An Overview on Ethnopharmacological and Phytochemical properties of *Thunbergia* sp.

**Sultana KW**, **Chatterjee S***, **Roy A**² and **Chandra I**¹

¹Department of Biotechnology, The University of Burdwan, West Bengal, India
²Department of Microbiology, M.U.C Women’s College, BC Rd, Khosbagan, Burdwan, 713104, West Bengal, India

**Abstract**

The worldwide emergence of multidrug resistance, unavailability of drug in the developing Countries and side effect of drug raises the necessity of alternative herbal medicine as drugs. So, researchers are trying to find out the effective herbal medicinal plants for different medical health issues. The ethnomedicinal importance of common *Thunbergia* species, their pharmacological properties and also some bioactive compounds regarding their pharmacological properties has been reported in this review. Genus *Thunbergia* belongs to the Acanthaceae family. More than 100 species of *Thunbergia* has been included in this genus. Antibacterial, antifungal and anthelmintic activity of *Thunbergia grandiflora*, anti-inflammatory, antitumor, antioxidant antinociceptive activity of *Thunbergia laurifolia* due to presence of rosmarinic acid and also antidiabetic and hepatoprotective activity of *Thunbergia laurifolia* has been reported in the present review article.

**Keywords:** *Thunbergia*; Antibacterial; Antifungal; Anti-inflammatory; Antitumor; Antioxidant; Antidiabetic; Hepatoprotective; Rosmarinic acid

**Introduction**

*Thunbergia* is a genus of flowering plant of Acanthaceae family, native to tropical regions of Africa, Madagascar, Australia and South Asia. *Thunbergia* species include some 100 species of annuals, perennials and shrubs. There are many twinning climbers, as well as some shrubby types in this variable genus. Retzius named the genus *Thunbergia* in 1780 in honours of Carl Peter Thunberg, a Swedish Physician and Botanist employed in the Dutch East India Company [1,2].

The attractive climbers are a varied group usually with pointed oval to heart-shaped leaves, sometimes lobed or toothed. They occur in many colours, but are most often yellow, orange and purple-blue shades. Many of the *Thunbergia* species prefer full sun and well-drained soil but can bloom in partial shade also. A sunny location is required as they can receive direct sunlight for six or more hours a day. Regular and deep watering is needed for the plants, allowing the soil to dry slightly between watering (but total dry soil will cause wilting and premature flower drops). Most of the plants of this genus have ornamental value but some of them have medicinal value also.

**Classification of *Thunbergia***

Class: Equisetopsida
Subclass: Magnoliidae
Order: Lamiales
Family: Acanthaceae
Genus: *Thunbergia*

Some of the common *Thunbergia* species are as follows [1,2]:

- *Thunbergia alata*
- *Thunbergia annuia*
- *Thunbergia battiscombei*
- *Thunbergia coccinea*
- *T. cordata*
- *T. erecta*
- *T. elegans*
- *T. fragrans*
- *T. grandiflora*
- *T. gregorii*
- *T. gibsonii*
- *T. ikbaliana*
- *T. laurifolia*
- *T. lutea*
- *T. mysorensis*
- *T. vogeliana*

**Description**

Species of *Thunbergia* are different from each other based on their general characteristics such as their geological distribution, height, plant physiology and blooming season mentioned in the tables. Besides these, basic requirement of plant such as soil, water and sun exposure may vary from species to species of *Thunbergia* plant [2-4].

*Corresponding author: Chatterjee S, Department of Biotechnology, The University of Burdwan, West Bengal, India, Tel: 09474786086; E-mail: schatterjeebiotech@gmail.com

Received: October 22, 2015; Accepted: November 19, 2015; Published: November 23, 2015


Copyright: © 2015 Sultana KW, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
Thunbergia alata (Table 1 and Figure 1)

**Distribution**
Native to Tropical Africa, Brazil, Hawaii and Eastern Australia

**Common name**
Black-eyed Susan vine

**Height**
About 8 feet

**Plant type**
Perennial climbing vine

**Leaf arrangement**
Opposite

**Leaf surface**
Upper surface hairless (i.e. glabrous) or slightly hairy (i.e. puberulous)

**Leaf margin**
Toothed/dentate and acuminate, Acute or mucronate (pointed tips)

**Leaf shape**
Ovate/hastate (arrow-shaped)

**Leaf venation**
Reticulate

**Flower**
Bright yellow, white or orange with brownish purple tube like centre, salverform with five petals

**Blooming season**
Spring, summer

**Fruit**
Loculicidal capsule

**Soil for cultivation**
Rich, well-drained best for fast growing

**Water requirement**
Moderate

**Sun exposure**
Full sun to partial shade

Table 1: *Thunbergia alata* characteristic features.

