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A Review on Berberis aristata

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ABSTRACT

Berberis aristata, also known as daruharidra and Chitra, is a famous plant used in various medicinal Systems like Ayurveda, Homeopathy, Unani, Chinese, and allopathy for a very long time. About 450–500 deciduous evergreen shrub species comprise the genus, distributed in temperate and subtropical regions of Asia, Europe, and America. The herb is used to cure skin conditions, wound healing, diarrhoea, and even irritation of the eyes within the ancient system of medicine. Moreover, the plant's fruit would be a plentiful source of VIT-C. The plant has a variety of pharmacological qualities, including cardiotonic action, hepatoprotection, antibacterial, antipyretic, analgesic, and anti-inflammatory effects. Berberine, mainly found in the plant's roots, is its principal active component.

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INTRODUCTION

Since ancient times, India's indigenous medical system has used herbal plants as a source of traditional remedies. Over 6000 species of higher plants were employed in conventional medicine. According to WHO (global health agency) research, 4 billion people use herbal medicines as their primary medical care or as an alternative. Berberis aristate is known as Daruhaldi, Indian barberry, and the Berberidaceae family [1]. This plant is primarily produced in the sub-Himalayan territory, the Nilgiris hills in southern India, and the hilly regions of Nepal at elevations of 2000–3500 meters. The plant is utilized to cure ailments like wound repair, dermatitis illnesses, rheumatic, snake bites, jaundice, and eye problems, and acting as a tonic, demulcent, diaphoretic, or even diuretic [2].

Berberine, which may be found inside the plant's leaves, roots, rhizomes, and stems bark, is the primary alkaloid substance. In the traditional medical systems of India and Nepal, this plant is used to treat allergies, metabolic disorders, cholera, acute diarrhoea, latent malaria, amoebiasis, ophthalmia, and eye illnesses. It serves as a laxative.

According to studies, Berberis aristate's stem and roots are marketed as Daru Haridra in India. While this ingredient was initially given to treat diarrhoea and diabetes patients, it was in 1988 that the hypoglycaemic activity of the plant was first discovered.

Taxonomical classification of Berberis aristata

Kingdom: Plantae

Division: magnoliophyte

Sub- division: Angiospermae

Class: Dicotyledonae

Genus: Berberis

Species: Aristata

Common name: Daruharidra

Vernacular names of *Berberis aristata*

English: Indian beriberi, Tree turmeric

Telugu: Manupasupa

Tamil: Gangeti, Varatu manjal

Sanskrit: Katamkateri, Dirvi, Kata

Marathi: Daruhalad

Malayalam: Maramannal, Maramanjal

Hindi: Daruhaldi, Daruhald

Botanical description

It is an upright, spiky shrub with firm and yellow wood. The bark is deep yellow on the inside and yellow to brown on the exterior detachable in longitudinal strips by hand; 1.5 cm long, three-branched spines (actually modified leaves) [3].

Leaves

In tufts of five to eight, phyllotaxy verticillate, simple spiny, lanceolate, toothed, leathery, and sessile leaves are grouped. Length: 4.9 cm, width: 1.8 cm, acuminate, with reticulate pinnate venation, deep green on the dorsal side, and light green on the ventral surface.

Flower

Flowers were perigynous, stalked, yellow, complete, hermaphrodite, cyclic, actinomorphic, and had an average diameter of 12.5 mm. Inflorescence is a spike-like structure. With 11 to 16 blooms per cluster. Calyx is actinomorphic caducous, yellow, and polysepalous, with six sepals (3 little, three big) and 4 to 5 mm in length. Yellow, actinomorphic, polypetalous corolla with six petals that is 4 to 5 mm long. One gynoecium, about 4 to 5 mm in size, has a slight stigma and a shorter style. Six adnate, polyandrous, and 5 to 6 mm long androecium are present like stamens [4].

Fruits

Fruits are globose to ovoid in shape and typically bloom like plums. Fruits measure 7 mm in length, and 4 mm in diameter, weigh 227 mg, and have a volume of 237 microliters. The fruit has an aconite violet [5].

