WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 6.805
Volume 5, Issue 7, 403-412. Review Article ISSN 2277– 7105

ACANTHACEAE: TAXONOMY AND USES IN TRADITIONAL MEDICINAL SYSTEM

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Article Received on
30 April 2016,

Revised on 20 May 2016,
Accepted on 11 June 2016

DOI: 10.20959/wjpr20167-6522

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ABSTRACT

Acanthaceae family is derived from the Scrophulariaceae or stocks ancestral to them. Hutchinson considered it as the most advanced family of his Personales. The family includes large number of ornamentals and has high therapeutic applications mainly due to alkaloids present in the leaves. Taxonomic Considerations (Phylogeny): Acanthaceae is divided into two subfamilies depending upon the presence or absence of jaculators, i.e. the curved retinacula which support the seeds. *Justicia adhatoda* (L.) Nees (family Acanthaceae) is a shrub widespread throughout the tropical regions of Southeast Asia. This plant has great medicinal value.

KEYWORDS: Acanthaceae, Scrophulariaceae, Justicia adathoda, Traditional medicines. Antimicrobial activity.

1. INTRODUCTION

Traditional medicinal practices such as Chinese Traditional Medicine, Ayurveda, national and regional Pharmacopeias are all dependent significantly on medicinal plants as the raw base for the preparation of the medicines (Patwardhan *et al*., 2005). Among the medicinal plants out of 30,000 species estimated to be used by the indigenous and ethnic societies of world, around 10,000 have been used in traditional systems of medicine of respective countries such as in Ayurveda, Siddha, Unani and Homeopathy medicines in India (Sharma *et al*., 2015).

2. Taxonomy

Lamiales an order of ~ 23,000 species includes Acanthaceae family which has around 4000 species in some 230 genera. Fossils of Acanthaceae are substantially older than the lower

Cretaceous estimate for Angiosperms (Tripp and McDade, 2014). Sharma et al. (2015) reviewed some of the medicinal plants of order Lamiales.

2.1 Systematic position Acanthaceae and Scrophulariaceae

Most taxonomists presume Acanthaceae to have been derived from Scrophulariaceae or stocks ancestral to them (Lawrence, 1951).The family includes large number of ornamentals and has high therapeutic applications mainly due to alkaloids present in the leaves. Taxonomic Considerations (Phylogeny): Acanthaceae is divided into two subfamilies depending upon the presence or absence of jaculators, i.e. the curved retinacula which support the seeds.

Subfamily **Thunbergioideae**-seeds without jaculators.
Subfamily **Acanthioideae -** seeds with jaculators.

Most taxonomists presume Acanthaceae to have been derived from Scrophulariaceae or stocks ancestral to them (Lawrence, 1951).

Hutchinson (1969 and 1973) considers it to be the most advanced taxon of the Personales. Bessey (1915) treated it as the most advanced amongst the members of Scrophulariales. Cronquist (1968 and 1981) also includes this family in the same order as Bessey.

2.2 Classification

Angiospermae.
Dicotyledonae.
Gamopetalae.
Bicarpellatae.
Personales.
Acanthaceae.

2.2 Family Acanthaceae

Family Acanthaceae is a large family comprising, according to 4300 species in 346 genera. Acanthaceae is a large cosmopolitan family distributed mostly in thetropical and subtropical areas of the world. They are found in the equinoctial regions of both the Old and New World, with a few species extending north into the south of Europe, Pennsylvania and Japan and Southwards to the Cape of Good Hope and the southern coast of New Holland. The plants

of Acanthaceae are centered on IndoMalaysia, Asia, Africa, Brazil and Central America In New Zealand region members of Acanthaceae are entirely absent (Royle, 1970).

They are common in plains and also at considerable elevations in the mountains of central, south, north, east, and west India. They are found in moist and shady habitats in waste lands in the forest, among the grassy localities. Many of the genera of this family are peculiar to India, especially its southern parts, the Malayan Peninsula and Indian Archipelago. It also extends from forests of Silhet a few extend to Nepal and hence, as far north as the banks of the Sutlej. Some penetrate from the longitudinal into the transverse valleys of the Himalaya, even in most northern parts. Only some genera of this family ascend the mountains, at as great an elevations as between 7000 and 8000 feet, in 30° N. latitude. In Rajasthan this family is represented by 30 genera and 81 species (Shetty and Singh, 1993). Members of the Acanthaceae are distributed throughout Rajasthan, in arid, semi-arid, rocky region as well as buried and marshy places. All the genera of the family are shrub, undershrub and annual or perennial herbs, including only one perennial climbing herb Thunbergia laevis Nees (Sharma, 2004).

