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## Phytochemical, botanical and Ethnopharmacological study of *Scoparia dulcis* Linn. (Scrophulariaceae): A concise review

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### Abstract

The ancient world had huge faith on the herbal medicines for curing various ailments. *Scoparia dulcis* Linn. is a medicinal herb of family Scrophulariaceae is considered to be one of such plants which have remarkable curative property. *Scoparia dulcis* is the commonly known as Sweet broom weed and is distributed throughout the tropical and subtropical region of the world. This herbaceous weed comprises of typical morphological characteristics which are of great use. Dried or fresh leaves, fruits and some other parts of plant serve the purpose of providing with essential components for the body metabolism. Some of the scientific studies demonstrated about the bioactive compounds present in the plant extract. These bioactive compounds were flavonoids, polyphenols, tannins and terpenoids. The fresh and the dried leaves of the herb showed its richness in ascorbic acid content. Scoparic acid, scopadulcic acid, scopadulciol, scopadulin and ammeline are the major chemical components to which have contributed to the medicinal effect of the plant. Ethnomedicinal application of this herb revealed its uses for diabetes, jaundice, stomach problems, skin disease, fever, kidney stones, reproductive issues and piles. Evidences reported its flawless activity in anti-diabetic, anti-inflammatory, anti-ulcer, antioxidant, anti-microbial and analgesic illnesses. The current review is concerned with morphological, phytochemical, pharmacological, therapeutic and nutritional aspects of the plant *Scoparia dulcis*. This review may assist one to acquire encapsulated concept about the herb.

**Keywords:** *scoparia dulcis*, phytochemicals, ethnomedicine, pharmacological property

### 1. Introduction

A belief prevailed throughout that the use of herbal medicines prone to have very less or no side effects in human body. The herbs exhibited the pharmacological activity, then replacing the synthetic ones, now. In order to bring up these medicinal properties of the herb for accepting certain scientific evaluations were performed. Various illnesses and diseases were cured by these plants. From the time immemorial, the herb *Scoparia dulcis* of the family Scrophulariaceae showed huge range of usable characteristics and its judicious utilization (Figure 1). Some researchers and scientists found that between 1980 and 2014, diabetes became very common disease, and it rose significantly in many countries, including China, India and Indonesia. Current treatment for diabetes included insulin therapy and administration of oral hypoglycaemic agents which had shown deterioration in hyperglycaemic and increased rich of diabetic complication in due course of long term usage. Naturally obtained bioactive products from plants served as cure of several ailments. *Scoparia dulcis* sufficed the need of artificial insulin. This folkloric medicinal plant also contributed efficiently to the anti-sickling activity. Sick cell anaemia basically is a genetic disorder where the red blood cells are assumed to have sickle like shape. This disease is characterised by inadequate oxygen transport in the red blood cells of blood. *Scoparia dulcis* was used as one of the healers and designated to have anti-sickling activity. Tropical and sub-tropical areas of India, South East Asia, America, Brazil, West Indies, Phillipines and Myanmar ensure growth of the perennial this herb abundantly. They grow at a pace in wetland areas mostly. The herb is available almost throughout the year but fruiting and flowering time is during monsoon. Further, clinical evaluation was carried out which discovered a potential remedy for combating pyorrhea, eye trouble, joint pain, susceptibility to cold. The herb offered tremendously into pharmaceutical industry which led to phytochemical screening. The herb contained terpenoids, flavonoids, tannins, alkaloids, hexacosanol,  $\beta$ -sitosterol, ketone, dulcitone and amellin types of phytochemicals [1-4].



**Fig 1:** Natural Habitat of the herb *Scoparia dulcis* Linn.

#### Taxonomy <sup>[5]</sup>

Kingdom:	Plantae
Sub-kingdom:	Trachcobionta
Division:	Magnoliophyta
Super-division:	Spermatophyta
Class:	Magnoliopsida
Sub-class:	Asteridae
Family:	Scrophulariaceae
Genus:	<i>Scoparia</i>
Species:	<i>dulcis</i>

**Botanical name:** *Scoparia dulcis* Linn.

#### Vernacular names <sup>[6]</sup>

English: Sweet Broom Weed; Hindi: Ghoda Tulusi; Bengali: Bon Dhonia; Malayalam: Kallurukki; Tamil: Sarakkotthini; Kannada: Mruganmhi Gida; Assamese: Modhu-mehari; Marathi: Dulas; Bodo: Bongphang Rakhib.

