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THERAPEUTIC POTENTIALS OF BERBERIS ARISTATA: A COMPREHENSIVE REVIEW OF ITS PHARMACOGNOSTICAL, PHARMACOLOGICAL AND MEDICINAL PROPERTIES

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ABSTRACT

Berberis aristata, known as Indian barberry or Tree Turmeric, is a medicinal plant that is widely utilized in traditional medicine systems, including Ayurveda, Unani, and Siddha. This review investigates the plant's varied pharmacological properties, phytochemical ingredients, and medicinal potential. *Berberis aristata* contains major phytoconstituents such as alkaloids, including berberine, palmatine, and jatrorrhizine, has a variety of biological activities, including antibacterial, anti-inflammatory, antidiabetic, hepatoprotective, and anticancer actions. These activities are mostly due to its powerful antioxidant mechanisms and ability to modulate metabolic pathways. The plant's usefulness in treating chronic diseases such as diabetes and cardiovascular disease highlights its importance in modern pharmaceutical research. However, obstacles such as long-term cultivation, extract standardization, and clinical validation of traditional usage persist. We are writing this review article on *Berberis aristata* to highlight its medicinal significance, phytochemical properties, and therapeutic potential. This comprehensive review aims to provide insights into its traditional uses, modern applications, and ongoing research, promoting further exploration and utilization of this valuable plant.

KEYWORD:- *Beriberis aristata*, herbal plant, pharmacological activity**.** Phytochemical profile, traditional medicine, therapeutic applications.

1. INTRODUCTION

B. aristata is predominantly native to the Himalayan region, but it has been introduced to other Asian areas and regions with comparable climates. While it is not extensively found outside of Asia, it is cultivated in some temperate regions for its therapeutic properties. Herbal plants are regarded a source of traditional remedies and have been employed in India's indigenous medicinal system since antiquity. Approximately 6000 species of higher plants are used in traditional healthcare traditions.*Berberis aristata*, often known as Indian Barberry or Daruharidra, is a thorny deciduous shrub from the Berberidaceae family. This plant is native to the Himalayan areas of India and Nepal, and it is well-known for its therapeutic benefits and brilliant yellow roots. It normally grows at altitudes of 2,000 to 3,000 meters. The shrub has yellowish bark, prickly branches, and tiny, oblong crimson berries. Berberis aristata, which contains alkaloids such as berberine, has long been utilized in Ayurvedic medicine for its anti-inflammatory, antibacterial, and antidiabetic qualities. It also promotes liver function and can help with eye infections and gastrointestinal disorders.Herbal plants are regarded a source of traditional remedies and have been employed in India's indigenous medicinal system since antiquity. Folk healthcare traditions use around 6000 species of higher plants.[1] Berberis aristata is also known as Daruharidra, Daru Haldi, Indian barberry, Tree turmeric, and Chitra. It is a spiny, hard, yellowish herb belonging to the Berberidaceae family. This plant is mostly grown in the sub-Himalayan region, the Nilgiri hills in southern India, and hilly portions of Nepal up to an elevation of 2000 to 3500 meters.[2] It is regarded as the most significant herbal plant in the Ayurvedic, Siddha, and Unani medicinal systems due to its therapeutic properties.[3] According to clinical and experimental investigations, the chemical constituents of *Berberis aristata*, particularly berberine have a variety of pharmacological activities, including anti-diabetic, antimicrobial, anti-cancer, antipyretic, hepatoprotective, ophthalmic, and cardiotonic action. This plant has tremendous therapeutic significance and requires additional study and investigations to generate new herbal and ayurvedic formulations. Although the findings of this analysis are extremely encouraging for the use of B. aristata plants to cure a variety of diseases and ailments.[4]

2. Plant profile

- **Scientific name:** *Berberis aristata*
- **Common names:** Indian Barberry, Tree Turmeric
- **Native region:** Himalayan region
- **Elevation range:** Grows well between 1,000 and 3,000 meters
- **Family:** Berberidaceae
- **Characteristics:**
  - Glabrous (smooth, hairless) herb
  - Vertically spinous (spiny) branches
- **Medicinal uses:** Known for its therapeutic properties, especially in traditional medicine systems like Ayurveda and Unani.[4]

