ISSN 0975-6299 Vol 2/Issue 1/ Jan-Mar 2011

International Journal of Pharma and Bio Sciences

RESEARCH ARTICLE

MEDICINAL CHEMISTRY

PHYTOCHEMICAL AND PHARMACOGNOSTIC STUDIES ON THE BARK AND LEAVES OF *BARRINGTONIA ACUTANGULA* GAERTN.

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ABSTRACT

Barringtonia acutangula Gaertn., (Samudraphal,Indian Oak), an important medicinal plant of India is studied for its phytochemical and pharmacognostic biomarkers in both leaves and bark. The leaves contained flavonols like 3', 4'-diOMe quercetin, gossypetin and 3'-OMe gossypetin and quinones while the bark possessed only 8-oxygenated flavonols, gossypetin and 3'-methyl ether and quinones. Gossypetin and its derivatives are the distinct biomarkers here. The pharmacognostic markers of bark are two types of rectangular cork cells, rows of square cells containing red deposits and very narrow gelatinous fibres while those of leaves are single layered palisade wherein each cell containing 3-4 chloroplasts, sclereids, absence of indumentum and flask shaped vascular bundle.

ISSN 0975-6299 Vol 2/Issue 1/ Jan-Mar 2011

KEY WORDS

Barringtonia acutangula Gaertn., phytochemical and pharmacognostic biomarkers, gossypetin, quinones. gelatinous fibres.

INTRODUCTION

Barringtonia acutangula Gaertn., popularly known as *Samudraphal* (Indian Oak in English) in an important medicinal plant of India . It is an evergreen tree of 9-12 m in height common in the sub-Himalayan tracts from the Ganges eastwards to Assam, and in Madhya Pradesh, extending into peninsular India. All the parts are used in medicine. An aqueous extract of the bark is found hypoglycemic and is reported to be used in pneumonia, diarrhoea and asthma in Papua New Guinea, and in malaria and contraceptive in Indo-China[1]. Root is bitter and is cooling. Leaf juice is given in diarrhoea. Fruit is bitter, acrid, anthelmintic, emetic, expectorant and vulnerary. It is prescribed in gingivitis, as an astringent and tonic.

The few reports on the chemistry of the various parts of this tree are on the triterpenoids and tannins. Leaves were reported to possess steroidal compounds such as barringtogenic acid, tangulic and acutangulic acids while the fruits yielded saponins based on barringtogenol B, C and D[1]. Bark contained tannin (16%) and heartwood contained barringtogenic acid, barringtogenol E and a new triterpene diacid, barrinic acid. There is absolutely no record of any water soluble bioactive compound from this plant and no data are available on the pharmacognosy either.

Looking to the extensive lacunae existing on the active principles and biomarkers (both phytochemical and pharmacognostic) in this plant, in the present work, the leaves, bark and stem of *B. acutangula* have been subjected to a phytochemical screening for their flavonoids, phenolics and alkaloids as well as a detailed pharmacognostic analysis.

MATERIALS AND METHODS

B. acutangula was collected from Botanical Gardens, Baroda. The voucher specimen of the plant has been deposited in the Herbarium, Department of Botany, The Maharaja Sayajirao University of Baroda (BARO), Vadodara. Standard methods[2,3,4], were followed for the extraction, isolation and identification of the phytochemicals. Pharmacognosy has been done by standard methods[5].

RESULTS

***a) Phytochemistry*: -** *Barringtonia* leaf is found to contain steroids, flavonols and phenolic acids. Alkaloids were absent. The steroids located were barringtogenic, tangulic and acutangulic acids as reported earlier. The flavonols located are 3', 4'-diOMe quercetin, and 8-methoxy flavonols like gossypetin and 3'-OMe gossypetin. Vanillic, syringic, gallic, melilotic and *p*-coumaric acids were the phenolic acids present. The bark possessed only 8-oxygenated flavonols, gossypetin and 3'-methyl ether and only two phenolic acids *i.e*. vanillic and syringic acids. The bark contained gossypetin and myricetin alongwith vanillic and syringic acids. Quinones were found in all the three parts of the plant.

