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Review Article

SCOPARIA DULCIS: A REVIEW ON ITS PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILE

MEERA PAUL[1*], KAVITHA VASUDEVAN[2], KRISHNAJA K R[3]

[1,3]Department of Pharmaceutical Chemistry, Mookambika College of Pharmaceutical Sciences and Research, Muvattupuzha, Kerala-686667, [2]Department of Pharmacognosy, Mookambika College of Pharmaceutical Sciences and Research, Muvattupuzha, Kerala-686667

Email: meera5paul@gmail.com

ABSTRACT

The aim of the study is to describe importance of Scoparia dulcis and the experimental studies that we have reviewed from different sources. Scoparia dulcis commonly known as 'sweet broom weed' is distributed throughout the tropical and subtropical region of the world. The plant is used traditionally as used as a remedy for treating diseases such as; stomach ailments, kidney stones, hypertension, diabetes, inflammation, bronchitis, haemorrhoids, analgesic, antipyretic and urinary disorders. Further, studies reveal the presence of various phytochemical constituents mainly terpenoids, flavonoids and steroids, glycosides and some miscellaneous compounds. These studies reveal that Scoparia dulcis is a source of medicinally active compounds and have various pharmacological effects; hence, this drug encourage finding its new therapeutic uses.

Key words: *Scoparia dulcis Linn.,* sweet broom weed, Phytoconstituents, Pharmacological activity, Therapeutic uses.

INTRODUCTION

Scoparia dulcis Linn (Scrophulariacae) is an important ethnomedicinal plant, commonly called as sweet broom weed is a perennial herb, widely distributed in tropical and subtropical regions of India, America, Brazil, West Indies, and Myanmar[1,2]. India being a tropical country is blessed with best natural resources and ancient knowledge for its judicious utilization. However, in order to make these remedies acceptable to modern medicine, there is a need to scientifically evaluate them to identify the active principles and understand the pharmacological action. Humankind first utilized material found in environment on an empirical basis to cure various ailments. Natural products from plants and animals traditionally have provided the pharmaceutical industry with one of its important sources of lead compounds in search of new drugs and medicines. The search for new pharmacologically active agents from natural resources such as plants, animals and microbes led to discovery of many clinically useful drugs.

Description of the plant:

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

Common name: Sweet Broom Weed, Sweet Broom Wort

Hindi: Mithipatti, Ghodatulsi
Tamil: Sarakkotthini
Bengali: Bon-dhonya
Malayalam: Kallurukki
Parts used: whole plant, leaves, barks, roots[3]

Fig.01: *Scoparia dulcis* plant

DISTRIBUTION

Distributed throughout the tropical and sub-tropical region of the world and is found in abundance in South America and the Amazon rain forest and is known as Vassourinha in India [4].

BOTANICAL DESCRIPTION

Sweet Broom Weed is a branched herb with wiry stems, growing up to 1 m tall. . Leaves 3-notely whorled, obovate-oblong to oblanceolate, 1.4 - 3.5 x 0.8 -1.5 cm, tapering to base, subacute at apex, coarsely crenate-serrate from above base, glabrous on both surfaces. Small white, hairy flowers occur in leaf axils; petioles up to 9 mm long. Pedicels 5-7 mm long, glabrous. Calyx lobes divided to base, oval-oblong, 2.5-3 x l mm, 3- nerved, glabrous within and without, ciliate at margins. The stamens are greenish and the ovary is green. Roots are profusely branched. Flowers small, white, i n small 2-4 or 5 flowered inflorescence; corolla white; limb 7-8 mm across; lobes spathulate, 3-3.5 x 2 mm, reflexed with age; seeds minute, many[3].

CHEMICAL CONSTITUENTS

Scoparia dulcis is a rich source of flavones, terpenes and steroids, phenols, tannins, saponins, amino acids, coumarins and carbohydrates. The main chemicals include scopadulcic acids A and B, scopadiol, scopadulciol, scopadulin, scoparic acids A – C and betulinic acid [3, 4]. Other chemicals include: acacetin, amyrin, apigenin, benzoxazin, benzoxazolin, benzoxazolinone, cirsimarin, cirsitakaoside, coixol, coumaric acid, cynaroside, daucosterol, dulcinol, dulcioic acid, gentisic acid, glutinol, hymenoxin, linarin, luteolin, mannitol, scoparinol, scutellarein, scutellarin, sitosterol, stigmasterol, taraxerol, vicenin, and vitexin[3].