Fig. 1: *Beriberis aristata* fruit.[5]

Fig. 2: *Beriberis aristata* leaves.[6]

2.1 Morphology

The thorny evergreen shrub *Berberis aristata*, often called Indian barberry or "Daruharidra," is distinguished by its small, oblong leaves, yellow wood, and prickly branches. Typically found in the Himalayan highlands, it has crimson to purple oblong berries and bright yellow flowers.Clusters of five to eight spinous, simple, lanceolate, leathery, toothed, sessile, verticillate leaves measuring 4.9 cm in length and 1.8 cm in width are present.

General characteristics

- Thorny evergreen shrub
- Common Names: Indian Barberry, Daruharidra
- Height: 2 to 3 meters
- Upright, spiky shrub with strong, yellow wood

Bark: Deep yellow inside, yellow to brown on the surface

Leaves

- Shape: Small, oblong, lanceolate
- Size: 4.9 cm long, 1.8 cm wide
- Texture: Leathery, toothed edges, sessile
- Venation: Reticulate pinnate
- Color: Light green on the ventral surface, deep green on the dorsal surface

Arrangement: Clusters of five to eight leaves in a verticillate pattern.[7]

Spines

- Modified leaves
- Length: 1.5 cm

Structure: Three branches.[7]

Flower

- Type: Racemose
- Color: Yellow
- Characteristics: Complete, perigynous, hermaphrodite, actinomorphic
- Diameter: 12.5 mm when fully open

Flower Count per Raceme: 11 to 16 flowers[8]

Fruit

- Shape: Ovoid to elliptical
- Color: Brilliant crimson
- Size: 7 mm long, 4 mm wide
- Taste: Acidic, edible

Weight: Around 227 mg.[9]

Seeds

- Number: 2 to 5 per fruit
- Color: Yellow to pink
- Weight: 25 mg per seed
- Volume: 29 ml per seed.[9]

2.2 Geographical distribution

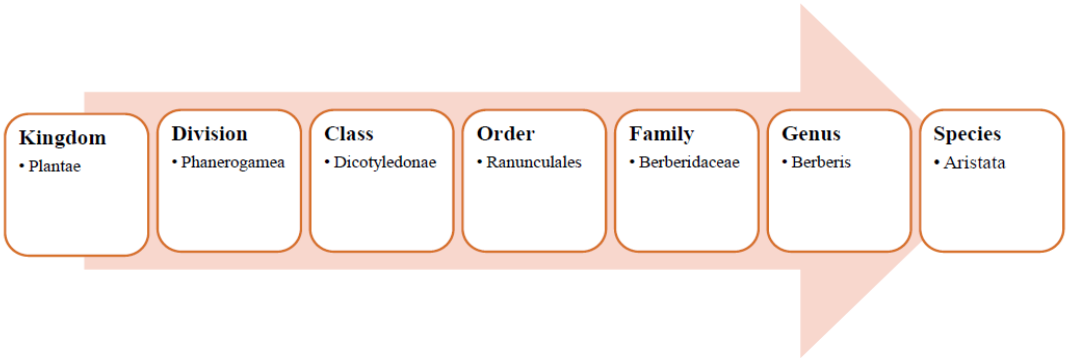
While *B. aristata* is mainly concentrated in the Himalayan region, it has also been introduced to other parts of Asia and regions with similar climates. The plant is not widely found outside of Asia but has been cultivated in some temperate regions due to its medicinal properties. It is mostly found in the sub-Himalayan region of India at elevations of 1000–3000 meters, the Nilgiri hills in South India at elevations of 1000–2400 meters, and the regions of Jammu and Kashmir, Himachal Pradesh, Madhya Pradesh, Tamil Nadu, Uttar Pradesh, Uttarkhand, and Sikkim. It can grow up to 2000–3500 meters in elevation.[14]