The leaves are usually in opposite decussate parts, exstipulate, simple, entire or sometime pinnately lobed. The occurrence of cystoliths which appear as protuberances or streaks when the leaf is held against light is characteristic feature of most of the taxa. However they may be lacking in some of the taxa.

The inflorescence is built upon a basically cymose plan. In the floral region, the bracts are arranged in opposite-decussate pairs. The internodes are comparatively much shorter. The bracts are usually green but may become petaloid. In the axil of each bract, there is either a single flower or a cyme of three. Flowers are bracteate, pedicellate or subsessile, the presence of two or more bracteoles is a very characteristic feature of this family. The flowers are complete, characteristically medianly zygomorphic either due to suppression of one or three posterior stamens or due to the bilabiate corolla or both. Androecium consists of four didynamous stamens or only two stamens. In such cases, it is the posterior one or three stamens which are either completely suppressed or reduced to staminodes.

Fruit is a loculicidal capsule which splits almost up to the base. In the subfamily Acanthoideae, the funicle forms a hook like projection, known as the jaculator or retinaculum which presses the seed like a leaf-spring. As the fruit dehisces, the seed break from

thefuniculus and is thrown to a considerable distance by the hook-like jaculator.Pollination is by insects cross pollination is favoured by protandry.

2.3 Genus Justicia L

The genus Justicia L. belongs to Acanthaceae subtribe Justiciinae (Scotland&Vollesen, 2000), with seven and nine sections in the Old and the NewWorlds, respectively (Graham, 1988). The genus is recognized by having simple spicate or compound inflorescences, rarely in solitary or sessile clusters, subtended by bracts and bracteoles, a tubular and bilabiate corolla, a fold or rugula along the centre of the upper lip and anthers with two completely superposed thecae (Rueangsawang *et al.* 2013).

2.4: *Justicia adhatoda* (L.) Nees. (Synonym: *Adhatoda vasica* Nees. and Adhatoda zeylanica Nees.) *Adhatoda vasica* Nees synonym: *Justicia adhatoda* of the Acanthaceae family is a well-known plant drug in Ayurvedic and Unani medicine . The plant has been used in the indigenous system of medicine in India for more than 2000 years. *Justicia adhatoda* (L.) Nees (family Acanthaceae) is a shrub widespread throughout the tropical regions of Southeast Asia (Chakrabarty and Brantner, 2001). The name J. adhatoda (L.) Nees and *Adhatoda zeylanica* Nees are used synonymously. It is commonly known as Vasaka or Malabar nut. *Adhatoda vasica* Nees is a synonym of Justicia adhathoda L. according to plant list given out by Kew latest version 1.1 in 2013. *Justicia adhatoda* is valid name of *Adhatoda vasica* Nees. They are bitter-tasting. Some other Justicia acuminate (Nees) Lindau; Justicia acutangula H.S. LO and D. Fangl; Justicia acutifolia Herden; Justica adhaerens Wassh and J.R.I Wood Justicia gendarussa Burm F., are other common species found in different parts of the world.

2.4.1. Occurrence and Distribution

It commonly grows in waste lands and distributed throughout India upto an altitude of 1300m. Besides India, it is found in Myanmar, Sri Lanka, Burma and Malaysia.

2.4.2. Classical names

Vasa, Vasaka, Simhasya, Shimhaparna, Tamra, Vaiska, Vajidanta, Atarusha, Atarushka, Shimhika, Vrisha.

2.4.3. Vernacular names

It is commonly known as Malabar nut tree and local names in some areas are Ya-Zui-Hua in China, Vasaka (Sanskrit), Arusa (Hindi), Bakas (Bengali), Nongmangkha-agouba(Manipuri), Adulso (Gujarati),Adasaramu (Telugu), Adhatodai (Tamil), Adusoge (Kannada) and Adalodakam (Malayalam) in India.

2.4.4 Botanical description

Perennial, evergreen, profusely branched shrub, 1.2-2.5m high with unpleasant smell. (Fig. 1A and 1 B).

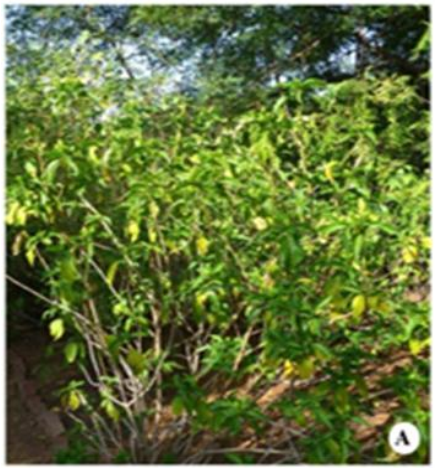

Fig 1 A Habit of *Justicia adhatoda*

Fig 1 B Flowering in J. adhatoda

Leaves are cauline, opposite, decussate, petiolate, lanceolate or ovate-lanceolate, entire, leathery with acute apex. The leaves are retained throughout the season.

