Myrica Esculenta: A Health Perks

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ABSTRACT

Our research delves into the multifaceted nature of Myrica esculenta, commonly known as the Bayberry or Box Myrtle. By conducting an extensive review of literature, including research articles, ethnobotanical surveys, and environmental studies, we have gathered valuable insights into various aspects of this botanical species. Our focus lies in understanding the taxonomy, morphology, habitat preferences, and distribution patterns of M. esculenta. Additionally, the phytochemical analysis revealed to identify bioactive compounds and explore their therapeutic applications. Furthermore, we have explored the ethnobotanical significance of M. esculenta, shedding light on its cultural roles and traditional practices within different communities. Overall, our findings emphasize the plant's pharmacological versatility, ecological importance, and cultural value, contributing to a comprehensive understanding of Myrica esculenta for future scientific and cultural endeavors.

Keywords: Myrica esculenta, Taxonomy, Morphology, Distribution, Phytoconstituents, Pharmacological properties

1. INTRODUCTION

India is home to four of the 34 global biodiversity hotspots, namely the Himalayas, the Western Ghats, the Nicobar Islands, and the Northeastern rainforests. The Himalayan region in India is particularly known for its diverse range of edible plants, with over 670 different species.These plants are valued for their health perks and nutritional worth. One such plant is Myrica esculenta Buch-Ham. Ex D. Don from the Myricaceae family, which is valued for its medicinal properties. Multiple other names for it exist as well, including "Katphal" in Sanskrit, "Kaiphal" in Urdu, "Nagatenga" in Assam, "Soh-phi" in Khasi, and "Box myrtle" in English [1]. It is a valuable medicinal tree found in Jaintia, Khasia, Shimla, Naga, Bengal, and Lushai hills at elevations of 900-2100 meters [2]. It is scattered all over the outer

Himalayas from Ravi (Punjab) eastward to Assam. Within the Myricaceae family, the Genus Myrica is a broad group that includes over 97 species [3]. It has been stated that Myrica Esculenta is the only species found in India; [4] other species are found all over the world, such as M. Rubra in China and Japan, M. Australiasica F. Muell in Australia, and M. persylvanica Mirb in North America. This plant also has other synonyms, such as Myrica sapida Wall. And Myrica farqhariana Wall [5]. *Myrica Esculenta* bark decoction is thought to help with diuresis, asthma, dysentery, fevers, lung infections, diarrhea, antioxidant [6], antibacterial [7], and chronic bronchitis. The bark is chewed to ease toothaches, and it is made into a lotion that is used on festering sores. Even the bark's extracted yellow color is being used as a medicinal coloring agent [8, 9]. Additionally, bark is used to make ropes and paper [10]. Fruit is regarded as a pectoral, stomachic, sedative, and carminative [11]. Because it is actinorhizal, it also helps soils that are low in nitrogen regenerate [12]. The plant is mostly harvested for its delicious fruits and has been shown to have nutritional and medicinal value [13]. The plant's fruits are also used for producing pickles, jams, syrups, and cool drinks [14].

Table 1: Botanical classification [15]

Kingdom: plant	**Order**: Fagales
Division: Spermatophyta	**Series**: Unisexuale
Sub-division: Angiospermeae	**Family**: Myricaceae
Class: Dicotyledonae	**Genus**: *Myrica*
Sub-class: Monochlamydeae (Incompletae or Apetalae)	**Species**: *esculenta* Buch – Ham

Table 2: Vernacular names [5, 16, 20]

Sanskrit	Aranya, Kathphala, Mahavalkala Krishnagarba	**Kannada**	Kirishivani, Kandujai kai, Kirishivane,
Assamese	Ajooree, Vdulbark, Nagatenga	**Marathi**	Kayaphala
Bengali	Kayachhal, Satsarila, Kaiphal	**Malayalam**	Maruta
English	Bayberry, Box myrtle	**Telugu**	Kainaryamu
Gujrati	Kariphal	**Hindi**	Kaiphal, Kapha
Punjabi	Kahela, Kaiphal, Kahi	**Nepali**	Katphala, Kobuli