Glycoflavones also were absent in all the parts.

b) Pharmacognosy of bark and leaf:

Bark in transverse section (**T.S**.) showed the following characteristics (**Fig. 1**). There was a prominent cork region. The cork cells were of two types- outer region of thick walled (24-31 x 10-17µm, lumen: 8-15µm) and inner thin walled cells (24-31 x 10-17µm), both rectangular in shape. In between the thin walled cork cells were tangential rows of rectangular sclereids (10-31 x 10-17µm). Bast was composed of square, oval or spherical shaped parenchyma cells (24-58 x 14-51µm) and tangential patches of gelatinous fibres (10-17 x 13-34µm, lumen: 10-32µm). These fibres were of very small diameter. Some of the parenchyma cells contained tannin or sphaeraphides (10-41µm). Those cells with tannin were thick walled.

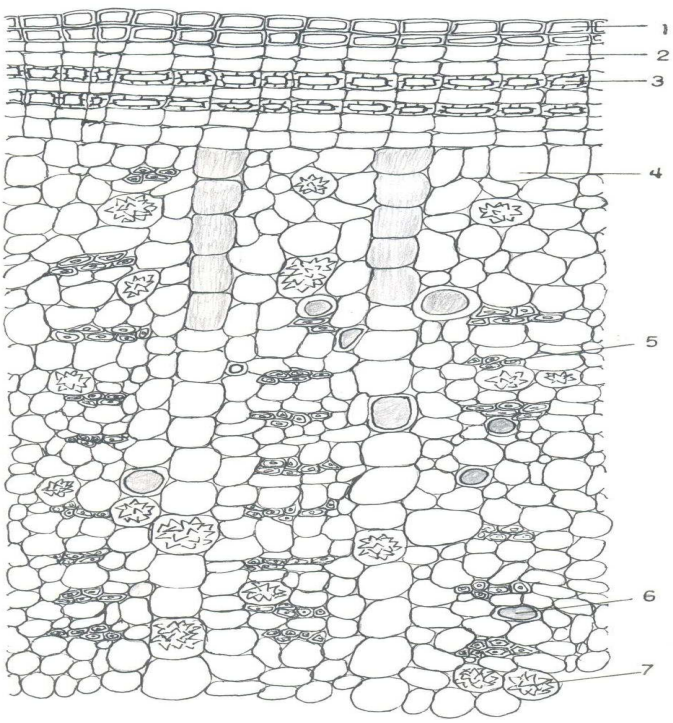

Fig. 1

Barringtonia acutangula Bark, T. S.: 1. Thick walled cork, 2. Thin walled cork, 3. Sclereid, 4. Parenchyma, 5. Gelatinous Fibres, 6. Thick walled tannin cells, 7. Sphaeraphides

Powder study of Bark (Fig.2)

The distinguishing cellular components of the powdered bark include both the types of **c**ork cells - thick walled (17-31 x 17-38µm, lumen: 15-35µm) as well as thin walled (17-31 x 17-38µm), sclereids (20-37 x 17-31µm), sphaeraphides, parenchyma containing sphaeraphides, gelatinous fibres (1088-1292 x 10-17µm, lumen: 7µm), thick walled tannin cells as well as parenchyma cells containing thick walled tannin cells (24-58 x 14-51µm, lumen: 10-40µm)

