aristata* with altitude was determined. It was found that plants growing at lower altitude have more Berberine content. Berberine content in plant is also influenced by potassium and moisture content of soil.²⁰ HPTLC fingerprinting of Berberine in *B. aristata* was done to quantify the amount of Berberine.²¹ Total alkaloidal content of *B. aristata* was also done.²²

PHARMACOLOGICAL STUDIES

Hepatoprotective

B. aristata roots have been used in treatment of jaundice in Ayurveda. Hepatoprotective and antioxidant activity of dried aerial part of *B. aristata* was investigated in aqueous and methanolic extract and berberine, against CCl₄ induced liver injury. Results obtained were comparable to standard drug silymarine.²³

Crude extract of *B. aristata* (Shoot and fruit) shows Paracetamol and CCl₄ protection against induced liver toxicity and it also indicates that hepatoprotective action of extract is partially through inhibition of microsomal drug metabolizing enzyme.^{24,25}

Butanolic extract of *B. aristata* shows effective action of hepatoprotection by selective inotropic activity.²⁶

Antidiabetic

Hypoglycemic effect of *B. aristata* root was evaluated. Dried and powdered root extracted with water and methanol and crude extract was administered to normal and alloxan induced diabetic albino rabbit. The results show that *B. aristata* roots contain potent and orally effective antidiabetic component which either triggers the formation of insulin or shows insulin like effect.²⁷

Antidiabetic activity was screened in albino wistar rat by inducing diabetes by alloxan²⁸ and streptozocin.²⁹ Diabetic rats were treated with ethanolic extract of *B. aristata*. The results conclude that ethanolic extract possess antidiabetic activity.²⁸

Methanolic³⁰ and ethanolic³¹ extract of stem bark of *B. aristata* shows significant antihyperglycemic effect in Alloxan induced diabetic rat. Crude extract was given orally to diabetes induced rats.

The antihyperglycemic and antioxidant potential of 50% aqueous ethanolic root extract of *Berberis aristata* in alloxan induced diabetic rats was found. The extract besides being safe, lowered the blood glucose significantly without any hypoglycemic effect on their control counterparts. The extract of *Berberis aristata* (root) has strong potential to regulate glucose homeostasis through decreased gluconeogenesis.³²

Anticancer

Methanolic extract of stem of *B. aristata* was screened for anticancer potential against human colon cancer cell line and it was found to be effective. Methanolic extract of stem of *B. aristata* shows concentration dependent inhibition of HT29 cells.^{33,34}

Berberine, an alkaloid isolated from the plant *Berberis aristata*, has been found to inhibit significantly the carcinogenesis induced by 20-methylcholanthrene or N-nitrosodiethylamine, in a dose-dependent manner in small animals.³⁵

Antimalarial

Antiplasmodial efficacy of root bark of *Berberis aristata* has been found to exert significant schizont maturation inhibition of *P. berghei* isolates in vitro.³⁶

Antimicrobial

Ethanolic root extract of *B. aristata* shows antifungal activity.³⁷ Three extracts of *B. aristata* (aqueous, alcoholic and powdered root in distilled water) were tested for antifungal activity. All the three extracts showed antifungal activity against the *Candida* and *Aspergillus* species tested, except *C. krusei* out of the three types of extracts, the best results were obtained by using the alcoholic extract. Significant antifungal activity

was found against *Candida* species and *Aspergillus* species.³⁸

Above three extracts also shows wide antibacterial activity against Gram-positive bacteria. The extract was also tested for antibacterial activity against Gram-negative bacteria; the antibacterial activity was limited against *E. coli*, *S. typhimurium*, *S. dysenteriae type 1* and *V. cholerae*, the best activity being against *V. cholerae*. The Gram-negative bacteria reported here as susceptible to the extracts of *B. aristata* are important human pathogens responsible for causing diarrhea and dysentery.³⁸

The antimicrobial activity of hydroalcoholic extracts of four *Berberis* species including *Berberis aristata* was observed. *Berberis aristata* was tested against eleven bacterial and eight fungal strains. *B. aristata* root extract gave low MICs values against *Bacillus cereus*, *Escherichia coli*, *Staphylococcus aureus* and *Aspergillus flavus* while stem extract against *B. cereus* and *Streptococcus pneumoniae*.³⁹

Berberine an alkaloid from the plant *Berberis aristata*, which has been known since ancient times as an antidiarrheal medication inhibited by approximately 70% the secretory responses of the heat-labile enterotoxins of *Vibrio cholerae* and *Escherichia coli* in the rabbit ligated intestinal loop model. Berberine also markedly inhibited the secretory response of *E. coli* heat-stable enterotoxin in the infant mouse model.⁴⁰