---

**Antibacterial activity**

Jenifer et al. have evaluated the antibacterial activity of Chloroform stem extract of *Thunbergia alata* against *Pseudomonas aeruginosa* and significant antibacterial activity of higher concentration of ethanolic leaf extract of *Thunbergia alata* against *Salmonella typhi* [20]. Methanolic crude extract of *Thunbergia grandiflora* leaves against some Gram positive and Gram-negative bacteria showed significant antibacterial activity [21]. Methanolic extract of flower of *Thunbergia grandiflora* showed antibacterial activity against *Escherichia coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Bacillus cereus*, *Proteus mirabilis* and *Streptococcus pyogenes* due to the presence of phenols, alkaloids and flavonoids in the flower extract of that plant [22].

**Thunbergia coccinea** (Table 2 and Figure 2)

**Distribution**
Native to India and Myanmar

**Common name**
Scarlet vine, Red clock vine

**Height**
3-8 metres

**Plant type**
Perennial climbing vine

**Root system**
Tuberous

**Leaf arrangement**
Opposite

**Leaf surface**
Both surfaces pubescent

**Leaf margin**
Dentated

**Leaf shape**
Ovate or lanceolate

**Leaf venation**
Pinnate

**Flower**
Salmon-red tubular flower

**Blooming season**
January to April

**Fruit**
Loculicidal capsule (glabrous)

**Soil for cultivation**
Moderately moist soil sandy-loamy or gritty-loamy soil

**Water requirement**
Moderate

**Sun exposure**
Full sun to partial shade

Table 2: *Thunbergia coccinea* characteristic features.

---

**Ethnomedicinal Importance of *Thunbergia* Species [5-19]**

**Antifungal activity**

Chowdhury et al. have evaluated the antifungal activity of methanolic crude extract of *Thunbergia grandiflora* leaves [21]. It is reported that the decoction of leaves of *T. fragrans* used in fungal infection [23].

**Distribution**
Native to Western Africa

**Common name**
Bush Clock vine, King’s Mantle

**Height**
4 to 6 Feet

**Plant type**
Shrub

**Root system**
Tuberous

**Leaf arrangement**
Opposite/sub opposite

**Leaf surface**
Pubescent

**Leaf margin**
Entire

**Leaf shape**
Elliptic (oval)/Ovate elliptic

**Leaf venation**
Bowed: Pinnate

**Flower colour**
Yellow throated tubular Purple flower having five petals

**Blooming season**
Spring to summer

**Fruit**
Loculicidal capsule

**Soil for cultivation**
Moist but well drained loamy

**Water requirement**
Moderate

**Sun exposure**
Full sun to shade

Table 3: *Thunbergia erecta* characteristic features.
Anthelmintic activity

The anthelmintic activity of methanolic extract of *Thunbergia grandiflora* on *Tubifex tubifex* worm due to presence of Proanthocyanidin tannin content was reported [24].

Anti-inflammatory activity

Ethanol and hexane extract of leaves of *Thunbergia laurifolia* plant showed anti-inflammatory activity against carrageenan-induced paw edema in mice [25]. Rosmarinic acid was found in ethanolic extract of *T. laurifolia* leaf and was isolated, which showed the anti-inflammatory effect on two mouse models of carrageenan-induced paw edema and cotton pellet-induced granuloma formation [26]. Anti-inflammatory activity of *Thunbergia coccinea* plant was observed [27].

Antipyretic and analgesic activity

Both analgesic and antipyretic activity of methanol extract of *Thunbergia coccinea* Wall was observed in rats [28].

Antidiabetic potency

Administration of aqueous extract of dried *Thunbergia laurifolia* leaves in alloxan-induced diabetic rats showed hypoglycemic effect [29].

Antidote and detoxification activity

Leaf extract of *Thunbergia laurifolia* is reported as an antidote against poisonous insecticide [30]. Tejasen et al. also demonstrated that the cholinergic effect on rats is reduced after administration of aqueous extract of *T. laurifolia* and mortality rate of rats treated with folidol
Distribution

