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THE PHARMACOGNOSTIC AND PHARMACOLOGICAL ASPECTS OF *BERBERIS ARISTTATA*: A COMPREHENSIVE REVIEW

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Keywords:

Berberisaristata, Berberine, Nephroprotective, Bioprospecting

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ABSTRACT: An ayurvedic herb utilised since ancient times, *Berberis aristata* is an Indian medicinal plant that is a member of the Berberidaceae family. Other names for it are Daruharidra, Daruhaldi, Indian berberi, Darvi, and Chitra. Antipyretic, antibacterial, antimicrobial, anti-hepatotoxic, anti-hyperglycemic, anti-cancer, antioxidant, and antilipidemic properties are all beneficial properties of the plant. Additionally, gynaecological disorders, HIV-AIDS, osteoporosis, diabetes, eye and ear infections, wound healing, jaundice, skin illnesses, malarial fever, and diarrhoea can all be treated using *B. aristata* extracts and formulations. In order to provide insights into the development of possibly novel bioactives from plant scaffolds, this review attempts to emphasise the pharmacognostic and pharmacological uses of *B. aristata*. The geographic origins and taxonomy of *Berberis aristata* will also be highlighted in this review. The plant's fruit is high in vitamin C and edible. This plant produces a very valuable ayurvedic concoction called Rashut, which is used as a laxative, tonic, and blood purifier to treat human ailments such ulcers and ocular diseases. According to phytochemical analyses, the plant *B. aristata* mostly includes tannins, sugar, starch, and the yellow-colored alkaloids berberine, oxyberberine, berbamine, aromoline, palmatine, oxycanthine, and taxilamine, as well as a protoberberine alkaloid karachine. The plant exhibits a potential future for additional research and has an effective medicinal function.

INTRODUCTION: *Berberis aristata*, a member of the Berberidaceae family, is considered an essential herb in many traditional medical systems. Other names for it include Tree Turmeric, Indian barberry, Daru Haldi, Chitra, and Daruharida. About 77 of the more than 500 pharmacologically relevant species in the genus Berberis are native to India. The stiff, erect, spiny shrub *Berberis aristata* appears to be between dark brown and yellow on the outside, but when it is cut, it acquires a deep yellow colour.

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It may grow to a height of two to three meters and has light green leaves that are 4.9 cm long and 1.8 cm broad. Its blooms are yellow and aconite violet in colour [2].

Geographical Distribution and Trade: The hilly areas of northern India, Nepal, and Bhutan, as well as the Nilgiris hills (6000–7000 ft) in South India and Sri Lanka, are sub-Himalayan environments (6000–10000 ft) that are home to *B. aristata*. The height of the tall, spiky *Berberis aristata* shrub ranges from 2 to 3 meters (6.6 to 9.8 feet). This woody shrub has bark that is yellow to brown on the outside and deep yellow on the interior. Three-branched thorns, which resemble modified leaves and can be manually removed in longitudinal strips, cover the bark. The leaves are 4.9 cm (1.9 in) long and 1.8 cm (0.71 in) wide, and they are arranged in tufts of five to eight.

The dorsal surface of the leaves is dark green, while the ventral surface is light green. The leaves have pinnate venation and are simple. The leaves have a leathery texture, are serrated, and have numerous tiny indentations along their margins [2].

Taxonomical Classification:

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Ranunculales

Family: Berberidaceae

Genus: Berberis

Spesies: aristata

Taxonomical Classification Kingdom:

Plantae Division: Magnoliophyta

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Family: Berberidaceae

Genus: Berberis

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Vernacular Names:

English Names: tree turmeric, Indian barberry. Darhaldi (Bengal), kashmoi (Garhwal), rasont, kashmal (Himachal Pradesh), chitra, dar-hald, rasaut, kashmal (Hindi), maradarisina, maramanjal (Kerala), mullukala, usikkala (Tamil Nadu), daruhald (Maharashtra), chitra, chutro (Nepal), and kasmal are some of the Indian names. Simlu, pitadaru, suvarnavarna (Sanskrit), daruharidra, darvi and Sumlu (Punjab).