Berberis aristata shows effect against hepatitis infection.⁴¹

In vitro comparative study of antimicrobial activity of *Berberis aristata* and berberine was also performed.⁴²

The ethanolic (by maceration) and aqueous (by Soxhlet) extracts of *Berberis aristata* bark were used for the evaluation of the in vitro and in vivo antidiarrheal activity, oral acute toxicity. The antimicrobial (minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) by micro dilution) and antidiarrheal (castor oil induced diarrhea, charcoal motility) tests were conducted. The active principle, berberine was characterized by different spectroscopic and chromatographic techniques.⁴³

Staphylococcus epidermidis have been recognized as pus-forming bacteria triggering an inflammation in acne. These are etiologic agents of acne vulgaris. Ethanolic extracts of *Berberis aristata* was tested for antimicrobial activities by disc diffusion and broth dilution methods. The results from the disc diffusion method showed that *B. aristata* could inhibit the growth of *Propionibacterium acnes*.⁴⁴

Berberine is an alkaloid from the Indian medicinal plant *Berberis aristata*. It may be an effective anti-giardial

drug. The clinical study was carried out to study its anti-giardial activity and data suggest that berberine, administered orally, resulted in satisfactory parasitological cure, comparable to that obtained with other established anti-giardial drugs.⁴⁵

Berberine sulphate salt (berberine derived from the plant *B. aristata*) on the growth of *Trichomonas vaginalis* in vitro was compared to the efficacy of metronidazole as a reference. Results showed that berberine sulphate was comparable to metronidazole as regards to potency and can be used in possible replacement in metronidazole resistant cases. It has one more advantage of being safer.⁴⁶

Anti-inflammatory

Topical instillation of aqueous extracts *B. aristata* showed potent anti-inflammatory activity against endotoxin-induced uveitis in rabbit. Anterior uveitis was induced in rabbits by intravitreal injection of lipopolysaccharide from *Escherichia coli* after pretreatment with *B. aristata* aqueous extracts.⁴⁷

The 50% alcoholic extracts of *Berberis aristata* Linn. was screened for possible anti-inflammatory potential. To understand the possible anti-inflammatory potential of the selected plants, trypsin and β -glucuronidase inhibition assays were carried out of the plant extracts did not show β -glucuronidase inhibitory potential. The *Berberis aristata* plant was found to have moderate antiproteolytic activity toward trypsin-induced hydrolysis of bovine serum albumin.⁴⁸

Alcoholic and aqueous extracts of *Berberis aristata* showed good activity against acute inflammation and significant activity was achieved at two hours after Carrageen injection. Aqueous extract was effective in the early phase of acute inflammation and alcoholic extract in the later phase of acute inflammation. This suggest that the alcoholic extract may be acting by blocking the mediators released in the later phase (i.e. prostaglandin), while the aqueous extract may be acting by blocking the mediators released in the early phase (i.e. bradykinin, histamine, and serotonin), as well as by blocking the mediators released in the later phase (i.e. prostaglandin).³⁸

Antioxidant

Antioxidant potential of 50% aqueous ethanolic root extract of *Berberis aristata* was studied. Effect of extract on antioxidant enzymes of liver was studied in diabetic rats along with its safety parameters. The extract of *Berberis aristata* (root) has strong potential to decrease oxidative stress.³²

Antioxidant potential of dried aerial part of *B. aristata* was investigated in aqueous and methanolic extract and

berberine, against CCl₄ induced liver injury. The result was found significant.²³

Other pharmacological activities

Decoction of stem bark of *B. aristata* plant shows significant protection against cisplatin induced Nephrotoxicity.⁴⁹

Berberis aristata is also used as wound healing agent. A study was conducted on male adult goat under which wound healing activity was evaluated on the basis of clinical observation, rate of healing and change in histomorphological features. Aqueous and alcoholic extract were used in form of ointment on open wounds and results are significant in wound healing.⁵⁰

The anti-PAF (platelet activating factor) activity of the alcoholic extract of the root of *B. aristata* has been studied on rabbit platelets. It inhibits the PAF induced aggregation of platelets in a dose dependent manner in the microgram range. It shows that *Berberis aristata* can be used in treatment of allergic disorder.⁵¹

Dried aqueous extract of leaves of *B. aristata* showed effective antidiarrheal and antidysentery activity in animals.⁵²

B. aristata can also be used as valuable source of non-conventional feedant for animals.⁵³

Berberine is an isoquinoline alkaloid isolated from *Berberis aristata*. Berberine possessed a wide range of biological activity including central nervous system activity as well. The involvement of L-arginine-nitric oxide (NO)-cyclic guanosine monophosphate (cGMP) signaling pathway in the antidepressant action of berberine chloride was investigated.⁵⁴

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