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Brownlowia tersa (Linn.) Kosterm: A review of traditional uses, phytochemistry and pharmacology

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Abstract
The approximately 30 species of the genus Brownlowia Roxb. are distributed worldwide. *Brownlowia tersa* is comprised of the family Tiliaceae. Locally, it is called by "Sundari lata" in Bangladesh. It is known from mangrove communities and is classified as true mangrove species. It is found along the eastern coast of India and the Andaman and Nicobar Islands, Bangladesh, Myanmar, Thailand, Malaysia, Indonesia, Singapore, Philippines, and Brunei. Based on the traditional knowledge, different phytochemical and pharmacological activities have been at the focus of research. This review aims to provide an overview of the current state of knowledge of local and traditional medical uses, phytochemical constituents, pharmacological activities, toxicity, and safety of *Brownlowia tersa*, in order to identify the therapeutic potential of *Brownlowia tersa*. Different chemical tests showed the presence of reducing sugars, saponins, tannins, glycosides, flavonoids, carbohydrates, and alkaloids. Traditionally, it is commonly used in the treatment of diarrhea, dysentery, wounds and boils. It serves as an antiinflammatory, antinociceptive and antioxidant activities. Pharmacological research on this plant is quite elementary and limited, thus, more advanced research is necessary to isolate and determine the activities of bioactive compounds *in vitro* and *in vivo*, establish their mechanisms of action, safety, efficacy and commence the process of clinical research.

Keywords: *Brownlowia tersa*, mangrove, traditional uses, antibacterial, antioxidant

Introduction
With growing interest in herbal drug development with minimum side effects, there are better opportunities to explore the medicinal and other biological properties of previously inaccessible natural products. To establish its usefulness, it is mandatory to focus on visualization and identification of unused herbal plants over the world. Then, it is emphasized on extraction, its isolation, and characterization of phytochemicals, which is a gift of nature in a rational and scientific way. There is an unmet need for utilization of the natural products for the benefit of human kind and development of new lead for drug discovery. Once the phytochemical is obtained, this can be used for further exploration through quantitative structure activity relationship (QSAR) studies, molecular modeling, and animal studies followed by clinical trial. The success of natural products in drug discovery essentially for pharmaceutical companies and research institutes is essentially related to their ability and benefits to common person that is socio-economic benefits for well-being of common person its health is important for the world rather than all coming come to your hands if health is top priority. Natural products contain complex chemical structures, which differ according to their various species in nature, and when the existing high technology methods that are available are applied, it can lead to new discovery of drugs, benefitting the whole world (Koparde *et al*., 2019) [1].

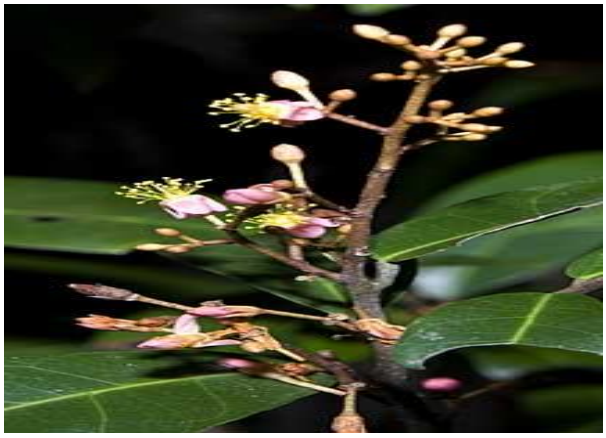
The genus Brownlowia Roxb. Has about 30 species in the world. Two species, *Brownlowia tersa* and *Brownlowia argentata*, are known from mangrove communities and are classified as true mangrove species (Duke 1992; Polidoro *et al*., 2010) [2, 3]. *Brownlowia tersa* is comprised of the family Tiliaceae. Locally, it is known by "Sundari lata" in Bangladesh (Hettiarachchi *et al*., 2009) [4]. *Brownlowia tersa* was first reported from the Andaman and Nicobar Islands (ANI) from Dhani Khari Creek, Middle Andaman, by Parkinson as *B. Lanceolata* (Parkinson, 1923) [5]. It is shrub, usually 1.5-2 m (rarely 5 m) tall. The smaller branches are covered with a dense layer of minute, flattened scales. Branches are grey, smooth and marked with lines and grooves along their length. The narrow, lanceolate to elliptic-lanceolate leaves are rigid and

thin or leathery, 2-5 by 6-20 cm, with a rounded base and a pointed tip. The upper surface is glossy and smooth, while the lower surface is grey-green and covered with a dense layer of tiny, hairy scales. The leaf stalk is 1-2 cm long. The flower heads occur in axils or at the ends of branches, few-flowered, and are up to 4 cm long. The calyx is bell-shaped and 5 mm long, with 3-5 lobes. The corolla is pink with a yellow base, slightly longer than the calyx (about 6 mm), with 5 petals. Fruit is a woody capsule or nut, 15 mm long, bilobed or heart-shaped (alternatively: shaped like a golf putting-club), and is pale greyish-green, covered with small, brown warts. It is often confused with Camptostemon because both have a scaly leaf. It can be distinguished by the shape of its fruit and the flowers, which occur in clusters (Giesen *et al*., 2007) [6].