Seeds

There are 2 to 5 seeds per plant, each weighing 25 mg and having a volume of 29 microliters. They range in colour from yellow to pink [6].

Geographical distribution of Berberis aristata

The plant Berberis aristata is endemic to Nepal and can be widely distributed throughout Asia, Bhutan, India, and Sri Lanka [Figure 2]. The sub-Himalayan region of India in which it is primarily found between 1000 and 3000 meters, the Nilgiri Hills in South India between 1000 and 2400 m, Himachal Pradesh, Madhya Pradesh, Tamil Nadu, Uttar Pradesh, Uttrakhand, Sikkim, and it has increased to an elevation range among 2000 and 3500 m [7].

Phytochemical constituents

Nearly each of Berberis aristata sections contains different chemical components. The B. aristata plant's main chemical constituents are alkaloids. Berberine is among the essential alkaloid components in the B. aristata plant. The root bark of the B. aristata plant contains the protoberberine alkaloids Karachine, dihyrokarachine, tetrahydropalmatine, tetrahydro Berberine, epi berberine palmatine, palmatine dihydro caroline, jatrorhizine, columbamine, as well as palmatine chloride [Figure 1]. Other extracted alkaloids include aroma line, oxy berberberine, Berberine, oxyacanthine, and Berberine chloride. Alkaloids, including taxilamine, pseudo palmatine chloride, pseudo berberine chloride, pakistanine, and 1-O-methylpakistanine, were also extracted from the plant's bark. The B. aristata plant's blooms include the polyphenolic flavonoids quercetin, martin, and rutin [8]. Two more acids were e-caffeic acid but also chlorogenic acid that is present. The ethanolic extract of the plant also contains the aliphatic hydrocarbon n- docasane is also detected in the heartwood ethanolic extract. The heavy metals in the plant's rhizomes are cadmium, lead, chromium, zinc, iron, and manganese [9].

Pharmacognostic investigation of root

Microscopic characters

In miniature characters, the juvenile root has a single-layered epidermis of more giant cells that are mostly radially elongated and protected by a cuticle. The cortex, composed of tangentially elongated, polyhedral, circular, and isodiametric cells and is 5-7 layers broad, comes next [10]. It has a polymeric stele inside of it. The cork cambium develops in the fifth and sixth layers of the cortex. Cork cambium creates phelloderm on the inside and cork on the outside as the secondary development progresses. Thus, the pin is 9–10 layers broad and has thin-walled, tangentially elongated cells in the adult root. A small region of phelloderm with thick-walled ellipsoidal cells and minimal intercellular gaps, measuring 3-5 layers broad, follows [11]. The secondary phloem that follows is a wide zone mostly made up of phloem parenchyma with intact sieve tubes and plates that are more on the inner side of the phloem. Some phloem's parenchymatous cells are transformed into fibres and stone cells. Compared to stone cells, the threads are far more numerous.

The fibre clusters in 2-3 circular bands that are not continuous surround the xylem. The fibres are of two sorts and are heavily lignified. The first ones are comparatively thinner, pointed at their respective ends, free of pits, and some expand toward their futures. The other ones have many thickening and bordering holes on their walls, and they are smaller in length than their initial counterparts but substantially larger in diameter. The number of fibres with pits is significantly lower than those without holes. In addition to being extensively lignified, stone cells are appreciably smaller, have considerably thicker walls, and have vertical pits. The wood is porous, diffuse, and made up of xylem parenchyma, 2-3 celled broad medullary rays, trachea, and fibre tracheids [12]. The medullary rays pass through the secondary phloem zone; they enlarge and take on a funnel-like appearance. Except for medullary rays, all xylem components are heavily lignified. The xylem vessels are drum-like, and some have pointed tail-like extremities [Figure 3]. They generally have bordered pits on their walls with noticeable perforation rims. The tracheids have framed holes on their walls and are blunt to pointed ends. The sharp extremities of xylem fibres are long, thick, and have a visible lumen. Rarely does one see outgrowths of threads on their walls near its ends. Fibre tracheids are longer than xylem fibres and have bordered pits on their walls. Simple holes can be seen on the walls of rectangular or polygonal xylem parenchyma [13].