2. MORPHOLOGICAL CHARACTERISTICS OF MYRICA ESCULENTA

Myricae Esculenta is a deciduous tree that remains green throughout the year. It is a medium-to-large tree, reaching a height of 12 to 15 meters. Interestingly, both male and female trees have a very similar appearance. The bark of the tree can vary in color, ranging from light brown to black. The leaves are densely packed at the tips of the branches and have a lanceolate, ovate shape with serrated edges. The tree bears succulent drupe fruits that come in various shapes, such as small ellipsoidal or ovoid to globose. Initially, the fruits are green but gradually turn reddish-purple as they mature. Due to their perishable nature, these fruits have a relatively short shelf life of two to three days. The flowering season of Myricae Esculenta begins in October and continues until the end of December. Following this, the fruit-setting season commences in November, and mature fruits can be harvested from April to June [17]. The inner bark of the tree is dark brown, smooth, and hard, emitting an unpleasant fragrance

and having a bitter taste. On the other hand, the outer bark appears greyish-dark in color, rough, and vertically wrinkled. The tree produces drupe fruits that range in color from red to dark brown. These fruits are ellipsoidal or oval-shaped and have a diameter ranging from 2 to 7 mm. Inside the fruits, there is an ovoid-shaped, smooth-surfaced, light brown seed that measures between 1 and 6 mm in diameter and has a greasy taste [5,13].

3. HABITAT

Myrica esculenta is a plant species that can be found in the Himalayan region of India, specifically in areas such as Jammu & Kashmir, Uttarakhand, Himachal Pradesh, Assam, Naga, Jaintia, and the Lushi Hills. It thrives at altitudes ranging from 900 to 2100 meters. Interestingly, this species is not limited to India alone, as it can also be found in other countries such as China, Japan, Myanmar, Singapore, Malaysia, and China [18].