Flowers are white with red or yellow barred throats, in spikes with large bracts (Fig 2 and 3).

Fig: 2. Inflorescence J. adhatoda

Fig: 3. Flower J.adhatoda

Fruits are Capsule, clavate, longitudinally channeled, and around 1.9-2.2 cm long. Seeds are globular, endospermic and provided with jaculator (Fig.4 and 5).

Fig: 4. Fruits of J. adhatoda

Fig 5. Seeds with jaculator mechanism.

2.4.5. Cytology

Basic chromosome number is 2n = 34 (Daniel, 2000; Daniel and Balkwill, 2000 and Sharma et al., 2010).

2.4.6: Traditional medicines

A large number of Adusa based traditional medicines are sold in market (Fig 6)

3. Chemical composition

Calderón *et al* (2013) studied chemical composition of three species of Justicia e.g. *Justicia secunda*, *Justicia refractifolia* and *Justicia graciliflora*. Olean-12-en-3β-24 diol, auranamide, aurantiamide acetate, 2α,3β-dihydroxy-olean-12-en-28-oic acid and quindoline were isolated from the dichloromethane (CH_2Cl_2) extract of the stems of *Justicia secunda* (Acanthaceae), Justicia refractifolia and Justicia graciliflora.

4. Economic importance

The family includes large number of ornamentals and has high therapeutic applications mainly due to alkaloids present in the leaves.

4.1 Parts used

Root, leaf, flower and fruits are used for therapeutic use.

5. Antimicrobial activity

Acanthaceae have also been reported for their use as antiinfective phytomedicines (Forero Pinto, 1980) and antimicrobial activities (Chiappetta and DeMello, 1994). Species of the

families Scrophulariaceae and Acanthaceae have been reported to contain a group of unusual macrocyclicspermine alkaloids (Koblikova *et al*., 1983). This group of compounds has previously not been investigated for biological activity.Meurer-Grimes *et al*. (1996) reported the investigation of 101 plant extracts obtained from various plant parts of 59 taxa belonging mostly to the plant families Scrophulariaceae and Acanthaceae. Meurer-Grimes *et al*. (1996) reported significant activity against the Gram-positive bacterium Staphylococcus aureus or the fungus Candida albicans was found in over 40% of the samples investigated. They found no significant activity was found against the Gram-negative bacteria Escherichia coli and Pseudomonas aeruginosa. Antimicrobial activity was most consistently detected in the genera Aphelandra, Eranthemum, and Ruellia of the Acanthaceae.

6. Medicinal Properties

Several phytochemical constituents have been isolated from J. adhatoda which possesses activities like abortifacient, antimicrobial, cardiovascular protection, anticholinesterase, antitussive, anti- inflammatory and other important activities. It is also used for the treatment of bleeding piles (Ahmad *et al*., 2009), impotence and sexual disorders (Pushpangadan *et al*., 1995).

It is a highly valuable Ayurvedic medicinal plant used to treat cold, cough, asthma and tuberculosis (Sharma *et al*., 1992). The plant is used for treatment of excessive phlegm and menorrhagia in Sri Lanka (Kirtikar and Basu, 1975).

Fig: 6. Adusa based traditional medicines.

7. DISCUSSION

There is a general consensus of opinion that the Acanthaceae are derived from the Scrophulariaceae or stocks ancestral to them, Hutchinson considered it as the most advanced family of his Personales. Bessey (1915) had adopted a similar view by placing it at the top of his Scrophulariales. The family differs from the Scrophulariaceae in having cystoliths in the leaves and the often presence of retinacula on the seeds. The genus Nelsonia with numerous ovules in each loculus is a link form between the two families. The findings of Meurer-Grimes *et al*. (1996) confirm that higher plants used as anti-infective phytomedicines may serve as a valuable source for novel antibiotics. The high percentage of extracts found to exhibit antimicrobial activity in their study illustrated the effectiveness of selecting plant species based on ethnobotanical and chemotaxonomic information. *J. adhatoda* is an important source of many pharmacologically and medicinally important chemicals such as Vasicoline, Vasicinone, Vasicine, and other various useful minor alkaloids. The roots also contain alkaloids (vasicinal, vasicinolone, vasicinone and adhatonine), a steroid (daucosterol), carbohydrates and alkanes Dhankar *et al* 2011. In the flowers triterpenes (α-amyrin), flavonoids (Apigenin, Astragalin, Kaempferol, Quercetin, Vitexin) and alkanes have been found (Haq *et al*., 1967).

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