FIG. 1: *BERBERIS ARISTATA*

Description of Microscopic:

Stem: The stem displays rhytidoma with cork, which is made up of 3-45 squarish and rectangular cells with thin walls that are yellow in colour and organised radially. The irregularly shaped, thin-walled sieve elements contain a few cells with yellowish-brown contents. Phloem fibres are grouped in tangential rows and comprise one to four cells. Each fibre has a wide lumen, thick walls, and a spindle shape. Secondary phloem rays traverse the inner half of the rhytidoma, which is made up of radially elongated parenchymatous cells. Nearly all phloem ray cells have a single prismatic crystal of calcium oxalate, while a small number of rhytidoma cells also have prismatic crystals of calcium oxalate. Stone cells can also be seen sporadically in phloem ray cells in clusters; they are rarely single, elongated, rounded, and organised radially. Some of these cells have a single calcium oxalate crystal prism. Phloem fibres and sieve elements make up secondary phloem, which is traversed by multiserate phloem rays. Phloem fibres are short, lignified, thick-walled, and have pointed ends. Sieve elements are arranged in tangential bands and tangentially compressed cells that alternate with one to five rows of phloem fibres. Xylem vessels, tracheids, xylem fibres, and multiseriate xylem rays make up the vast secondary xylem. Numerous tiny to medium-sized xylem vessels are found throughout the xylem region, either in groups or alone. These groups are often orientated radially, whereas isolated vessels are cylindrical, rounded, or protrude at one or both ends with spiral thickening. There are many lignified, big, thick-walled, lumen-wide, and pointed xylem fibres; xylem rays are fairly distinct, straight, and multiseriate, with rectangular cells organised radially, each ray being 30–53 cells high, 8–12 cells broad, and a few ray cells with brown contents [49].

Phytochemistry: The presence of carbohydrates, glycosides, alkaloids, proteins, amino acids, saponins, tannins, flavonoids, and other phytoconstituents was discovered by the initial phytochemical examination of *B. aristata* preparations. Several phytoconstituents, such as phenolic, triterpenoidal, flavonoidal, and steroidal chemicals, were detected by the TLC examination. [6].

Barberine, palmatine, oxyberberine, berbamine, aromoline, karachine, taxilamine, and oxyacanthine were among the phytoconstituents found in *B. aristatas*, according to phytochemical investigations. Protoberberine and bisisoquinoline are alkaloid types found in *B. aristata* [7]. The main Ayurvedic medications and concoctions made from traditional Indian herbal systems are well known for their numerous significant uses. Known in Hindi as "Dāruhaldi" and "Citra," *Berberis aristata* DC (Berberidaceae) is a significant medicinal herb that is indigenous to the Northern Himalaya region. Traditional Indian medical texts like Charaka and Susruta have discussed its many qualities and how it can be utilised to treat a wide range of ailments [1]. Such as an antibacterial, antiperiodic, antidiarrheal and anticancer and it is also used in the treatment of ophthalmic infections. Its root, stem and leaves also find their use in treatment of various ailments and hence is used extensively in Ayurveda.

The alkaloids berbamine, berberine, oxycanthine, epiberberine, palmatine, dehydrocaroline, jatrorhizine, karachinedihyrokarachine, taximaline, oxyberberine, aromoline, and columbamine are found in the roots of the plant *Berberis aristata* [8, 9, 10, 12]. Four alkaloids, pakistanine, 1-O methyl pakistanine, pseudo palmatine chloride and pseudo berberine chloride were also isolated from *Berberis aristata* [13, 14].