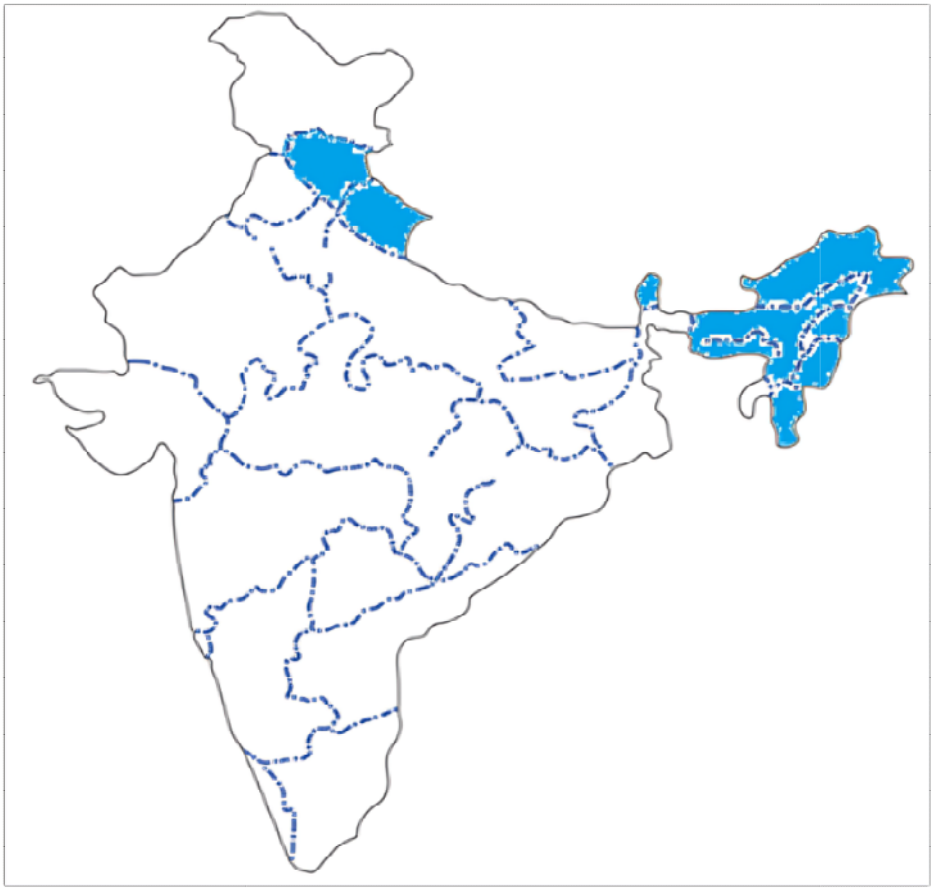

Figure 1: Distribution of Myrica esculenta in India [19]

4. MORPHOLOGICAL AND MICROSCOPICAL CHARACTERISTICS

The morphological analysis of the M. esculenta plant and its components (Figure 2A-2D) reveals that it is a compact medium-sized perennial tree that can reach heights ranging from 3 to 15 meters.The leaves of this plant are described as lanceolate and obovate, measuring approximately 9 by 3 centimeters in diameter. Additionally, the lower surface of the leaves displays a light green color, while the upper surface appears dark green.

Figure 2: Myrica esculenta A: Whole plant, B: Leaf, C: Bark, D: Fruit.

5. PHYTOCHEMISTRY

Analysis of phytochemicals conducted on the leaves, stem bark, bark, and seeds of M. esculenta unveiled numerous potent phytoconstituents including alkaloids, tannins, phenols, flavonoids, phytosterols, glycosides, and saponins as indicated in Table 3. These bioactive compounds have demonstrated a diverse range of therapeutic effects and could be utilized in the development of new drugs or natural remedies. Further research and studies on the phytochemical composition of M. esculenta could lead to the discovery of novel bioactive compounds with significant health benefits and therapeutic applications.

Table 3: Phytoconstituents of various extracts of different parts of M. esculenta

Phytoconstituent	Leaf	Stem	Bark	Seed	Root	Ref.
Alkaloid	Present	Absent	Absent	Absent	Absent	[21, 22]
Glycosides	Present	Absent	Absent	Absent	Absent	[21, 22]
Saponins	Present	Present	Present	Present	Absent	[21, 22]
Phytosterols	Present	Present	Present	Absent	Absent	[21, 22]
Phenols	Present	Present	Absent	Absent	Absent	[21, 22]
Flavanoids	Present	Present	Present	Present	Absent	[21, 22]
Tannins	Present	Absent	Absent	Present	Absent	[21, 22]

Some bioactive compounds were reported in the plant belong to the class of alkaloids, glycosides, diarylheptanoids, ionones, steroids, saponins, triterpenoids, volatile compounds **(Table 4).** The structures of some important bioactive phytoconstituents reported in M. esculenta plant is presented in **Figure 3.**

Table 4: List of major phytoconstituents from different parts of Myrica esculenta

Plant part	Reported compound	Reference
Leaves	Flavone 4'-hydroxy-3',5,5'-trimethoxy-7-O-β-D-glucopyranosy) (1→4)-α-L-rhamnopyranoside; Flavone 3',4'-dihydroxy-6-methoxy-7-O-α-L-rhamnopyranoside; Myricetin; Quercetin; Myricetin 3-O-rhamnoside; Ethyl-β-D-glucopyranoside; 3-hydroxybenzaldehyde; Isovanillin; 4-(hydroxymethyl)-phenol; β- sitosterol; 4-methoxybenzoic acid; Oleanolic acid	19, 23, 25, 26, 27, 29, 30
Bark	Myricetin-3-O-(2''-Ogalloyl)-α-L-rhamnopyranoside; Gallic acid; Epigallocatechin 3-O-gallate; 3-O-galloyl-epigallocatechin-(4β→8)-epigalloc-atechin3-O-gallate; Myricetin; Quercetin; Myricetin 3-O-rhamnoside; Oleanolic acid; β- sitosterol; Stigmasterol; Myricanone	24, 25, 26, 27, 30, 31
Fruits	Tannin, Ascorbic acid, Myricetin, Quercetin, Gallic acid, Ferulic acid	25, 28, 29