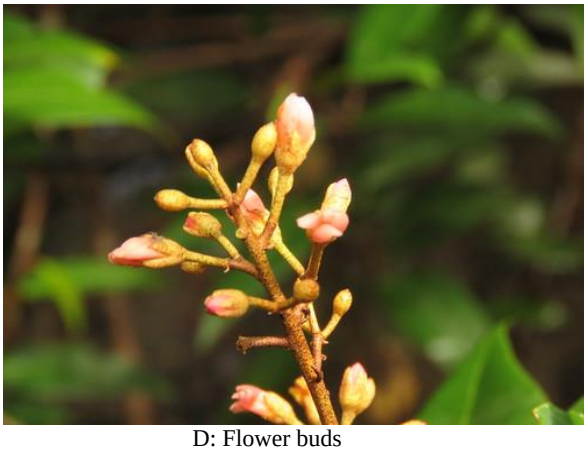
However, there is no recent review paper of the medicinal potential of *Brownlowia tersa* (Linn.). Therefore, the aim of this review study is to provide a comprehensive summary of the ethnobotany, phytochemistry and pharmacology of *Brownlowia tersa* (Linn.) and to highlight the gaps in our knowledge for future research opportunities.

A: Habitat

B: Silvery grey underside of the leaf



C: Flowers



D: Flower buds

E: Mature fruits.

Fig 1: *Brownlowia tersa* (Linn.). A: Habitat. B: Silvery grey underside of the leaf. C: Flowers D: Flower buds. E: Mature fruits.

Ethnobotany
Taxonomy
Kingdom: Plantae
Phylum: Tracheophyta
Class: Magnoliopsida
Order: Malvales
Family: Tiliaceae
Genus: Brownlowia
Species: tersa (Linn.) Kosterm.
Taxon Name: *Brownlowia tersa* (Linn.) Kosterm

Synonyms: Brownlowia beccarii (Mast.) Pierre, Brownlowia lanceolata Benth., Dialycarpa beccarii Mast., Glabraria tersa Linné, Heritiera attenuata, Heritiera lanceolata, Litsea tersa, Malapoenna tersa, Niota polyandra, Tetranthera tersa, Vittmannia Polyandra.

Vernacular Names: Dungun (Malaysia), Dungun air (Indonesia, Singapore), Maragomon (Philippines), Nam nong (Thailand) (Giesen *et al*., 2007) [6].

Geographic Range

Distribution: *Brownlowia tersa* (Linn.) Kosterm is found along the eastern coast of India and the Andaman and Nicobar Islands, Bangladesh, Myanmar, Thailand, Malaysia, Indonesia (Molluccas, Irian Jaya, Kalimantan, Natuna Island), Singapore, Philippines, and Brunei.

Country occurrence

Native: Bangladesh, Brunei Darussalam, Cambodia, India, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand.

FAO marine fishing areas

Native: Indian Ocean-eastern, Pacific-northwest, Pacific-western central.

Population: *Brownlowia tersa* (Linn.) Kosterm is common in many parts of its range, but is considered very rare in the far western portion of its range. In India for example, there are only approximately 2,500 mature individuals which are restricted to the eastern coast of India and the Andaman Islands.

Current population trend: Decreasing.

Ecology: Occurs in relatively sunny locations in mangrove swamps, and along creeks where mud is accreting. It is also found along tidal creeks, canals, and shallow channels. Often found on sandy shores or firm mud, along with Nypa. It is fast growing and found in pure stands (Kathiresan *et al*., 2010) [7].

Traditional uses

Brownlowia tersa (Linn.) has long been used as a traditional folk remedy for diarrhea, dysentery, wounds and boils (Atanu *et al*., 2012) [8]. This plant is sometimes used for fencing or fuel wood (Hettiarachchi *et al*., 2009) [4].