#### Distribution

Many studies have revealed *Scoparia dulcis* distribution in torrid zones. South America and the Amazon rain forest show a prodigious diffusion rate of this perennial herb. Thus, from the habitat it is clear that the tropical and sub-tropical region of the world ensures enormous blooming of *Scoparia dulcis*. Grazed grasslands, wet wastelands and cultivated lands are found with abundant growth (Figure 1) <sup>[1, 7]</sup>.

#### Botanical features



**Fig 2:** The plant *Scoparia dulcis*

**Roots:** The average lengths of the root are 7-13 cm and are pale yellow to brown in colour. Depending on the structure, the root is straight with numerous hairs like extensions known as lateral roots. This rooting style is categorized under the tap root system (Figure 3) <sup>[7]</sup>.



**Fig 3:** Root & Stem

**Stems:** It is a perennial branched herb with wiry stem grows up to 1m tall. During the rainy season there are young shoots available. The stem of the herb is woody at the base and contains no hair (Figure 3) <sup>[8]</sup>.

**Leaves:** The leaves (Figure 4) of the plants are serrate with tapering base, acute apex and shaped in lanceolate model. The leaves are arranged in whorled pattern. Texture wise the leaf is glabrous on both side. The leaf has normal leafy smell and is light green in colour <sup>[7, 8]</sup>.



**Fig 4:** Leaves



**Fig 5:** Flower



**Fig 6:** Fruit

**Flower:** The flowers (Figure 5) are hermaphrodite, complete and usually axillary, 5-7 mm in diameters and regular. The sepals are having calyx lobes oval-oblong, ciliated at the margin and persistent. There are corolla with densely hairy tube especially near the throat, long lobes and obtuse apex. There are 4 stamens exerted with greenish colour, filaments inserted at the top of the corolla tube, anthers are dorsifixed, erected style; stigma is truncate to 2-partite. The flowering time is almost throughout the year [7, 8].

**Fruits:** The fruits (Figure 6) are long dehiscent capsulated and ovoid shaped. The style surmounts the fruit. At ripened state it opens into two halves [9].

**Seeds:** The seeds are obconical shaped. The germination of the seeds of the herb occurs at 25°C to 30°C temperatures. Treatment with gibberellic acid, sodium nitrate and ammonium nitrate solution enhanced the germination of light incubated seeds. The seeds of this herb are dispersed by cattle and buffaloes. The seeds of *Scoparia dulcis* face enforced dormancy, where a sudden exposure to unfavourable environmental condition can terminate the germination [10, 11].

### Traditional uses

The ethnomedicinal value of *Scoparia dulcis* was recorded and noted from many part of the world. Ethnomedicinal study showed its usage in preparation of traditional rice beer, Bhuyan and Baislya all of which are used by several tribal groups. The tribal groups, Deori and Rabha tribes used the herb for prevention of diabetes, jaundice, stomach problems, skin disease and piles. A survey study on the plant species conducted in the South Indian state of Tamil Nadu stated that the therapeutic agents used by the Nadars revealed that the plants sap was consumed orally to treat fever and kidney stones. In Trinidad and Tobago the juice was used for cooling babies and for other reproductive problems in both men and women. The whole plant was used for treating nephritis, in Bolikhamsai Province and central Laos. Some researchers went on testing the anti-plasmodium activity due to frequent malaria update in Amazon Region. The traditional remedies included plant extract used by indigenous and Mestizo population. In the Province of Antioquia, in Colombia the whole plant is used as one of the treatments of snake bite. *Scoparia dulcis* was considered as a safe drug which exhibited properties to treat liver toxicity and hepatitis by the traditional practitioners. Ethnomedicinal studies revealed that it was also used as an anti-inflammatory agent for inhibiting discomfort created during menstruation or menopause [12-21].