THERAPEUTIC USES

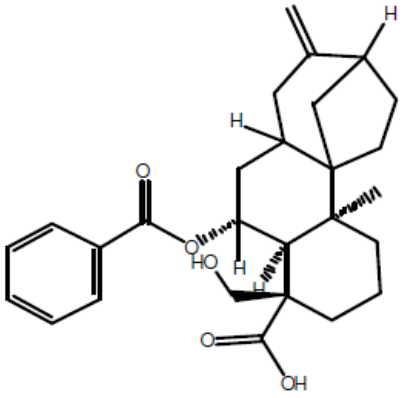
Traditionally the fresh or dried plant has been used as a remedy for treating diseases such as; stomach ailments, kidney stones, hypertension, diabetes, inflammation, bronchitis, haemorrhoids, analgesic, antipyretic and urinary disorders. Plant is also used for upper respiratory bacterial and viral infections, to relieve from all types of pain, to tone balance, strengthen heart function, for veneral diseases and urinary tract infections. The leaf of *Scoparia dulcis* is used for diabetes in India. Plant is also reported to possess cytotoxic, anti-cancerous, antimicrobial, anti-malarial, anti-ulcer, antacid, anti-cholesterol and antioxidant actions [3,5,6].

Innoriginal International Journal of Sciences | Volume 4 | Issue 4 | July-Aug 2017 | 17-21

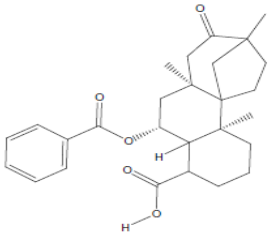
PHYTOCHEMISTRY

The available literature on phytochemical reports of the *S.dulcis* reveals that it comprises mainly terpenoids (24compounds), flavonoids (20 compounds) and steroids (4 compounds) and some miscellaneous compounds (14 compounds)[3,5]. In a previous study, on the anti-diabetic effect of *Scoparia dulcis*, a glycoside, amellin from fresh plant was obtained and reported that it brought relief in other complications accompanied with diabetes(i.e., pyorrhoea, retinopathy, joint pain, susceptibility to cold etc.) within a very short period[2,7].

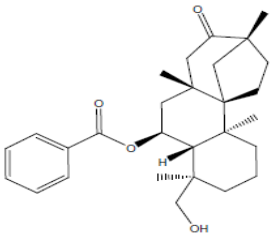
A number of different principles include Scoparic acid A, Scoparic acid B, Scopadulcic acid A and B, Scopadulciol and Scopadulin have been identified and these compounds were found to possess various biological activities such as inhibitor against replication of herpes simplex virus, gastric H+, K+ ATPase activator and antitumor promoting activity etc[8,9,10]. Glutinol, a major triterpene obtained from ethanolic extract and flavonoids and scoparinol, a diterpene demonstrated significant analgesic and anti-inflammatory activity in animals [9]. Two aetylated flavonoid glycosides Apigenin7-O-alpha-L-3-Oacetylrhamnopyranosyl-(1—>6)-beta D glucopyranoside and apigenin 7-O-alpha-L-2, 3-di-O-acetylrhamnopyranosyl-(1—>6)-beta-D glucopyranoside, isolated from *Scoparia dulcis* showed an enhancing activity of nerve growth factor-mediated neurite outgrowth in PC12D cells[7].