2.3 Cultivation

The plant can withstand severe frost and temperatures as low as -23°C. The shrubs do best in moderately moist soil that is sunny to partially shaded. Although it thrives in

thin, dry, and shallow soils, it is by no means picky and prefers warm, moist loamy soil with light shade. It is possible to severely prune plants and have them re-sprout from the base. When *Berberis aristata* reaches maturity, they drop their fruits on the ground. These seeds then sprout and new seedlings grow in the same area as the original fruit. After coming into contact with soil or water on the ground, seeds begin to germinate one or two weeks later. Water management systems that rely on rainfall are used to cultivate *Berberis aristata.* However, for commercial plant cultivation, the drip irrigation system can be installed. Avoiding too much water will keep plants and roots from becoming wet.[15]

2.4 Taxonomical classification[4,11]



2.5 Vernacular names of *beriberis aristata*[12]

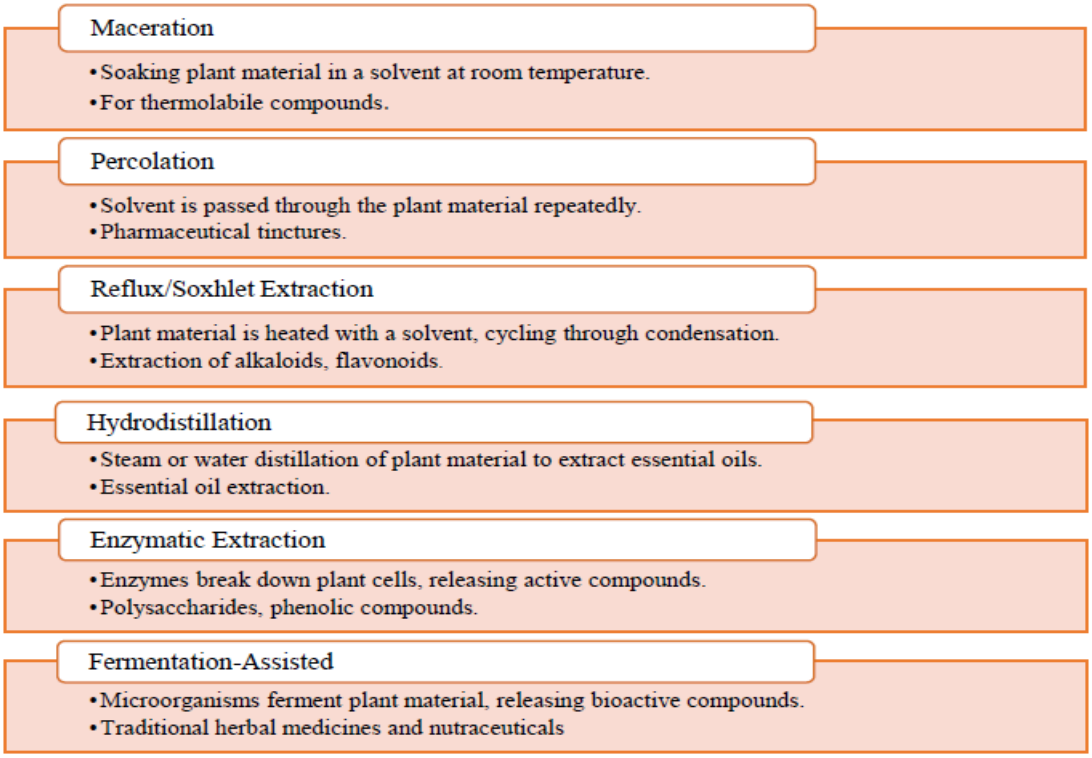
Table No. 1: Synonyms of *beriberis aristata.* [4]

English	Indian beriberi Tree Turmeric
Hindi	Chitra, Chotra, Dahaldi, Kashmal, Kashmar, Raswat
Bengali	Daruharidra, darhaldi
Marathi	Daruhalad Oriya Daruharidra, Daruhalidi
Greek	Lykion indikoc
Gujrat	Daruhalad
Kannada	Doddamaradarisina
Malayalam	Maradarisina, Maramanjal
Punjabi :	Chitra, Kasmal, Simlu, Sumlu, Daruhaldi
Tamil	Mullukala, Usikkala, Garamenjal
Telugu:	Kasturipuspu
Sanskrit	Katamkateri, Dirvi, pitadaru, kata, suvarnavarna
Himachal Pradesh	Rasont, kashmal
Nepal	Chitra, chutro