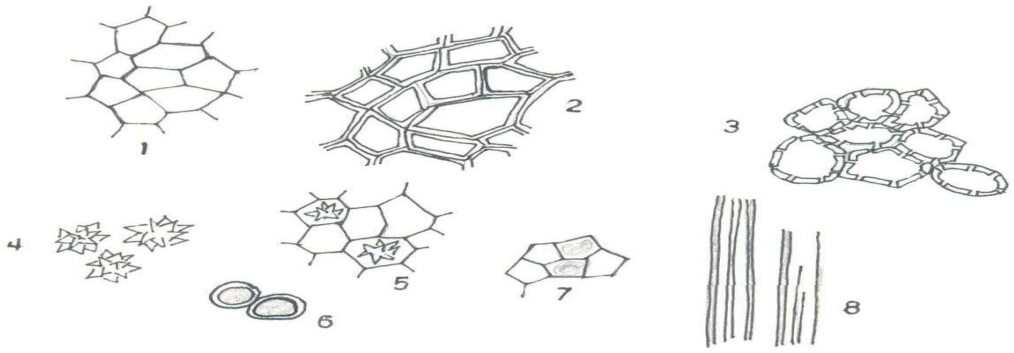

Fig. 2

Barringtonia acutangula Bark, Powder study.: 1. Thin walled cork, 2. Thick walled cork, 3. Sclereid, 4. Sphaeraphide, 5. Parenchyma containing sphaeraphide, 6. Thick walled tannin cells, 7. Parenchyma containing thick walled tannin cells, 8. Gelatinous Fibres

Leaf micromorphology

Stomata were anomocytic found only on lower epidermis. Stomatal index was 16-19. Trichomes were absent.

Leaf - T.S. (Fig.3)

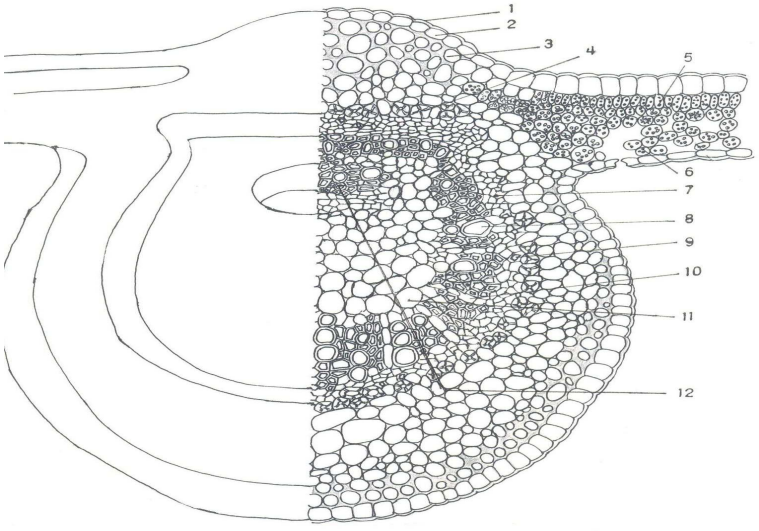

Fig. 3

Barringtonia acutangula Leaf, T. S.: 1. Cuticle, 2. Epidermal cell, 3. Lacunar collenchyma, 4. Stone cells, 5. Palisade tissue, 7. Phloem, 8. Xylem, 9. Phloem containing crystal, 10. Xylem rays, 11. Parenchyma, 12. Small vascular bundle

Leaf was dorsiventral with a ridged midrib. In the **midrib** region, cells of upper epidermal cells (17-24 x 17-20µm) were rectangular in shape covered by a thin cuticle. Hypodermis consisted of nine to ten layers of lacunar collenchyma (20-34 x 17-20µm). Next to the hypodermis was the ground tissue of five to six layered parenchyma cells (27-58µm). Vascular bundle was flask shaped with a swollen base and a neck. Endodermis was not clearly seen. Pericycle consisted of one to two layers of stone cells (14-20 x 13-17µm) mingled with parenchyma cells of isodiametric shape. Outer phloem between stone cells and xylem were of seven to eight layers which contained many rhomboidal crystals (13-17µm). Xylem tracheids (32-37µm) were of spherical shape and in radial rows separated by uniseriate xylem rays (14-17 x 14-20µm). Xylem tissues were more on the lower side of the bundle. There was a small vascular bundle in the region of the neck. This vascular bundle consisted of xylem on the upper side and phloem towards the inner side. At the centre of the main vascular bundle was ground tissue of large isodiametric parenchyma (34-60µm). The ground tissue below the pericycle was of seven to eight layers of large spherical parenchyma cells surrounded by four to five layers of lacunar collenchyma. Lower epidermal cells were barrel shaped covered by a thin cuticle.

In the **lamina** portion, upper epidermal cells were larger and barrel shaped covered by a thin cuticle. Mesophyll was differentiated into single layered palisade (24-31 x 10-14µm) of small size and 13-14 layers of spongy cells (21-27 x 17-27µm) with large intercellular spaces. Each palisade cell contained three to four chloroplasts and the spongy cells contained four to six chloroplasts. Sphaeraphides were observed in spongy cells. Cells of lower epidermis were of rectangular shape with sunken stomata.