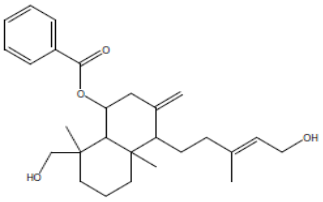
Scopadulcic acid A



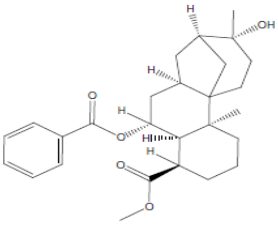
Scopadulcic Acid B



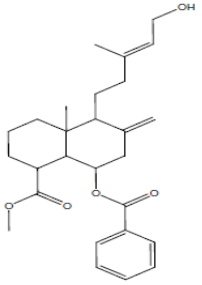
Scopadulciol



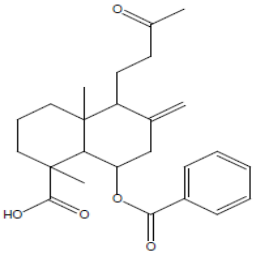
Scopadiol



Scopadulin



Scoparic Acid A



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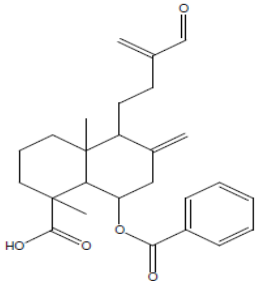
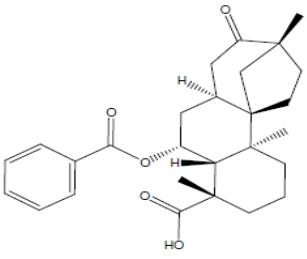
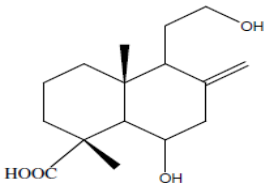


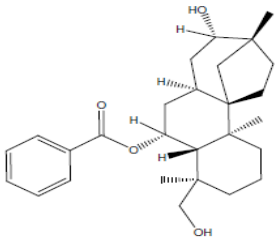
Scoparic Acid C



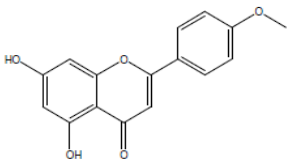
4-epi-scopadulcic Acid B



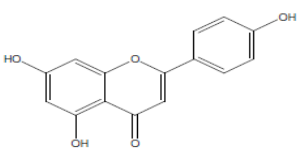
scoparic acid D



Dulcidiol



Acacetin



Apigenin

Innoriginal International Journal of Sciences | Volume 4 | Issue 4 | July-Aug 2017 | 4-9