<table>
<thead>
<tr>
<th>Common name</th>
<th>Native to India, Thailand and Malaysia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>15 metre in height</td>
</tr>
<tr>
<td>Plant type</td>
<td>Perennial climbing, creeper plant</td>
</tr>
<tr>
<td>Root system</td>
<td>Tuberosus</td>
</tr>
<tr>
<td>Leaf arrangement</td>
<td>Opposite</td>
</tr>
<tr>
<td>Leaf surface</td>
<td>Pubescent</td>
</tr>
<tr>
<td>Leaf margin</td>
<td>Entire or slightly toothed (crenated), hairless (glabrous) and acute or acuminate apex</td>
</tr>
<tr>
<td>Leaf shape</td>
<td>Oval (i.e. elliptic) to narrowly egg-shaped in outline (ovate-lanceolate)</td>
</tr>
<tr>
<td>Leaf venation</td>
<td>Pinnate</td>
</tr>
<tr>
<td>Flower</td>
<td>Blue, violet or purple trumpet-shaped flowers have a pale yellow or whitish coloured throat</td>
</tr>
<tr>
<td>Blooming season</td>
<td>Summer and autumn</td>
</tr>
<tr>
<td>Fruit</td>
<td>Loculicidal capsule</td>
</tr>
<tr>
<td>Soil for cultivation</td>
<td>Moist but well-drained</td>
</tr>
<tr>
<td>Water requirement</td>
<td>Moderate</td>
</tr>
<tr>
<td>Sun exposure</td>
<td>Full sun to shade</td>
</tr>
</tbody>
</table>

**Table 6: Thunbergia laurifolia characteristic features.**

(Received for publication in June 2013, revised and accepted in September 2013) (Aqueous extract of *Thunbergia laurifolia* leaves has shown the antitumor activity [36]. Microwave-dried leaf extract of *Thunbergia laurifolia* showed more antioxidant activity [37]. Oonsivilai et al. 2008 evaluated the antioxidant activities and total phenolic content of *Thunbergia laurifolia* extracts using free radical scavenging, ferric reducing antioxidant power assay (FRAP) and the Folin-Ciocalteu methods. Aqueous extract of *T. laurifolia* leaf exhibited highest antioxidant activity, while ethanol and acetone extracts of *T. laurifolia* leaves showed moderate antioxidant activity. All of these mentioned extracts have high phenolic acids content as caffeic acid, gallic acid, protocatechuic acid and flavonoids as apigenin showing antioxidant activity [38]. Rosmarinic acid isolated from 95% ethanolic extract of dried *Thunbergia laurifolia* leaves has antioxidant activity [39]. Potential antioxidant activity of methanolic extract of *Thunbergia coccinea* leaves was observed [40].

**Cytotoxicity**

The aqueous extract of *T. laurifolia* leaf showed low cytotoxicity (>200 µg/ml concentration) to L929, BHK (21) C13, Caco-2 and HepG2 cell lines when compared between other extracts such as ethanol and ether and this report suggested the application or use of aqueous extract of *T. laurifolia* leaf due to its low cytotoxicity to kidney cells and human liver cell lines [38].

**Hepatoprotective activity**

The hepatoprotective activity of aqueous extract of Thunbergia laurifolia against ethanol induced liver injury in rat hepatocytes was observed by Pramyothin et al. [41].

**Antinociceptive activity**

Administration of Rosmarinic acid isolated from ethanolic extract of *T. laurifolia* showed significant antinociceptive activity in the hot-plate test and rosmarinic acid at 50 and 100 mg/kg significantly showed its reducing activity on acetic acid induced writhing by 52% (p<0.01) and 85% (p<0.001) respectively and also on formalin-induced pain in the early and late phases. These results indicated both central and peripheral antinociceptive activities of rosmarinic acid [38].

**Phytochemical constituents of Thunbergia species**

**Glucosides**

Damtoft et al. have isolated two iridoid glucosides named Thunaloside and alatoside from *Thunbergia alata* along with the known iridoid glycosides, stilbericoside, 6-epi-stilbericoside and thunbergioside [42]. Ismail et al. have isolated iridoid glucosides such as isounedoside, which contains C-10 as a carboxylic acid group and grandifloric acid, which contains a rare 6,7-epoxide functional group from *Thunbergia grandiflora* [43]. Kanchanapoom et al. 2002 have isolated two new iridoid glucosides: 8-epi-grandifloric acid and 3’-O-beta-glucopyranosyl-stilbericoside from the methanolic extract of the aerial part of the *Thunbergia laurifolia* plant along with these known compounds such as benzyl-2’-O-β-glucopyranosyl glucopyranoside, grandifloric acid, E-2-hexenyl-β-glucopyranoside, hexanol-β-glucopyranoside and they have also determined the structure of these compounds [44]. Subramanian et al., have reported to contain luteolin-
7-glucoside, malvidin-3, 5-di-glucoside and stibbericoside in flowers of Thunbergia grandiflora [45].