Pharmacognostic investigation of stem

Tiny figures A transversely cut and smoothed surface reveals a yellowish bark roughly half the radius of a stem's size and a yellow wood with an obvious centre pith. A tree is nearly cylindrical, 0.2-1.0 cm in diameter, and has on the outside surface; there are parallel longitudinal fine creases. Short, somewhat fibrous, and bitter-tasting fractures. Miniature characters A juvenile stem's transverse section depicts a wavering contour and comprises a single layer of epidermis with cells that range in shape from cubical to radially elongated and are protected by a thick cuticle. A little lumen is left inside some elongated epidermal cells, forming short unicellular trichomes with significantly thicker walls. They do not contain lignin. The cortex, separated into three zones, is the following structure. The outer one is a confined area comprising three to four layers of parenchymatous cells with moderately thick walls and few intercellular gaps [14]. Their walls have rich colouring, giving them the appearance of being stanniferous. The intermediate zone comprises 3–6 layers of heavily lignified sclerenchymatous fibres. The fibers have lengthy, thicker walls with a discernible lumen and, for the most part, pointy ends, though occasionally, they may have blunt ends. Only one to two layers broad, the third zone of the cortex comprises parenchymatous cells with thin walls. Indistinct pericycles and endodermis surround an ectophloic siphon stele in a polymeric condition surrounded by a large pith. Phloem fibers are absent in primordial phloem, comprising sieve tubes, plates, and phloem parenchyma [15]. Vessels, tracheids, xylem fibers, and xylem parenchyma make up the xylem. There are separate medullary rays that pass through the xylem area. The pith's big, circular to isodiametric cells have solid walls and a mild sclerosed appearance; most have pits on their surfaces. Cork cambium develops on the parenchymatous cortex's second layer, while secondary development continues slightly beyond the central stele. It produces phelloderm on the inside and cork on the outside. The primary cortex comprises stanniferous and sclerenchymatous cells, and the epidermis, which has unicellular, uniseriate trichomes, is peeled off. The cork in the adult stem is made up of 12–16 layers of obliquely elongated, extremely suberized cells that are oriented radially [Figure 4]. The zone of phelloderm that follows has just 4-6 layers of thickness and is made mainly of thin-walled parenchyma. A large area of secondary phloem follows, and giant funnel-shaped medullary rays cross this zone in between [16]. Companion cells, sieve tubes, plates, phloem parenchyma, and phloem fibers comprise the secondary phloem. There are also some sclerites in the secondary phloem zone; these are mainly rectangular to squarish in form, have thick lignified walls, and occasionally have pits on their walls. Tracheids, xylem fibers, and xylem parenchyma make up the secondary xylem. Although certain vessels are shown to have spiral-shaped thickening, dishes are often surrounded by pits with definite perforation rims. Nevertheless, some are noted to have spiral-shaped thickening.

They are usually cylindrical and short. However, they come in a variety of sizes. The tracheids have temporary walls with straightforward pits [Figure 5].

The fibers are pretty long, thick-walled, and lignified. Most have pointy, tapering tips, but some have blunted or forked ends [17].

Pharmacognostic investigation of leaf

Microscopic characteristics that are obovate to elliptic, 3.8-10 by 1.5-3.3 cm, and have no teeth or spinous teeth, base progressively narrower, with noticeable reticulate nerves, glossy dark green above, shiny light green but not glaucous underneath, brittle, faint odour, and bitter taste are the macroscopic characteristics [18].