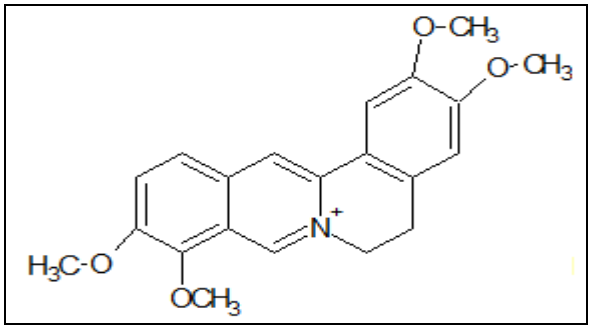

FIG. 2: PALAMATINE

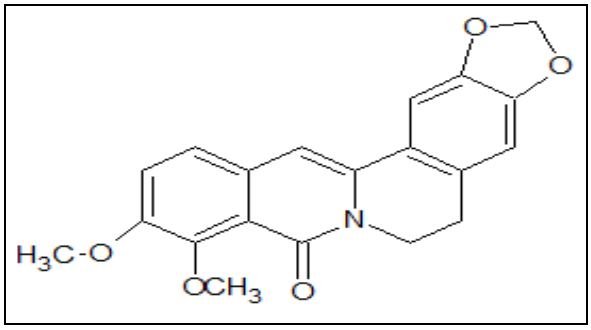

FIG. 3: OXYBERBERINE

Pharmacological Importance of Berberine: The isoquinoline alkaloid berberine, also known as protoberberine, is made from *Berberis aristata* and has a variety of pharmacological characteristics, such as antibacterial, antiamoebic, antifungal, antihelminthic, leishmanicidal, and anti-inflammatory properties. It also inhibits the contraction of smooth muscle, inhibits the formation of bacterial enterotoxins, inhibits the accumulation of intestinal fluid and ion secretion, inhibits platelet aggregation, and stimulates the secretion of bile and bilirubin [17, 18, 19, 20]. The animal study of Berberine suggested a vasodilatory/ hypotensive activity attributable to its acetylcholine potentiating properties in rats [21]. By suppressing delayed after-depolarization in the ventricular muscle of rats, berberine reduced peripheral vascular resistance and blood pressure. It also avoided ischemia induced ventricular tachyarrhythmia and increased cardiac contractility [21, 22, 23]. Additionally, berberine stimulates the immune system by increasing splenic blood flow, activating macrophages, raising platelet counts in primary and secondary thrombocytopenia, and increasing conjugated bilirubin excretion in experimental hyperbilirubinemia [20]. Berberine inhibited cyclooxygenase-2 (COX-2) transcription and N-acetyltransferase activity in colon and bladder cancer cell lines [24, 25, 26].

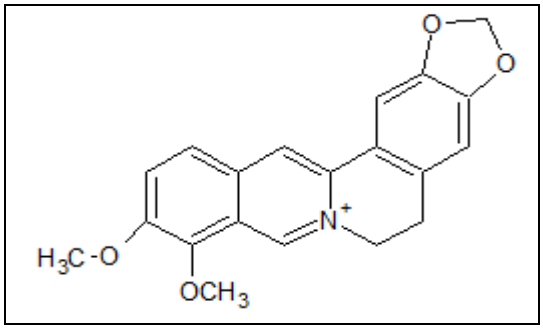

FIG. 4: STRUCTURE OF BERBERINE

Pharmacological Activity: Ayurvedic, Chinese, and other traditional medical systems around the world have long utilised *B. aristata*. Each component of this plant, including its main active ingredients like berberine, has become more significant due to its various medicinal uses. Anti-diabetic, anti-microbial, anti-cancer, antilipidemic, antipyretic, anti-inflammatory, anti-PAF, anti-

diarrheal, hepatoprotective, ophthalmic, dermatological, and cardiotonic action are among this plant's most significant medicinal qualities. Additionally, the plant extract is used in skin care and cosmetic formulations. Rabbit platelets have been used to test the alcoholic extract of *B. aristata* root's anti-PAF (platelet activating factor) properties. In the microgramme range, it suppresses platelet aggregation caused by PAF in a dose-dependent way. It demonstrates that allergic disorders can be treated with *Berberis aristata* [42].

In Ayurveda, the hepatoprotective properties of *B. aristata* roots have been utilised to cure jaundice. The dried aerial component of *B. aristata* was tested for its hepatoprotective and antioxidant properties against CCl4-induced liver damage in aqueous and methanolic extracts as well as berberine. The outcomes were similar to those of the common medication silymarine [47]. Antimalarial Antiplasmodial efficacy of root bark of *Berberis aristata* has been found to exert significant schizont maturation inhibition of *P. berghei* isolates *in-vitro*. [48].

B. aristata is officially noted in Ayurvedic& Siddha Pharmacopoeia of India. Due to its various pharmacological activities it is an important part of polyherbal formulations in the treatment of different diseases and disorders. A brief review of literature on the various type of activities as reported for the plant is summarised below table.

TABLE 1: PHARMACOLOGICAL ACTIVITIES OF *B. ARISTATA*

Plant part	Extract	Pharmacological activity	Methods
Bark	Hydroalcoholic extract	Antiinflammatory and antigranuloma activity [1], Hepatoprotective Activity [34]	Carrageen an Administration induced Paw Edema in Rats, Cotton Pellet Implantation induced Granuloma Formation, Galactosamine induced hepatic damage in rats
	Ethanol	Antidiarrheal Activity [35]	Castor oil-induced diarrhea
	Aqueous	Antidiarrheal Activity [35]	Castor oil-induced diarrhea
Stem	Methanolic extract	Antimicrobial Activity [28, 31], Anticancer Activity [40, 41]	Agar well diffusion method, MTT Assay, Soft agar colony formation assay, Live/Dead assay
Stem Bark	Ethanol	Anticancer Activity [39]	Ehrlich ascites carcinoma-bearing mice model
Root	Acetone extract	Antimicrobial Activity [11]	Agar well diffusion method
	Ethanol	Antihyperglycemic activity [36, 37], Anti-PAF (platelet activating factor) activity [42]	alloxan-induced diabetic rats, streptozotocin induced diabetic rats
	Aqueous	Hypoglycemic Activity [38]	*In-vitro* glucose diffusion, *in-vitro* amylolysis kinetics and glucose transport across the yeast cells
Leaves	Acetone extract	Antimicrobial Activity [11]	Agar well diffusion method
	80% aqueous methanol	Hepatoprotective activity [32]	Liver injury induced by acetaminophen model, Paracetamol and CCl4 induced hepatotoxicity
Fruit	80% aqueous methanol	Hepato protective activity [32]	Paracetamol and CCl4 induced hepatotoxicity
Leaf, stem and bark (combined)	Methanol extract	Antioxidant Activity [30]	2, 2-Diphenyl-1-Picrylhydrazyl assay, Folin–Ciocalteau and aluminum chloride method
	aqueous and ethanolic extracts	Antidiabetic Activity [43]	Streptozotocin (type I) and Streptozotocin-Nicotinamide (type II) induced diabetic models