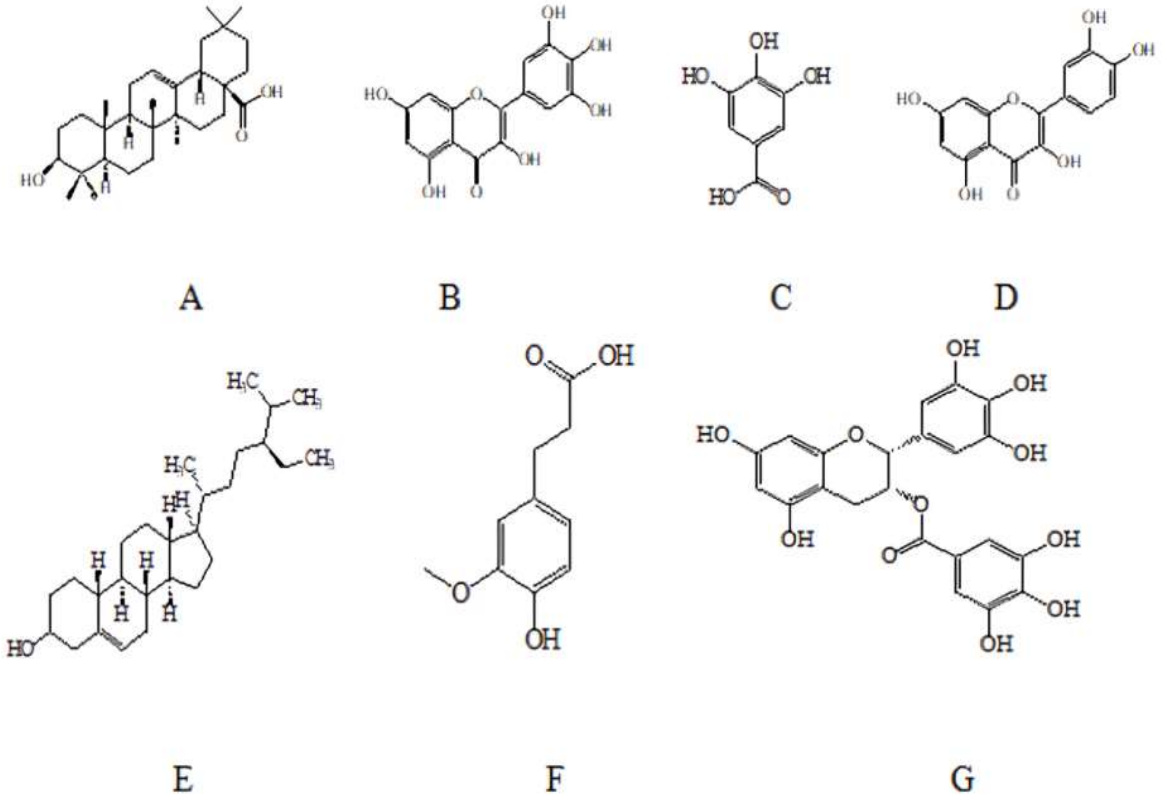

Figure 3: Structures of some important bio active molecules present in Myrica esculenta: A. Oleanolic acid; B. Myricetin; C. Gallic acid; D. Quercetin; E. β-sitosterol; F. Ferulic acid; G. Epigallocatechin 3-O-gallate

6. AYURVEDIC FORMULATION

Various Ayurvedic formulations like Chwayanprash and Brahmarasayan are created using fruits and roots to improve digestion, memory, intelligence, concentration, and physical strength. The bark of M. esculenta is a key component in the Ayurvedic formulation Visweshwara rasa, which is specifically designed to address fevers originating from kapha

and pitta imbalances. Additionally, other Ayurvedic remedies that utilize fruits or bark of M. esculenta as a significant ingredient include Katphaladi churna, Kaas-har churna, Katphala taila, Katphala kvatha, Khadiradi gutika, Maha vatagajankush rasa, Brihatphala ghrita, Pusyanuga churna, Arimedadi taila, Bala taila, and Mahavisagarbha taila. These formulations are commonly used in the treatment of various conditions such as rheumatoid arthritis, diarrhoea, dysentery, headache, menorrhagia, and other menstrual disorders, showcasing the diverse therapeutic applications of *M. esculenta* in Ayurvedic medicine.