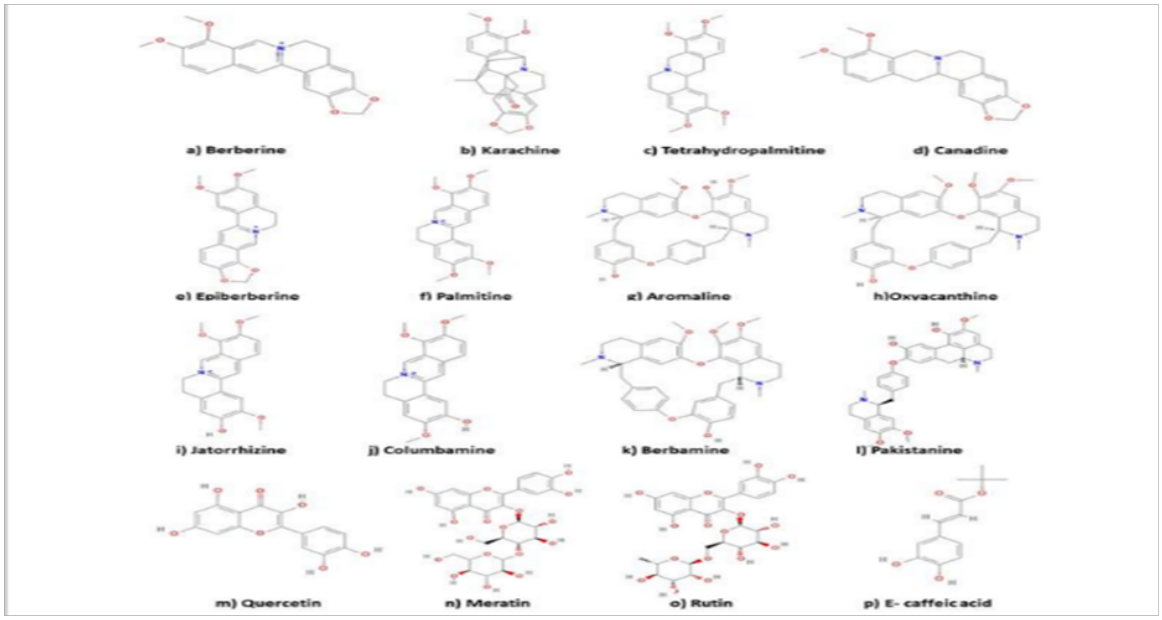

Figure 1: Chemical structure of some significant phytochemical constituents of Berberis aristata

Figure 2: Plant of Berberis aristata (Daruharidra)

Table 1: Ayurvedic properties of Berberis aristata

Property	Uses
Rasa/ Taste	Katu / Bitter, Tikta / astringent
Vipak / Potency	Katu / Bitter
Virya / metabolic Property	Ushna/Heat
Guna / Physical property	Ushna / heat, Ruksha