Chemical Constituents

Different chemical tests on the ethanolic extract of *Brownlowia tersa* leaves showed the presence of reducing sugars, saponins, glycosides, flavonoids and tannins (Hossain *et al*., 2013) [9]. Another phytochemical analysis showed positive results for carbohydrates, alkaloids (Atanu *et al*., 2012) [8]. The volatile phenolic compound 2′- hydroxy Acetophenone and the lignan carinol both have been isolated for the first time from *Brownlowia tersa* (Hettiarachchi *et al*., 2009) [4]. (4-nitrophenyl) propandiamide and (4-methylphenyl) propandiamide have also been reported from the aerial parts of *Brownlowia tersa* (Shehata *et al*., 2003) [10].

Pharmacological Activities

The present study was to investigate the in-vitro antibacterial activity and antidiarrheal and analgesic activity of ethanol extract of *Brownlowia tersa* leaf by using Swiss-Albino mice (Atanu *et al*., 2012) [8]. The ethanol extract of *Brownlowia tersa* leaf was investigated for antinociceptive and antidiarrhoeal activity (Sariful *et al*., 2012) [11]. Another study was designed to investigate the antiinflammatory and antioxidant activities of ethanolic leaf extract of *Brownlowia tersa* (Linn.) Kosterm (Hossain *et al*., 2013) [9]. The antimicrobial activity of the extract was investigated, using disc diffusion method which showed antimicrobial activity against some gm (+) and gm (-) bacteria (Alam, 2011) [12]. *Brownlowia tersa* roots have been found to possess significant antibacterial activity (Hettiarachchi *et al*., 2009) [4].

Cytotoxicity and Toxicity

Brownlowia tersa extract was assessed using brine shrimp lethality as an indicator of toxicity and showed significant level of toxicity (LC50=10µg/ml and LC90=86µg/ml) (Alam, 2011) [12].

In acute toxicity study, oral administration of graded doses (200, 400, 800, 1,600 and 3,200 mg/kg, p.o.) of the ethanol extract of *Brownlowia tersa* to rats did not produce any significant changes in behaviour, breathing, cutaneous effects, sensory nervous system responses or gastrointestinal effects during the observation period. No mortality or any toxic reaction was recorded in any group after 72 h of administering the extract to the animals. *Brownlowia tersa* leaf extract was safe up to a dose level of 3,200 mg/kg of body weight in rats (Hossain *et al*., 2013) [9].

Threats

Brownlowia tersa is categorized as Near Threatened by the IUCN. This species is threatened by habitat loss from coastal development, erosion, and the construction of shrimp and fish ponds throughout its range (Kathiresan *et al*., 2010) [7]. All mangrove ecosystems occur within mean sea level and high tidal elevations. Distinct species zonations that are controlled by the elevation of the substrate relative to mean sea level. This is because of associated variation in frequency of elevation, salinity and wave action (Duke *et al*., 1998) [13]. The habitat requirements of each species will be disrupted with rise in sea-level. All species zones will suffer mortality at their present locations. Re-establish at higher elevations in areas that were previously landward zones (Ellison, 2005) [14]. If sea-level rise is a continued trend over this century, then there will be continued mortality and re-establishment of species zones.

In addition, mangrove area is declining globally due to a number of localized threats. The main threat is habitat destruction and removal of mangrove areas. Reasons for removal include cleared for shrimp farms, agriculture, fish ponds, rice production and salt pans, and for the development of urban and industrial areas, road construction, coconut plantations, ports, airports, and tourist resorts. Other threats include pollution from sewage effluents, solid wastes, siltation, oil, agricultural and urban runoff. Climate change is also thought to be a threat, particularly at the edges of a species range. Natural threats include cyclones, hurricane and tsunamis (Kathiresan *et al*., 2010) [7].

Future Perspectives

Populations of *Brownlowia tersa* are experiencing severe loss at the range margins due to human activities and coastal development. This is an endangered species in the world (Gopal and Chauhan, 2006) [15]. There are no conservation measures specific to this species, but its range may include some marine and coastal protected areas. Continued monitoring and research is recommended, as well as the

inclusion of mangrove areas in marine and coastal protected areas.so immediate and effective conservation measures should be taken for their protection and propagation (Ragavan *et al*., 2016) [16].

Conclusions

The present study is the first to provide a review on the traditional uses, phytochemistry and pharmacology of *Brownlowia tersa*. There is still considerable scope for research field to explore and document these practices. This study was described for the first time in ethnobotanical literature as treatment of diarrhea, dysentery, wounds and related conditions. Therapeutic claims made by this plant is well supported by ethnobotanical literature and therefore, to some extent, corroborate the reliability of ethnobotanical information documented in this study.

Conflict of interest statement

We declare that we have no conflict of interest.

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