***Powder study** (**Fig.4**)*

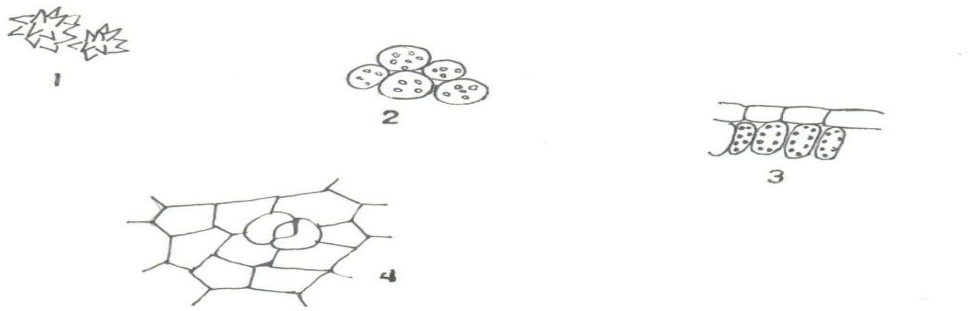

Fig. 4

***Barringtonia acutangula* Leaf, Powder study.: 1. Cuticle, 2. Epidermal cell, 3. Lacunar collenchyma, 4. Stone cells, 5. Palisade tissue, 7. Phloem, 8. Xylem, 9. Phloem containing crystal, 10. Xylem rays, 11. Parenchyma, 12. Small vascular bundle**

Leaf powder was characterized by sphaeraphides, spongy cells (21-27 x 17-27µm), palisade cells (24-31 x 10-14µm) and anomocytic stomata.

DISCUSSION

The present study unearths a number of phytochemical as well as pharmacognostic features of the bark and leaves of *Barringtonia acutangula*, an important medicinal tree of India. Only a few steroidal constituents were known from the various parts of this plant which were insufficient to explain the pharmacological properties of the plant. The identification of a good number of water-soluble compounds like flavonoids and phenolic acids with proven medicinal properties, helps in filling the vacuum existed earlier. All the flavonoids are excellent anti-oxidants, strengthen the capillary walls and reduce the agglutination of RBC as well as anti-inflammatory in nature. Myricetin and gossypetin, are two hexahydroxylated flavonoids, capable of modifying low density lipoprotein (LDL) to increase greatly its uptake by macrophages[6]. Quercetin is a well known flavonol exhibiting cardiovascular protection, anticancer and anti-ulcer effects, anti-allergic activity and cataract prevention as well as antiviral and anti-inflammatory effects. It is antiarthritic, antiasthmatic, antibacterial, anticataract, antidiabetic, antiherpetic, antiviral, hepatoprotective and antimalarial in nature. It is known to act against tumours in the bladder, colon, lung, ovary and skin[7]. Similarly the phenolic acids also are efficient anti-oxidants. Vanillic acid**,** one of the most commonly found phenolic acids in plants, is known to be anthelmintic, anti-fatigue, anti-inflammatory, antileukemic, antiseptic and anti-sickling. Syringic acid is known to be allelopathic, antioxidant, anti-peroxidant and anti-radicular[8]. Thus the presence of these compounds in *Barringtonia* explains some of the medicinal properties of this plant. The present study provides useful chemical and pharmacognostic biomarkers much needed in the quality control procedures of this drug. The various **Phytochemical biomarkers** of different parts of *Barringtonia acutangula* are the following.

a) Leaves = Gossypetin and 3',4' diOMe quercetin
b) Bark = Gossypetin and Myricetin
c) Stem = Gossypetin as the sole flavonol.

Similarly the **pharmacognostic markers** of different parts of *Barringtonia* are listed below.

a) Bark: Two types of rectangular cork cells, Rows of square cells containing red deposits. Very narrow gelatinous fibres and thick walled tannin cells.
b) Leaves: Palisade single layered each cell with 3-4 chloroplasts, Sclereids, absence of indumentum and flask shaped vascular bundle

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