Antiulcer Property of *B. aristata*: Although the plant has historically been used to treat gastroduodenal ulcers, a study of the literature found no scientific evidence supporting *B. aristata's* antiulcer properties. The utilisation of plants in polyherbal formulations for antiulcer action is the only scientific proof currently available. The antiulcer properties of Digitrall, a polyherbal preparation, were described by Jana *et al.* in 2005 [44]. Aqueous extracts of *Zingiber officinale*, *Amomum sabulatum*, *Berberis aristata*, *Piper nigrum*, Ptychoyisajowan, *Caria papay*, and *Foeniculum vulgar* are included in Digitrall (DG), a product made by M/s. S.C. Pharmaceuticals Ltd. in Kolkata, India. The author reported the preventive action of DG on indomethacin induced ulcer in rats. The dose selected for study was 1, 2 and 4 ml/kg body weight and malondialdehyde (MDA), superoxide dismutase (SOD), reduced glutathione (GSH) and protein were estimated. The results

suggested that DG caused reduction in MDA, enhanced the level of SOD and GSH in gastric mucosal tissue in dose dependent manner [51].

Anti-hyperglycaemic Effect: The ethanolic root extract of the *Berberis aristata* plant was able to considerably reduce both the fasting blood glucose level and body weight in rats with diabetes induced by alloxan [50]. The ethanolic root extract of *Berberis aristata* was reported to have a strong anti-diabetic effect in rats with alloxan-induced diabetes at a rate of 50 mg/kg and 100 mg/kg body weight, with a reduction in blood glucose levels of 63.01% and 66.27%, respectively, in comparison to diabetic control. Additionally, compared to the diabetic control group, the plant extract-treated group's levels of triglycerides and total cholesterol were much lower [52].

Reproductive Potential: When compared to the untreated rats, female wistar rats with high-fat diet-induced obesity-related reproductive changes showed a significant decrease in total cholesterol, triglycerides, insulin, leptin, visceral fat, and body weight, as well as a significant increase in oestradiol levels, after receiving 500 mg/kg of *Berberis aristata* extract for 45 days. Following treatment with the plant extract, oxidative stress biomarkers such as malondialdehyde, reduced glutathione, NO, and superoxide dismutase levels significantly improved [53].

Nephroprotective: Because of its antioxidative qualities, the root bark decoction of *Berberis aristata* has been shown to be useful in reversing the side effects of cisplatin, hence preventing nephrotoxicity or urinary problems caused by the drug. In a vancomycin-induced nephrotoxicity model in vero cells, ethanolic root extract of *Berberis aristata* was able to downregulate the mRNA expression of proliferative and antioxidant markers, such as p53, p21, Cas 4, Cas 5, Cas 9, and Cyt-c, which were upregulated in the vancomycin group without any treatment [54].

Other Pharmacological Activities: The *B. aristata* plant's stem bark decoction exhibits strong protection against cisplatin-induced nephro-toxicity. Another usage for *Berberis aristata* is as a wound-healing agent. A male adult goat was used in the investigation, and the wound healing activity was assessed based on clinical observation, heeling rate, and histomorphological feature alteration. The outcomes of applying alcoholic and aqueous extract as an ointment on open wounds are noteworthy in terms of wound healing [45].

Future Prospects: *Berberis aristata* may yield new medications to treat a range of illnesses; nevertheless, because to extensive root harvesting for the berberine alkaloid, the plant is endangered in conservation. In bioprospecting, endophytes from *Berberis aristata* can create bioactive substances that may assist treat human health issues, but more research is required to build agricultural and climatic conditions to support the plant's growth [11, 50].

CONCLUSION: The thorough studies conducted on the pharmacognosy of *B. aristata's* root, stem, and leaf have shown certain noteworthy diagnostic characteristics that enable one to distinguish it from other adulterants and/or substitutes. The herb *Berberis aristata* has strong anti-hyperglycemic, anti-ulcer, and wound-healing qualities. The results of this study offer a broad-spectrum examination of the most widely used *B. aristata* bark extracts, notwithstanding the need for additional investigation and understanding of biological activity.

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CONFLICT OF INTEREST: Nil

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