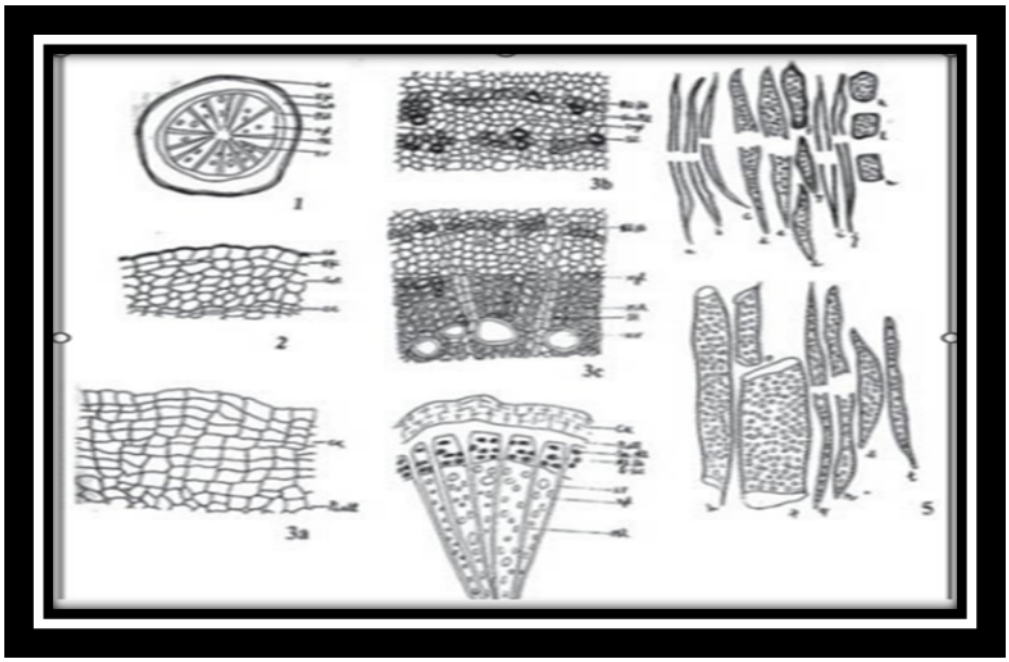

Figure 3: T.S mature root of Berberis aristata

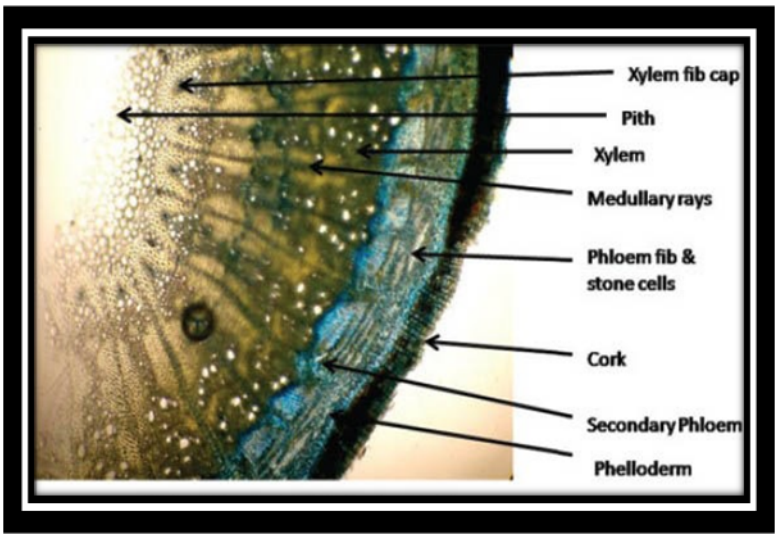

Figure 4: T.S mature stem of Berberis aristata

Microscopic midrib

The midrib has an outline that is concavo-convex, with greater dorsal convexity than ventral concavity. It has a single epidermis layer with cubic to tangentially elongated cell types. The size of upper epidermis cells is more significant than the lower epidermis cells' size. Externally, the epidermis is protected by a thick cuticle that has what seems to be deep ridges or furrows on both sides. The top side's cuticular folds are more comprehensive than the bottom. In a broad cortex, there are 3-5 layers of thick-walled parenchyma on the ventral side, while on the dorsal side, there are 5-8 layers under the epidermis. There are extremely few intercellular gaps inside the polyhedral, isodiametric, or circular parenchyma. A discontinuous thread of 4-6 layers of pericyclic fibers with thick, lignified walls and a small lumen in between surrounds the vascular tissue. The xylem and phloem regions are crossed by the 1-2 cell-wide medullary rays. Sieve tubes, sieve plates, and parenchyma make up the phloem. There are no phloem fibers. Trachae, tracheids, tracheal, xylem, and xylem parenchyma make up the xylem. These substances are all lignified. The trachea is elongated and has bordered, annular, spiral, and scalariform pits [Figure 6]. There are two types of tracheids. The short ones have a scalariform thickening and an uneven border. The longer ones have smooth edges and thickening that is either scalariform or pitted around the edge. Fiber tracheids are