### Phytochemistry

Some detailed chemical studies and literature review on the *Scoparia dulcis* revealed that it contained chemical constituents such as tannins, flavonoids, amino acids, terpenoids, polyphenols and catechol amines. High performance liquid chromatography (HPLC) analysis of small fraction of aqueous extract detected presence of terpenoids which are responsible for several medicinal effects. Some biologically active compounds such as scoparic acid, scopadulic acid and scopadulin are also found in this plant parts. Triterpene obtained from effective extracts and triterpene from the herb itself act significantly analgesic and anti-inflammatory activity. The study reveals the presence of flavonoids scutellarein, apigenin and luteolin and the terpenoids scopadulic acid B and betulinic acid in the plant

parts [8, 22-28].

### Pharmacological activity

#### Anti-diabetic activity

Amellin and scoparic acid D obtained from the leaves of the *Scoparia dulcis* serve as a source as anti-diabetic drug. The effect of the leaf decoctions leads to hypoglycaemia which proved to exhibit significant result when compared with Glibenclamide which is a standard anti-diabetic drug. Some rats were administered with streptozotocin, which is a diabetes inducing agent for monitoring the anti-diabetic effect. Diterpenes, triterpenes and flavonoids exposes the anti-diabetic property which has been collected from the aerial parts of the herb. Insulin secretagogue stimulates the beta cells to produce insulin and combat diabetes. Compounds obtained from the aqueous decoctions were coxiol and glutinol which were found to be potent and mildly active in insulin secretagogue activity [29-31].

#### Analgesic and anti-inflammatory activity

Administration of acetic acid in the mice caused a physical discomfort and irritation. When carrageenan was administered in a rat, it caused paw edema. Treatment with the leaf ethanolic decoction relieved the irritation in both the cases. Thus, it was concluded that treatment with diterpene scoparinol and triterpene glutinol significantly indicated that it contains analgesic activity. Inflammation is a response triggered by some irritants or by pathogens or damage caused to the living cells. Ethanolic extract elicited the anti-inflammatory activity. Drugs prepared out of these decoctions were used to relieve pains of menstrual discomfort. Labour pains are prevented as well as using the extract as medicine [28, 32].

#### Antimicrobial activity

An extract prepared out of acetone and water from the herb *Scoparia dulcis* was examined to possess antimicrobial activity against bacterial cultures of *Bacillus licheniformis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* and the fungal cultures. The antifungal activity was highly successful compared to antibacterial activity of the plant extract. Virulence factors of the two pathogens *Escherichia coli* and *Staphylococcus aureus* were inhibited by using the ethanolic extract of the leaf. Some gram positive bacterial strains such as *Bacillus* and *Corynebacterium* and some gram negative bacterial strains like *E. coli* and *Klebsiella pneumoniae* were used to check their activity on being treated with six extracts prepared out of leaves of the plant. The extracts were prepared with petroleum ether, toluene, chloroform, methanol, ethanol and water, respectively to examine the growth activity. The result recorded stated that the extracts had mild effect on the pathogens compared to the standard used - ampicillin and kanamycin. Some fungal strains such as *Aspergillus niger*, *Saccharomyces cerevisiae* and *Candida albicans* were examined for the same issue and small zones of inhibition were detected compared to nystatin standard [33-36].

#### Anti-sickling activity

Sickle cell disease is a highly morbid and mortal disease. The treatment aimed at relieving pain, reducing and preventing infection. The initial treatment basically included usage of folic acid, amino acid, hydroxyl urea and blood transfusion method to balance and preserve the haemoglobin level of the



patient. All of these marked the risk factor and are too expensive to be afforded. Sodium metabisulphite causes sickling of HbSS red blood cells up to certain degree. Crude extracts prepared from chloroform and water acts as an inhibitor of sodium metabisulphite. *In vitro* polymerization of such haemoglobin can also be inhibited by the bioactive compounds of the plant parts [4, 37-39].