Fig. no. 3: *BeriberisAristata.* [13]

3. Methods used for extraction

The extraction of bioactive compounds from *Berberis aristata* involves various techniques to isolate its medicinally valuable components, particularly alkaloids like berberine. These methods are essential for obtaining concentrated forms of the plant's therapeutic agents. Common extraction techniques include.[16]



The extraction of bioactive compounds from *Berberis aristata* is typically performed using methods such as solvent extraction, cold maceration, hot percolation (Soxhlet extraction), supercritical fluid extraction, and ultrasonic-assisted extraction. These techniques help isolate key phytochemicals, including alkaloids like berberine, which contribute to the plant's medicinal properties.[17]

4. Phytochemical screnning

Beriberis aristata leaves, stem bark, root, fruit, and seed have been shown to contain phytoconstituents such as primary and secondary metabolites from aqueous, ethanolic, and ethyl acetate extracts.

Table No. 2: Phytochemical screening of *beriberis aristata*.[18]

Sr. no.	Phytochemical	All parts of plant	Ethanolic Extract	Aqueous Extract	Ethyl Acetate Extract
1	Alkaloids	All parts	+	+	+
2	Flavonoids	Flower, stem, root	+	+	+
3	Tannins	Flower, stem, root	+	+	+
4	Saponins	Flower, stem, root	+	+	+
5	Terpenoids	Flower, stem, root	+	_	+
6	Phenolic Compounds	Flower, stem, root	+	+	+
7	Steroids	Flower, stem, root	+	_	+
8	Reducing Sugars	Flower, stem	+	+	+
9	Glycosides	Flower, stem, root	+	+	_

5. Chemical constituents

Berberis fruits contain chemical components with nutraceutical potential and health benefits. Recognizing their potential, numerous Indian research groups are now investigating the phytochemical and pharmacological properties of fruits from various Indian species. Almost all the parts of different Berberis species plants have been explored by various research groups, forgetting information on chemotaxonomical identification, variability studies among the same or different plants or species, and isolation and identification of various medicinally important chemical constituents from this genus.

Berberine, berbamine, palmatine, columbamine, jatrorrhizine, and oxyacanthine are the most commonly reported alkaloids from several Berberis species.[23,25] Berberine and berbamine are the most physiologically active chemicals found in practically all Berberis species.[26,28]The floral extract of B. aristata DC contains a variety of polyphenolic flavonoids, including (E) caffeic acid, quercetin, chlorogenic acid, meratin, and

rutin. The leaves and fruits of B. crataegina DC contain the phenolic chemicals rutin and chlogenic acid. Fruits included more rutin and apigenin 7-O-glucoside, while leaves contained more malic acid and citric acid.

Although the elements recorded from plant stems and roots were nearly identical, there has been some diversity in the chemical contents of leaves. Several alkaloids, terpenoids, flavanoids, sterols, anthocyanins, lignans, vitamins, proteins, lipids, and carotenoids have been isolated and described from distinct Berberis species plants.[19]

Table No. 3: Chemical constituents in parts of *beriberis aristata.* [19]

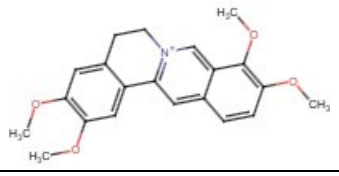
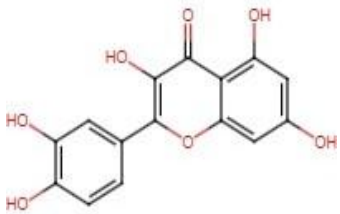
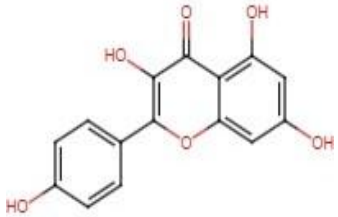
Sr. no.	Plant part	Chemical constituents
1	Root	Berberine, Palmatine, Jatrorrhizine, Berbamine, Tannins, Alkaloids
2	Stem Bark	Berberine, Palmatine, Jatrorrhizine, Magnoflorine, Oxyberberine
3	Fruits	Alkaloids, Flavonoids, Tannins, Anthocyanins
4	Leaves	Alkaloids, Flavonoids, Tannins, Vitamin C
5	Seeds	Alkaloids, Fixed Oils