7. ETHNOMEDICINAL USES

The plant is commonly utilized in both the Yunani and Ayurvedic medical traditions due to its various parts such as the bark, flowers, fruits, and roots. In Ayurveda, the bark is characterized as having a bitter, caustic, and pungent taste, making it a valuable component in medicinal preparations. Apart from its use in traditional medicine, this tree serves multiple purposes as it is considered a potent remedy for a wide range of health issues including anaemia, bronchitis, asthma, piles, sore throats, fever, liver problems, chronic dysentery, cough, sores, and urinary discharges. However, according to the Ayurvedic Samhita, Myrica esculenta is not recommended for individuals with spleen and liver issues. On a different note, the oil extracted from the flowers of this tree acts as a tonic and has been proven effective in the treatment of paralysis, headaches, earaches, and diarrhea [2]. This showcases the diverse range of benefits that this plant offers in the field of traditional medicine.

8. PHARMACOLOGICAL PROFILE

Myrica esculenta extracts possess a broad spectrum of pharmacological effects. Previous research has highlighted the remarkable efficacy of phenolic compounds as antioxidants, indicating that plants abundant in antioxidants hold great promise for the treatment of degenerative diseases. The antioxidant potential of *Myrica esculenta* extracts has been attributed to the presence of flavonoids and phenolic acids, as indicated by earlier investigations [32-34]. Furthermore, these extracts have demonstrated analgesic, antiasthmatic [35], anticancer [36], antidepressant [37], antidiabetic [38], antidiarrheal [39], antihypertensive [40], anti-inflammatory [40], antimicrobial [40], antipyretic [5,33], antiulcer [5,41], chemo-preventive, hepatoprotective, and wound healing [5] properties, as documented in various studies.

8.1. Antimicrobial Activity

The oil extracted from the Myrica esculenta plant has been found to possess antimicrobial and anti-inflammatory properties. It is effective against a range of microorganisms, including Saccharomyces cerevisiae, Bacillus pumilus, Candida albicans, Escherichia coli, Pseudomonas aeruginosa, Aspergillus niger, and Staphylococcus aureus. Additionally, it has demonstrated antifungal activity against Sclerotium rolfsii, Rhizoctonia solani, and Fusarium oxysporium, as reported in a study [42].

8.2. Analgesic Activity

Myrica esculenta fruits exhibited notable pain-relieving properties in a dosage-dependent fashion when extracted using methanol. On the other hand, the leaf extract demonstrated a substantial analgesic impact [5].

8.3. Antidiabetic Activity

The administration of Myrica esculenta leaf extracts in the form of methanol has shown significant effects on reducing blood glucose levels, blood cholesterol levels, and body weight in diabetic rats induced with streptozotocin. These effects were observed to be dependent on the dosage of the extracts used in the study, as higher doses resulted in greater reductions. The findings suggest that Myrica esculenta leaves may hold potential as a natural remedy for managing diabetes and associated metabolic disorders. This study provides valuable insights into the therapeutic properties of Myrica esculenta and its potential application in the treatment of diabetes [38].

8.4. Anti-Hypertensive Activity

To study the impact of phyto-constituents from Myrica esculenta leaves on hypertension management, researchers decided to inhibit the angiotensin I-converting enzyme. 2. The study revealed that Corchoionoside C and (6S,9R)-roseoside were the most effective ACE inhibitors among the compounds tested. 3. On the other hand, myricanol, 5-O-β-D-glucopyranosyl myricanol, and myricetin exhibited only minimal hypotensive effects in the experiment [25].