#### Anti-malarial activity

Aqueous extract of the plant was explored to detect the inhibitory property. The anti-malarial effect of the extract was not as significant as *Plasmodium falciparum*. There were many other plants which were selected for this anti-malarial study and those plants provided with better result compared to *Scoparia dulcis* [40].

#### Antioxidant activity

The aqueous extract of the plant *Scoparia dulcis* showed antioxidant property that had a satisfactory action against pathological variation. The antioxidant effect of the plant was seen in rats in comparison with glibenclamide. The brain cells were treated with aqueous extract and glibenclamide parallel for 6 weeks and observable changes in the plasma insulin, superoxide dismutase, catalase, glutathione peroxidase, glutathione-S-transferase and glutathione were recorded [29, 30, 41].

#### Anti-hyperlipidemic activity

For 6 weeks, streptozotocin diabetic rats were administered with aqueous extract of the plant orally which resulted in reduction of blood glucose, serum and tissue cholesterol, triglycerides, free fatty acids, phospholipids and very low density lipoprotein and low density lipoprotein cholesterol levels. Some normal animals were also treated with the plant extract, which solemnly showed anti-hyperlipidemic action in normal animals and diabetic rats (apart from diabetic symptoms) [42].

#### Anti-ulcer activity

Aqueous leaf extract was examined for anti-ulcer activity. Experimental rats were delivered with pylorus ligation and leaf extract, respectively. The result recorded and stated reduced gastric volume, free acidity and ulcer index in comparison to the control set as anti-secretory mechanism for anti-ulcer activity. Scopadulcic acid B along with its debenzoyl derivative - diacetylscopadol showed inhibition of gastric H<sup>+</sup> and K<sup>+</sup> - ATPase [43].

#### Toxicological activity

There was no mortality rate identified on administration of the aqueous extract of the *Scoparia dulcis* either orally or by injection. There were no observable change in behaviour, posture, nature and frequency of stooling, mood and motor activity. Neither there was any writhing, convulsion nor death. There were no toxicological symptoms observed during the 30 days when the extract was administered. While the rats were treated with this extract and no evidence was found of tissue necrosis on the heart, lung, liver and testis. The vital organs showed normal function indicating no metabolic or morphologic disruption in body. Thus, all of this signals low toxicity of the extract and it is being safe to be used as medicinal drug. An *in vitro* test performed revealed that three groups of Wister rats A, B and C injected with control of saline water, oral doses and extract of *Scoparia dulcis*,

respectively. This was regularly done for 30 days in every 30 min to observe minutely toxic outcome. The rats were then anaesthesia with chloroform which ends up in death of those rats. The organs such as liver, lung, heart and testis were removed and preserved in 10% formaldehyde solution for sectioning. Paraffin wax was used for embedding the organs and stains such as eosin and hematoxylin were efficiently used. The heart and the liver showed mild congestion on performing histopathology. The lungs and the testis showed no disintegration or degeneration. The aqueous and methanolic extract significantly inhibited the concentration and effect of metabisulphite causing sickling. This is a preventive measure for inhibiting polymerization of haemoglobin. This indicated no morphological disruption in the blood cells or tissues. Hence *Scoparia dulcis* is relatively safer to be used in further cases [39, 44, 45].

#### Conclusions

From the above explanation it can be stated that the bioactive compounds identified, confirmed and obtained from the plant *Scoparia dulcis* can serve as a novel purpose of treatment. The active principles of the plant declare the whole plant effective for usage. If more initiative and effort is taken for isolation and characterization the plant may pave its way and lead its path to discover yet more therapeutically useful compounds. Till date the plant has proved its worth and exposed itself as complementary and alternative mode of combating diabetes. The review study showed that the botanical, phytochemical, traditional uses, biological effects and healthcare uses of the plant. The plant may be used as nutritional purposes for its high availability and low cost. So, considering all the aspects it can be concluded that there is a huge scope for future study on *Scoparia dulcis* [1-3, 46-53].

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#### Conflict of interest

The author declares no conflict of interest.

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