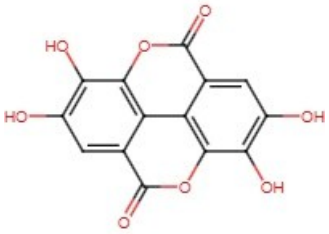
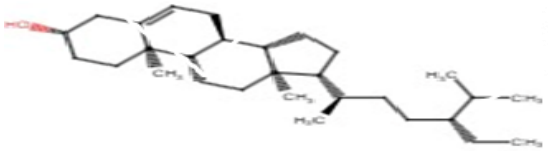
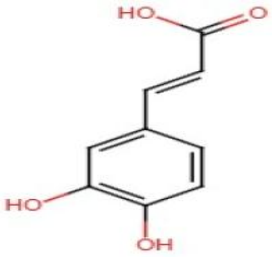
Major alkaloids reported from various Berberis species are berberine, berbamine, palmatine, columbamine, jatrorrhizine, oxyacanthine.[23-25] The berberine and berbamine are the most biologically active compounds widely distributed in almost all Berberis species.[26-28] Fourteen isoquinoline alkaloids of aporphine, proaporphine, protoberberine, protopine, benzylisoquinoline, proaporphine-benzyliso-quinoline and simple isoquinoline have been reported from B. sibirica Pall. Various polyphenolic flavonoids like (E) caffeic acid, quercetin, chlorogenic acid; meratin and rutin are reported from the flower extract of B. aristata DC. Phenolic compounds rutin and chlogenic acid are also present in the leaves and fruits of B. crataegina DC. Rutin and apigenin 7- O-glucoside were more in fruits whereas, leaves contain more malic acid and citric acid.[20]

Table No. 4: Chemical Constituents & Their role of *beriberis aristata.* [20]

Sr. no.	Chemical Constituent	Role of chemical constituents
1	Berberine	Antimicrobial, antidiabetic, hepatoprotective.
2	Palmatine	Anti-inflammatory, antimicrobial.
3	Jatrorrhizine	Antioxidant, liver protection.
4	Bebamine	Immune-modulating, anti-inflammatory.
5	Flavonoids	Antioxidant, combats oxidative stress.
6	Tannins	Antimicrobial, anti-inflammatory.
7	Anthocyanins	Antioxidant, supports heart health.
8	Phenolic Compounds	Antioxidant, reduces risk of chronic diseases.
9	Fixed Oils	Nutritional, supports skin health.

Table No. 5: Chemical structure of phytoconstituent.[4,21]

Sr. no.	Phytoconstituent	Structure	
1	Alkaloids	**Berberine** 	**Palmitine** 
2	Flavonoids	**Quercetin** 	**Kaempferol** 

S3	Tannins	**Gallic acid** 	**Ellagic acid** 
4	Terpenoids	**Beta sitosterol** 	
5	Phenolic compounds	**Caffeic acid** 	

6. Uses

Berberis aristata is widely distributed throughout India. A review of the literature found that Berberine, as an active component, is used in antibacterial, hepatoprotective, immunomodulatory, and antidepressant therapies. However, there is little information to support this plant's anti-neoplastic, anti-fertility, and anti-leprotic properties, thus more research may be needed to demonstrate its potential. The plant is now an endangered species, necessitating additional research into agricultural and environmental conditions for its cultivation. The time provides insight into the translational potential and clues to prospective novel bioactivities and targets yet to be uncovered with this wonderful plant species. It could be a valuable resource for future drug research and development.[22]

Table No. 6: Medicinal uses of *beriberis aristata.* [22]