Phenolic compounds and others

Plant phenolic compounds include tannin, phenolic acids, flavonoids, naphthelene and other. Kabir et al. have evaluated the total tannin content in Thunbergia grandiflora, which indicate the presence of Proanthocyanidin, a condensed tannin compound [24]. Purnima et al. and Kanchanaapoom et al. have reported the presence of some bioactive phenolic compounds like delpinidine-3,5-di-O-β-glucopyranoside, apigenin and apigenin-7-O-β-D-glucopyranoside and chlorogenic acid, 6-C-glucopyranosyl apigenin and 6,8-di-C-glucopyranosyl apigenin in the flower and leaf extract of Thunbergia laurifolia plants respectively [44,46]. Jansen et al. has reported that phenolic compounds such as caffeoylmalic acid, feruloylmalic acid and p-coumaroylmalic acid have found in the leaves of Thunbergia alata [47]. Oonsivilai et al. have extracted other phenolic acids such as gallic acid, caffeic acid and protocatechuic acid from the leaf extract of Thunbergia laurifolia plants [48]. Chowdhury et al. have purified flavonoid named 5- hydroxy-4', 6,7-trimethoxy flavone, C_H_O [21]. Subramanian et al. have reported to contain flavonoids such as apigenin-7-glucoronide, luteolin in flowers of Thunbergia grandiflora [45]. Hung et al. have purified and identified eight compounds. The identified compounds are 8-Hydroxy-8-methyl-9-methene-cyclopentane- [7,11]-1, 4, 6-trihydroxanaphthelene-12-one, named as Thunbergia A (1); 3,4-dihydro-4, 5, 8-trihydroxy-2-(3-methyl-2-butenyl) -naphtha [2,3-b] oxiren-1 (2H)-one (2); 8-(beta-glucopyranosyloxy) -3, 4-dihydro-2-(3-methyl-2-butenyl) naphtha [2,3-b] oxiren-1 (2H)-one (3); galangin (4); quercetin (5); luteolin (6); 5, 6, 3', 4'-tetrahydroxy-3, 7-dimethoxy- flavone (7) and upelo (8) [49]. Rosmarinic acid is present in the ethanolic extract of Thunbergia laurifolia [39].

Future Prospects

Purification, identification and characterization of unexplored bioactive compounds showing pharmacological activities of these species will be the area of future work. Production of bioactive compounds from these plant species can be increased since they possess pharmacological activities like antibacterial, antifungal, antidiabetic, antipyretic, anti-inflammatory, anthelmintic, antioxidant, antinoceptive, anti-drug, antidiote, antimutagenic, detoxifying, cytotoxic and hepatoprotective which may be advantageous for pharmaceutical industry to explore effective drugs from different species of the Thunbergia plant.

Conclusion

This review article reports about the medicinal importance of the most of the species of Thunbergia. According to this review article, Thunbergia, having the medicinal properties such as antibacterial, antifungal, antidiabetic, antipyretic, anti-inflammatory, anthelmintic, antioxidant, antinoceptive, anti-drug, antidiote, antimutagenic, detoxifying, cytotoxic and hepatoprotective activities, can be considered as potential alternative herbal medicine to treat different types of diseases.

Acknowledgement

I want to acknowledge Dr. Indrani Chandra and Dr. Sabyasachi Chatterjee of the Department of Biotechnology in the University of Burdwan for giving me the opportunity to make this review on Thunbergia species under their guidance. I am very grateful to them for supporting me. I would like to thank my family for their full support.

References

Increased global visibility of articles through worldwide distribution and indexing

700 Open Access Journals

Indexing at PubMed (partial), Scopus, EBSCO, Index Copernicus, Google Scholar etc.

Showcasing recent research output in a timely and updated manner

Sharing Option: Social Networking Enabled

50,000 Editorial team

Rapid review process

Better discount for your subsequent articles

Authors, Reviewers and Editors rewarded with online Scientific Credits

Submit your manuscript at: http://www.omicsonline.org/submission

OMICS International: Publication Benefits & Features

Unique features:

• Increased global visibility of articles through worldwide distribution and indexing
• Showcasing recent research output in a timely and updated manner
• Special issues on the current trends of scientific research

Special features:

• 700 Open Access Journals
• 50,000 Editorial team
• Rapid review process
• Quality and quick editorial, review and publication processing
• Indexing at PubMed (partial), Scopus, EBSCO, Index Copernicus, Google Scholar etc.
• Sharing Options: Social Networking Enabled
• Authors, Reviewers and Editors rewarded with online Scientific Credits
• Better discount for your subsequent articles