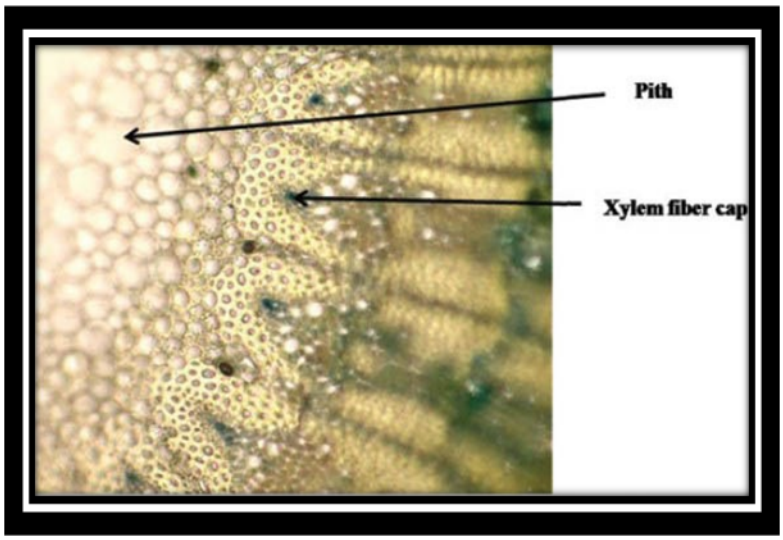

Figure 5: T.S mature stem of Berberis aristata

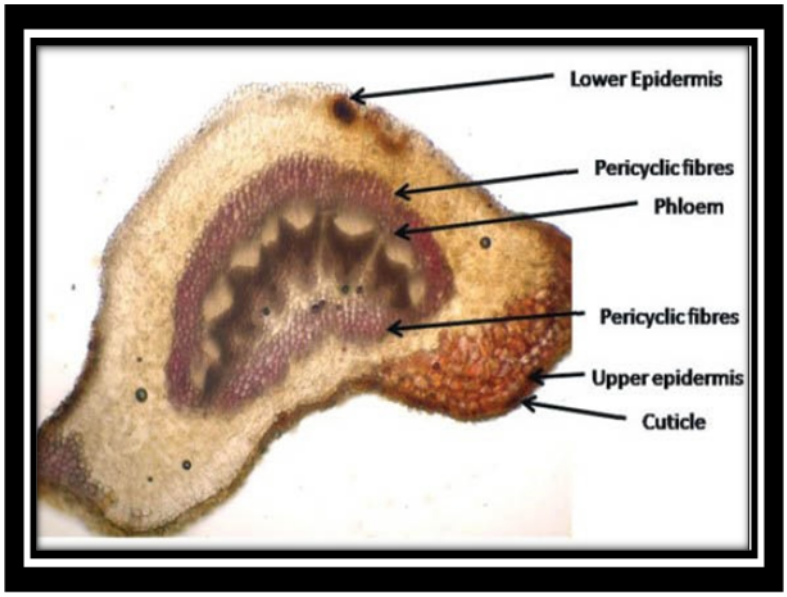

Figure 6: T.S of the mid rib of Berberis aristata

widely distributed, have pointy or blunt ends, and either scalariform- or bordered-pitted-type thickening. The latter have rims with evident perforations [19]. The xylem fibers are incredibly long, substantially thickened, and have a narrow central lumen. They also often have tapering pointed tips or, in some cases, truncated ends. Simple pits on the xylem parenchyma's walls also thicken it [20].

Properties of Berberis aristata

Lekhaniya: It aids in lowering harmful levels and surplus fat. Arshoghna: It has anti-haemorrhoidal properties. It functions as a lactose plant, Stanyasodhana [Table 1].

Ropana: It has wound-healing properties.

Svedala: It encourages perspiration.

Rasayana: It has to revitalize properties.

Kandughna: It works as an anti-pruritic agent and helps treat skin conditions.

Twacha is beneficial for treating skin conditions and is also used in cosmetics.

Taapkaram: It keeps your body temperature steady.

Shwasanasansthan: It helps treat respiratory diseases [21].

Pharmacological activities

Hepatoprotective activity

Golden hamsters were used in an immune modulation experiment to evaluate the plant's potential for hepatoprotection. The aqueous methanolic extract of the plant is hepatoprotective properties. The formulation has decreased the infection rate of hepatic amoebiasis B. aristata [22]. Other research had

shown that the plant's When berberine component was tested on rats, cytochrome p-glycoprotein and P-450, which regulate hepatobiliary excretion and liver metabolism, showed hepatoprotective benefits. The Chinese medical system has discovered that Berberine is beneficial against liver fibrosis.

Anti-inflammatory

According to reported investigations, an aqueous extract of the roots of B. aristata had an anti-inflammatory effect when tested on rats at doses of 500–1000 mg/kg[3]. Likewise, when tested in the rat model, B. aristate and C. fenestra tums methanolic and aqueous extracts demonstrated-inflammatory action in carrageenan-induced paw oedema [23].