Sr. no.	Part of Plant	Preparation	Used For	Ailment/Use
1	Root	Decoction, powder	Antimicrobial, tonic	Skin diseases
2	Root	Paste	Anti-inflammatory	Joint pain
3	Root	Decoction	Antibacterial	Diarrhea
4	Root	Infusion	Antipyretic	Fever
5	Bark	Powder	Blood purifier	Acne, boils
6	Bark	Extract	Astringent	Eye infections
7	Bark	Decoction	Hepatoprotective	Jaundice
8	Bark	Infusion	Antiseptic	Wound healing
9	Stem	Paste	Digestive aid	Indigestion
10	Stem	Powder	Antidiabetic	Diabetes
11	Stem	Decoction	Antimalarial	Malaria
12	Fruit	Raw juice	Antioxidant	Vitamin C deficiency
13	Fruit	decoction	Nutritional supplement	Anemia
14	Leaves	Decoction, infusion	Hepatoprotective	Liver disorders
15	Root, Bark	Powder	Anticancer potential	Supportive cancer therapy
16	Root, Bark	Decoction	Immunomodulatory	Boosting immunity
17	Bark	Powder	Cardioprotective	Heart-related disorders
18	Root	Decoction	Anti-inflammatory	Arthritis
19	Root	Paste	Antifungal	Ringworm, fungal infections

7. Biological activity of *beriberis aristata*

Berberis aristata is regarded as the most valuable herbal plant. The reported pharmacological actions of B. aristata are supported by a variety of scientific and experimental

research, which are detailed here.

1. **Hepatoprotective activity:** Berberis aristata, also known as "Indian Barberry" or "Tree Turmeric," has been examined for its hepatoprotective qualities, which are ascribed to the active component berberine. Berberis aristata extracts have been shown to protect the liver from chemical damage, including that caused by carbon tetrachloride (CCl_4).Berberine, a key alkaloid in Berberis aristata, lowers oxidative stress, decreases lipid peroxidation, and strengthens the liver's antioxidant defense mechanisms. This helps to prevent and repair liver damage. Histological investigations reveal that mice treated with Berberis aristata extracts had less liver damage than untreated groups.[19] An immunomodulation research was carried out in golden hamster to assess the plant's hepatoprotective properties. It was discovered that the formulation including B. aristata lowers the rate of infection in hepatic amoebiasis.[24]

2. **Anti-inflammatory:** Berberis aristata heartwood was investigated for anti-inflammatory properties using both ethanolic and aqueous extracts. In animal models, extracts at doses of 25 mg/kg and 50 mg/kg inhibited inflammation significantly (up to 57% for the aqueous extract at the higher dose). These effects are thought to be caused by the suppression of inflammatory mediators such as histamine, serotonin, and prostaglandins. According to reported investigations, the aqueous extract of B. aristata roots has anti-inflammatory properties when tested in rats at doses ranging from 500 to 1000 mg/kg.[25]

3. **Antimicrobial:** The plant's alkaloid extract shown antibacterial properties against trachoma. According to reports, the plant's berberine extract shown substantial antimicrobial action against a variety of microorganisms such as viruses, bacteria, fungus, protozoans, helminths, and chlamydia. When tested on Staphylococcus aureus, Pseudomonas aeruginosa, and Corynebacterium, the herbal gel formulation including B. aristata extract proved to be an effective medication against skin infections. It was also observed that the plant's root extract and hexane extract had antifungal efficacy against various fungal infections. [26]

4. **Antidiarrheal:** In vivo and in vitro tests were conducted to confirm the anti-diarrheal properties of the B. aristata plant. According to reports, berberine constituents isolated from the roots and barks of the B. aristata plant inhibited the secretory response of enterotoxins from Vibrio cholera and E. coli in a rabbit ligated intestinal loop model and an infant mouse assay. Furthermore, a crude dry preparation of B. aristata plant prevents cholera toxin-induced diarrhea.[27]

5. **Antidiabetic:** The largest reduction in serum glucose levels was reported in the methanolic extract of Berberis aristata DC at a dose of 500 mg/kg (Table 2). As a result, we may conclude that the methanolic extract of Berberis aristata DC improved glucose metabolism in diabetic rats. The substantial antihyperglycemic effect of the methanolic extract of Berberis aristata DC stem could be attributed to its therapeutic action against the abnormally high serum lipid concentrations found in diabetic rats.[28]