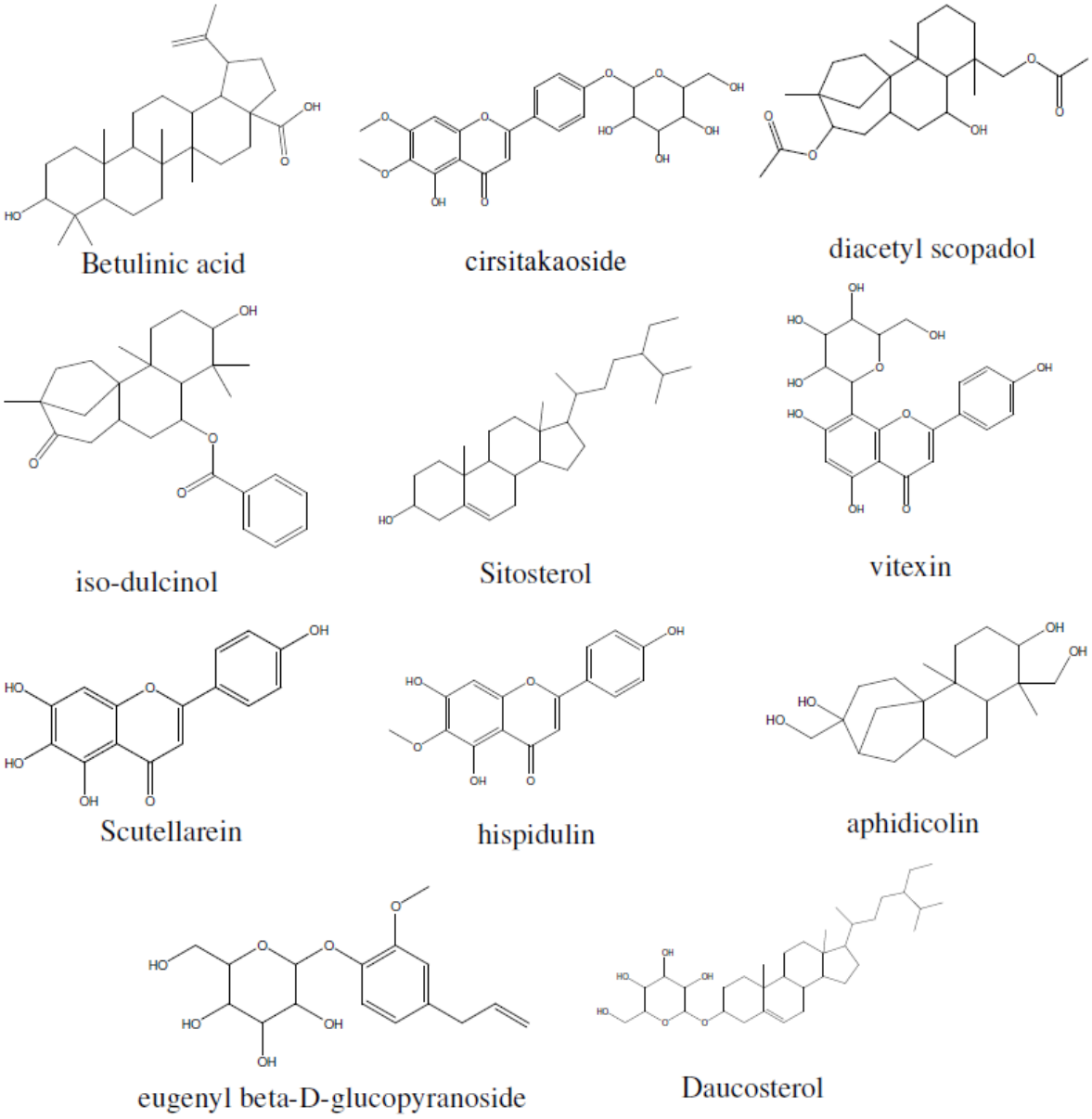


Fig.02: Structures of few compounds isolated from *Scoparia dulcis* L. [3,7].

PHARMACOLOGICAL STUDIES

Nephroprotective activity

Supplementation of *Scoparia dulcis* during cisplatin therapy reduces the risk of cisplatin induced nephrotoxicity in a dose dependent manner in curative regimen. The prophylactic regimen also possessed significant nephroprotection against cisplatin toxicity. The protective effect of *Scoparia dulcis* in curative and prophylactic regimen may be due to the antioxidant property of *Scoparia dulcis*. Results of this study suggest significant nephroprotection of *Scoparia dulcis* against cisplatin nephrotoxicity. Supplementation of ethanolic extract of *Scoparia dulcis* reduced the elevated serum creatinine, blood urea nitrogen levels, and lipid peroxidation levels and improved the creatinine clearance [4,8].

Antimicrobial and Antifungal Activity

The antimicrobial and antifungal effects of ethanol extracts of *Scoparia dulcis* and its cream base formulation were investigated against different bacteria like Staphylococcus aureus and Escherichia coli, and fungal strains such as Candida albicans and Aspergillus niger. The ethanolic extract and cream based formulation exhibited significant antimicrobial activity against gram positive organism and antifungal activity against all the tested organisms compared with respective reference drugs (Gentamicin and Clotrimazole).Thus a stable dosage form of the herbal medicinal plant, *Scoparia dulcis* can be used against gram positive and gram negative bacterial infections and fungal infections[11,12].The presence of chemical constituents such as flavonoid, alkaloid, tannin, carbohydrate, glycosides may be responsible for the antimicrobial activity[13].

Analgesic, Anti-inflammatory and Antipyretic Activities

The analgesic, anti-inflammatory and antipyretic activities of the water and ethanolic extracts of Scoparia dulcis L. were tested in mice and rats. The results indicate that the extract of S. dulcis is endowed with analgesic effects probably related to the anti-inflammatory activity of the plant. Those effects are related mainly to the presence of glutinol and flavonoids, which exert their action on the early phase of the acute inflammatory process through central and peripheral mechanism [9,14].