Antimicrobial

A plant extract's alkaloid shows an antibacterial action on trachoma. According to research, the plant's Berberine extract showed antimicrobial efficacy against various microorganisms, including viruses, bacteria, fungi, protozoans, helminths, and chlamydia. When Staphylococcus aureus, Pseudomonas aeruginosa, and Corynebacterium were used as test subjects for the herbal gel formulation that comprises B.aristata extract, it was discovered that the medication was effective against skin infections [24]. Additionally, it was noted that the plant's root extract and hexane extract had antifungal action against various fungus species pathogens.

Antidiarrheal

To validate the antidiarrheal action of the B. aristata plant, in vivo and in vitro investigations were conducted. According to studies that have been published, this ingredient berberine extracted from the roots and bark of the B. aristata plant suppressed the enterotoxin secretory response of Vibrio cholera and E. coli in rabbit ligated intestinal loop model and neonatal mouse assay. Moreover, a simple dry formulation of the B. aristata plant prevents cholera toxin-induced diarrhoea [25].

Antidiabetic

According to several experimental tests, B. aristate's ethanolic extract exhibited antidiabetic efficacy when tested on rats given the diabetes drug alloxan. The B. aristata plant's alcohol-based stem extract has anti-hyperglycemic properties. The plant's ability to inhibit DPP-IV suggested it could be an antidiabetic drug [26].

Anticancer

To assess its anti-cancerous properties, a human colon cancer cell line was used to test the methanolic extract of the B. aristata plant. B. aristata methanolic extract was reported to inhibit HT29 cells in a concentration-dependent manner. Additionally, a component of Berberine isolated from the B. aristata plant was reported to significantly suppress the carcinogenesis caused by 20-methylcholanthrene or N-nitroso diethylamine in small animals in a dose-dependent manner [27].

Antioxidant

The B. aristata plant's antioxidant capacity was studied using its aqueous ethanolic extract. The study was conducted on diabetic rats under strict safety conditions. The plant's root extract was found to reduce oxidative stress. A significant impact was also seen when the plant's aqueous and methanolic extract was tested against CCl4-induced liver damage [28].

Anti-platelet

Several research investigations have shown that when tested on rabbit platelets, the alcoholic extract of the B. aristata plant suppresses PAF (platelet-activating factor) induced Aggregation of platelets and 3H- PAF binding. Additionally, it was noted that the plant's Berberine component prevented platelet aggregation by interfering with the collagen-mediated adhesion process [29].

Antimalarial

Berberis aristata root bark's antiplasmodial effectiveness has been observed to impede P. berghei isolates' in vitro schizont development significantly.

DISCUSSION

An essential Ayurvedic medicinal plant called B. aristata (Daruharidra) is renowned for treating specific illnesses. The Indian medical system makes substantial use of the plant's root, stem, and leaves; the latter are also unprocessed medications. There has been some research on the pharmacognosy of its root, but the conclusions given seem incorrect. A detailed pharmacognostic analysis has been attempted in the current investigation to identify this plant from other species, related medications, or other substances. Pericyclic fibers have been placed in the groups of threads, and stone cells have been found in the region of fibers as distinct groups. The fibers are phloem fibers, and the stone cells and fibre groups coexist in concentric rings in the secondary phloem's outer region. According to previous reports, the phloem fibers are only of the primary type. Nevertheless, our research has revealed that threads with thickened borders also exist.

CONCLUSION

An upright, spiky shrub native to the northern Himalayas is called Berberis aristata. Its usage as an antibacterial, antifungal, hepatoprotective, immunomodulatory, antidepressant, and antidiabetic has been documented in studies. However, little evidence supports this plant's anti-leprotic, anti-fertility, or anti-neoplastic claims. Thus, further studies might be conducted to keep this plant's potential.

More studies may be conducted on the meteorological and agricultural circumstances needed to cultivate this plant because it is a species becoming threatened. With this beautiful plant species, the potential translational hints to the potential novel bioactivities and targets have yet to be uncovered.

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Conflict of interest

The authors declare no conflict of interest, financial or otherwise.

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