6. **Anticancer:** The current work was conducted to assess the in vitro cytotoxic activity of unexploited plants, stems of Berberis aristata DC, and rhizomes of Hemidesmus indicus R.Br., on the MCF7 breast cancer cell line, which is native to India. To assess anti-cancer efficacy, a methanolic extract of the B. aristata plant was tested on a human colon cancer cell line. Methanolic extracts of B. aristata were found to inhibit HT29 cells in a concentration-dependent manner.[29]

7. **Antioxidant:** Indian Barberry, commonly referred to as Daruharidra, is rich in phytochemicals, which give it potent antioxidant properties.Berberine, flavonoids, phenolic acids, and alkaloids are the key components that contribute to its antioxidant properties. These bioactive chemicals help to scavenge free radicals, reduce oxidative stress, and protect cells from harm.The antioxidant activity of the B. aristata plant was determined by studying its aqueous ethanolic extract. The study was carried out in diabetic rats with safety precautions. It was discovered that the root extract of the plant reduced oxidative stress.[30]

8. **Anti-platelet*:*** *Berberis aristata*, also called Indian Barberry or Daruharidra, demonstrates notable antiplatelet effects owing to its bioactive compounds, including berberine and other alkaloids. These compounds help inhibit platelet aggregation, reducing the risk of blood clot formation and related cardiovascular disorders.Various scientific studies revealed that the alcoholic extract of B. aristata plant inhibits the PAF (platelet-activating factor) induced Aggregation of platelets and 3H- PAF binding when tested in rabbit platelets . It was also reported that Berberine constituent of the plant inhibited the platelet aggregation by interfering with collagen-mediated adhesion process.[31]

9. **Cardiotonic:** The fruit extract of the B. aristata plant has favorable inotropic activity. The biochemical analysis was conducted on healthy rabbits to assess the plant's cardiovascular properties. The study found that serum cholesterol, triglycerides, and low-density lipoprotein levels decreased significantly, whereas fibrinogen and thrombin levels increased.[32]

8. Pharmacological studies of berberis aristata plant showing therapeutic properties

Berberis aristata exhibits a wide range of pharmacological properties due to its rich alkaloid content, particularly berberine. Studies have shown its potential as an antimicrobial, anti- inflammatory, and antidiabetic agent, along with antioxidant and hepatoprotective effects. These therapeutic properties highlight its importance in traditional and modern medicine for managing infections, inflammation, and metabolic disorders.

Table No. 7: Therapeutic properties of *beriberis aristata.* [22]

Sr. no.	Part Used	Therapeutic Property	Pharmacological Activity	References
1	Root Bark	Antidiabetic	Reduces blood glucose levels	[33]
2	Fruits	Antioxidant	Scavenges free radicals	[34]
3	Stem Bark	Anti-inflammatory	Reduces inflammation markers	[35]
4	Leaves	Antimicrobial	Inhibits bacterial and fungal growth	[36]
5	Root Extract	Hepatoprotective	Protects liver from damage	[37]
6	Whole Plant	Cardioprotective	Improves cardiac function	[38]
7	Root Bark	Anticancer	Inhibits tumor cell proliferation	[39]
8	Stem	Antidiarrheal	Reduces frequency of diarrhea	[40]
9	Root Bark	Antipyretic	Reduces fever	[41]
10	Fruits	Immunomodulatory	Enhances immune response	[42]

9. CONCLUSION

The plant's active ingredients, particularly berberine, have a variety of medicinal qualities, including antibacterial, anti-inflammatory, antioxidant, anti-diabetic, and hepatoprotective actions. Numerous studies have shown that B. aristata is effective in the treatment of infections, gastrointestinal disorders, skin illnesses, and metabolic abnormalities.Despite its potential applications, more thorough clinical trials are needed to determine the plant's safety, dosage parameters, and long-term effects. Furthermore, more research into the mechanisms of action and potential interactions with contemporary medications is required to fully integrate B. aristata into mainstream medicine. Berberis aristata has considerable promise for future therapeutic development and sustainable healthcare solutions, as scientific interest and traditional knowledge continue to grow. The plant is now an endangered species, necessitating additional research into agricultural and environmental conditions for its cultivation. The time provides insight into the translational potential and clues to prospective novel bioactivities and targets yet to be uncovered with this wonderful plant species. It could be a valuable resource for future drug research and development.

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