Ant diabetic activity

The antihyperglycemic effects of flavonoids from methanolic extract of aerial parts of *Scoparia dulcis* leaves in normal, glucose loaded and

streptozotocin induced diabetic rats were investigated. The extract exhibited significant hypoglycemic activity when compared with a standard antidiabetic agent Glibenclamide [2]. The hypoglycemia produced by the extract may be due to increased uptake of glucose at tissue level and or increase in pancreatic â-cell function or due to inhibition of intestinal glucose absorption of glucose. The huge reservoir of phytochemicals mainly amellin and scoparic acid D in *Scoparia dulcis* makes it a successful source of antidiabetic drugs [7].

Antihyperlipidemic Effect

The administration of *S. dulcis* plant extract to normal animals resulted in a hypolipidemic effect. The effect was compared with glibenclamide (600 μg/kg of body weight). The results showed that *S. dulcis* plant extract had antihyperlipidemic action in normal and experimental diabetic rats in addition to its antidiabetic effect. Oral administration of an aqueous extract of *S. dulcis* plant (200 mg/kg of body weight) to streptozotocin diabetic rats for 6 weeks resulted in a significant reduction in blood glucose, serum and tissue cholesterol, triglycerides, free fatty acids, phospholipids, 3-hydroxy-3-methylglutaryl (HMG)-CoA reductase activity, and very low-density lipoprotein and low-density lipoprotein cholesterol levels[15].

Sedative and Hypnotic Activity

The sedative and hypnotic activity of the ethanolic extract of whole plants of *Scoparia dulcis* were investigated using hole cross, open field, hole-board, rota-rod, and thiopental sodium-induced sleeping time determination tests in mice at the doses of 50, 100, and 200 mg/kg. Diazepam at the dose of 1 mg/kg was used as a reference drug in all the experiments. The ethanolic extract of whole plants of *Scoparia dulcis* produced a significant dose-dependent inhibition of locomotor activity of mice both in hole cross and open field tests. Besides, it also decreased rota-rod performances and the number of head dips in hole-board test. Furthermore, it significantly decreased the induction time to sleep and prolonged the duration of sleeping, induced by thiopental sodium. The study suggests that ethanolic extract of whole plants of *Scoparia dulcis* may possess sedative principles with potent hypnotic properties [10].

Antisickling activity

Aqueous and ethanol extracts of *Scoparia dulcis* have been evaluated for *in vitro* antisickling activity. The aqueous methanol extracts of *S. dulcis* showed significant inhibitory effects at the concentrations (100, 300 and 500 mg/ml) on sodium metabisulphite-induced sickling. The chloroform and aqueous fractions of the crude extract also inhibited sodium metabisulphite induced sickling of the HbSS red blood cells to varying degrees. The antisickling activity could be linked to the ability of the bioactive compounds present in *S. dulcis* to inhibit *in vitro* polymerization of haemoglobin or to some structural modification linked to the environment of haemoglobin by the extracts and fractions, indicating that it has a role in the treatment of sickle cell disorders [16].

Antiurolithiatic Activity

Urolithiasis was induced in rats by administrating 0.75 % of ethylene glycol orally for 30 days and analysed by the serum marker enzymes as ACP, ALP, AST, ALT, Creatinine and Uric acid. The toxic rats were treated with the ethanolic leaf extract of *Scoparia dulcis* for 30 days. Study shows that the treatment with *Scoparia dulcis* is capable of counteracting the toxic effect caused by Ethylene glycol in serum and it can be used as an anti urolithiatic drug [17].