8.5. Antioxidant Activity

The antioxidant capacity of the methanol extract derived from the fruit of Myrica esculenta was evaluated through three separate in vitro tests that measure radical scavenging activity: the 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay, the 2,2-azinobis (3-ethylbenzothiazoline-6-sulphonic acid) assay, and the ferric reducing antioxidant power (FRAP) assay. These assays provide valuable insights into the ability of the extract to neutralize free radicals and exhibit antioxidant properties. The results obtained from these tests contribute to our understanding of the antioxidant potential of Myrica esculenta fruit extract and its potential applications in various fields [24].

8.6. Anticancer Activity

The MTT assay was employed to investigate the impact of bayberry fruit extracts on three distinct cell types: non-transformed PBMCs, transformed normal HEK293 cells, and cervical cancer cells (C33A HeLa and SiHa). The results revealed that the extracts exhibited a dose-dependent suppression of cancer cell lines, while demonstrating no cytotoxic effects on non-cancerous cells. This finding highlights the potential of bayberry fruit extracts as a promising therapeutic agent for cancer treatment [36].

8.7. Hepatoprotective Activity

The hepatoprotective effects of the Ayurvedic polyherbal formulation Herbitars, containing 50 and 100 mg/kg doses along with 5 mg/g of Myrica esculenta, were demonstrated in Wistar rats exposed to carbon tetrachloride (CCl_4)-induced hepatotoxicity.This study revealed a significant reduction in the levels of thiobarbituric acid reactive substance and hydroperoxides in the liver and kidney of rats treated with Herbitars, indicating its potential in combating oxidative stress. Moreover, the antioxidant enzyme activities of glutathione peroxidase, superoxide dismutase, catalase, and reduced glutathione were found to be increased in the liver and kidney tissues of CCl_4-induced rats treated with Herbitars, suggesting a protective mechanism against liver and kidney damage induced by CCl_4 [43].

9. TOXICOLOGICAL STUDIES

M. esculenta, a commonly consumed plant, is generally regarded as safe with limited research conducted on its toxicity. Rawat et al. conducted a study to investigate the potential toxic effects of the methanol extract derived from M. esculenta leaves. Interestingly, their findings revealed no signs of toxicity when administering the extract orally at a dose of 300 mg/kg over two weeks. However, when the dose was increased to 2000 mg/kg, toxic effects were observed in Wistar rats [44]. Furthermore, another study focused on assessing the acute toxicity of ethyl-acetate and water extracts derived from M. nagi bark. The extracts were administered intravenously at three different doses: 100, 200, and 1000 mg/kg. The results indicated that the LD50 (lethal dose for 50% of the population) of both the ethyl-acetate and water extracts in mice was 1000 mg/kg [45]. These findings shed light on the potential toxicity of M. esculenta and M. nagi extracts, emphasizing the importance of further research in this area to ensure their safe usage.

10. SUMMARY

The examination of leaves at both macroscopic and microscopic levels revealed several characteristics. The leaves were lanceolate in shape, thin, and arranged in a spiral pattern. They had a dark green color and astringent taste. The apex of the leaves was acute, and the epidermis had a cuticularized surface with polygonal cells. On each surface of the leaves, there were single-layered palisade mesophyll cells. The spongy parenchyma, which consisted of 2-3 layers, was also observed. The leaves had unicellular and uniseriate hollow trichomes, and the stomata were of the anomocytic type. In the mid-rib portion, a bowl-shaped vascular bundle was present. Additionally, the leaves contained alkaloids, carbohydrates, flavonoids, glycosides, phenolic compounds, and tannins. M. esculenta, a plant species with therapeutic and nutritional potential, has been used in ancient Ayurveda and Unani systems of medicine. The plant contains various phytoconstituents that contribute to its medicinal value. However, further research is needed to identify the active therapeutic compound and understand its specific mode of action. M. esculenta has shown promising pharmacological effects in the treatment of asthma, diabetes, cancer, ulcers, and anxiety. Given its rich content of vitamin C and polyphenolic compounds, exploring its potential for immunomodulatory, cardioprotective, nephroprotective, and neuroprotective activities is crucial.

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