Antioxidant Activity

The antioxidant efficacy of *S. dulcis* in STZ diabetic rats was compared with Glibenclamide [2]. A significant increase in the activities of plasma insulin, superoxide dismutase, catalase, glutathione peroxidase, glutathione-S-transferase and reduced glutathione was observed in brain on treatment with 200 mg/kg body weight of *S. dulcis* plant aqueous extract and glibenclamide for 6 weeks. Both the treated groups showed significant decrease in thiobarbituric acid reactive substances (TBARS) and hydroperoxides formation in brain, suggesting its role in protection against lipid peroxidation induced membrane damage. It may be concluded that in diabetes, brain tissue was more vulnerable to oxidative stress and showed increased lipid peroxidation. The above observation shows that the aqueous extract of *S. dulcis* plant possesses antioxidant activity, which could exert a beneficial action against pathological alterations caused by the presence of free radicals in STZ diabetes[2,5,7].

Anti-allergenic effects of *Scoparia dulcis*

The hydro-ethanolic extract of *Scoparia dulcis* exhibited mast cell stabilizing and anti-anaphylactic effects in murine models upon exposure to a known allergen (compound 48/80). In vitro cytological and histological studies were conducted on guinea-pigs peritoneal cells and mesenteric tissues, respectively, to establish mast cell stabilization effect of the extract on compound 48/80-induced mast cell degranulation. The study revealed significant protection of SDE against compound 48/80-induced anaphylactic shock characterized by decrease in intensity, and delay in the development or onset of symptoms of dyspnoea, asphyxia, collapse and/or death. The pharmacological properties of SDE observed in this study could be attributed to the phytochemical constituents present. Tannins have been identified to inhibit the release of histamine, bradykinin and serotonin from inflammatory cells, whilst steroids and saponins are known to possess anti-inflammatory and mast cell stabilizing activities, via inhibiting the synthesis of specific asthma markers such as prostaglandins, leukotrienes, histamine, bradykinin and serotonin. Also, alkaloids and glycosides (for example, luteolin) have been reported to be potent inhibitors of histamine release from mast cells, and inhibit CD40 ligand expression by basophils and mast cells; which is required in the activation and differentiation of B cells into IgE-producing plasma cells. Hence, the hydro-ethanolic extract of *S. dulcis* has significant mast cell stabilizing and anti-anaphylactic activities; making it a better adjunct in asthma management [18].

Antiulcer activity

The aqueous extract of leaves of *Scoparia dulcis* was investigated for its anti-ulcer activity against pylorus ligation and ethanol induced ulcer models in experimental rats at doses of 250 and 500 mg/kg body weight p.o. and showed significant reduction in gastric volume, free acidity and ulcer index as compared to control indicating the anti-secretory mechanism involved in the extract for their antiulcerogenic activity. The protection of aqueous leaf extract of *Scoparia dulcis* against characteristic lesions may be due to Scopadulcic acid B (SA-B), and its debenzoyl derivative, diacetyl scopadol (DAS), has been shown to inhibit gastric H+, K(+)- ATPase 25. These results support the ethno medical uses of *Scoparia dulcis* in the treatment of ulcer [19].

Toxicological evaluation

The aqueous extract of *S. dulcis* did not produce any mortality up to the oral dose level of 8 g/kg body weight in mice. There were no changes in behaviour, posture, nature and frequency of stooling, mood and motor activity. The animals did not convulse, exhibit writhing or die.

Daily administration of the extract for 30 days did not produce gross toxicological symptoms or deaths. Histopathological effects of the administration of 250 and 500 mg/kg per day of the extract of *S. dulcis* to rats showed no evidence of tissue necrosis on the heart, liver, lung and testis. There were no marked adverse alterations or degeneration of tissues since these vital organs showed normal architectures suggesting no morphological disruptions as compared with the control group. It is an indication of the low toxicity of the extract, therefore *S. dulcis* could be said to be relatively safe [16].

Conclusion

From this review we can conclude that studies with new active principles obtained from the whole plant of *Scoparia dulcis* can results in novel and effective pattern of treatment. Chemical substances derived from this plant have been used to treat human diseases since the dawn of medicine. This plant may provide leads to find therapeutically useful compounds. Thus more efforts should be made towards isolation and characterization of the active principles

and their structure activity relationship. The combination of traditional and modern knowledge can produce better drugs for the treatment of various ailments with fewer side effects.

Conflict of interest

We declare that we have no conflict of interest

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