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REVIEW ON SCOPARIA DULCIS

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ABSTRACT

Scoparia dulcis is found in tropical and subtropical regions, such as America, Brazil, the West Indies, India, and Myanmar. It is a member of the family Scrophulariaceae. This shrubby perennial herb can grow up to 60 cm tall. It is erect, has many branches, and stems that are angled or ribbed. branches. 1.2–5 cm long, narrowly oblanceolate to elliptic-lanceolate, hairless but densely punctuated below, edge crenate to occasionally severely serrate in the upper half, and frequently having three or four leaves in whorls, sometimes opposite. Numerous phytochemicals, including tannins, flavonoids, amino acids, terpenoids, polyphenols, and catecholamines, are found in *Scoparia dulcis*. Several extraction techniques, including maceration and Soxhlet extraction, can be used to extract these phytochemicals. *Scoparia dulcis* has a range of pharmacological actions as a result of these phytochemicals. *Scoparia dulcis* has a number of medicinal applications.

KEYWORDS: Scoparia dulcis, Phytochemicals, Extraction, Pharmacological activity, Scrophulariaceae, Medicinal.

INTRODUCTION

Humans have naturally looked to herbal sources for healing since the beginning of time. People on every continent practice this tradition, and most have rich prehistories. There is proof that ethnomedicine still makes extensive use of plants worldwide. On Earth, there are between 250,000 and 500,000 different kinds of plants. Humans and other animals eat only a

small portion of them—probably between 1 and 10%. Thus, there is a great deal of potential for using plants as medicine and remedies.[1]

A remarkable ethnomedical plant, Scoparia dulcis (Scrophulariacae), also referred to as sweet broom weed, grows as a perennial herb in tropical and subtropical regions of India, America, Brazil, the West Indies, and Myanmar. India is a fortunate tropical nation. has a wealth of natural resources and age-old wisdom that can be used wisely. To be accepted by modern medicine, these medicines must undergo a scientific assessment in order to ascertain their pharmacological activity and understand their active principles. Historically, the pharmaceutical industry has relied on natural materials derived from plants and animals as a significant source of lead molecules for the development of novel pharmaceuticals and therapies. Numerous clinically beneficial medications have been found as a result of the hunt for novel pharmacologically active substances in natural resources like plants, animals, and microorganisms.[2]

US citizen. People have historically used it to treat bronchitis, inflammation, hypertension, and diabetes mellitus. Additionally, a number of studies revealed that this plant had antiviral, anti-hyperglycemic, and anti-inflammatory properties. A recent study demonstrated that *Scoparia dulcis'*s flavonoid fraction SDF7 (quercetin, p-coumaric acid, luteolin, and apelin in the ratio of 8: 26: 1: 3) might molecularly promote L6 myotubes' uptake of glucose.[3] In these regions, S. dulcis plants, either fresh or dried, have long been used as analgesics and antipyretics, as well as remedies for conditions including bronchitis, diabetes, hypertension, and stomach problems. The plant's stated. Numerous unique principles, such as scoparic acid A, scoparic acid B, scopadulcic acid A and B, scopadulciol, and scopadulin, have been connected to medicinal action. These compounds were found to possess a number of biological characteristics, such as the capacity to inhibit the herpes simplex virus's reproduction, activate the stomach's H+ and K+ ATPases, and possess anticancer effects. In a study on the antidiabetic activity of *Scoparia dulcis*, fresh plants were used to extract a glycoside called ammelin, which quickly cured additional diabetes-related conditions such as pyorrhea, eye problems, joint discomfort, cold sensitivity, etc.[4] One of the primary signs of osteoarthritis in the knee is pain, which also drives patients to seek medical care. The herb *Scoparia dulcis* is often used to ease pain from a variety of unpleasant ailments.[5]

Taxonomy

Kingdom: Plantae

Sub-kingdom: Trachcobionta

Division: Magnoliophyta

Class: Magnoliopsida

Family: Scrophulariaceae

Genus: Scoparia

Species: dulcis

Botanical name: *Scoparia dulcis* Linn

Morphology of *scoparia dulcis*

Roots: The roots are pale yellow to brown in color and usually measure 7 to 13 cm in length. The root may be straight or have several hair-like extensions known as lateral roots, depending on the structure. The tap root system is where this rooting method falls under.

Figure 1: Roots of *scoparia dulcis.*

Stems: It is a wiry-stemmed, perennial herb that can grow up to one meter in height. In the rainy season, young shoots are accessible. The herb's stem has no hair and is woody at the base.[6]

Figure 2: Stems of *scoparia dulcis.*

Leaves: The dark green, elliptic, oblong, or obovate leaves (1.3–3.8 cm) are opposite or three–four whored, with a tapering base, acute apex, and serrated edge. Lots of flowers in terminal panicles; pedicelate, stiff, slender pedicels; four oblong lobes on the calyx; a white, short tube; a globose capsule; and tiny, numerous seeds.[7]

Figure 3: Leaves of *scoparia dulcis.*

Fruits: The fruits are oval-shaped and have a lengthy, dehiscent capsule. The fruit is topped by the style. When it is fully mature, it splits into two sections.

Figure 4: Fruits of *scoparia dulcis.*

Flowers: The flowers are 5-7 mm in diameter, regular, hermaphrodite, complete, and typically auxillary. The calyx lobes of the sepals are persistent, ciliated at the border, and oval-oblong in shape. Corolla with long lobes, an obtuse apex, and a thickly hairy tube, especially toward the throat. The stigma is reduced to two sections, the anthers are fixed dorsi-rectally and have an erected style, and there are four greenish-colored stamens with filaments inserted at the apex of the corolla tube.Nearly the entire year is a blossoming period.

Figure 4: Flowers of *scoparia dulcis.*

Seeds: The seeds have an oblong form. The ideal temperature range for the herb's seeds to germinate is between 25°C and 30°C. Gibberellic acid, sodium nitrate, and ammonium nitrate solution treatments enhanced germination in light-incubated seedlings. The herb's seeds are spread by buffaloes and cattle. *Scoparia dulcis* seeds are subject to induced dormancy, meaning that a sudden exposure to unfavorable environmental conditions might stop the seeds from germinating.[6]

Phytochemistry of *scoparia dulcis*

Several thorough scientific tests and a review of the literature revealed that Scoparia dulcis contains chemical components such tannins, flavonoids, amino acids, terpenoids, polyphenols, and catechol amines. Terpenoids, which have a number of therapeutic properties, were found to be present in a minor fraction of the aqueous extract after examination using high-performance liquid chromatography (HPLC). These plant portions also include a few physiologically active substances, including scoparic acid, scopadulaic acid, and scopadulin. Strong analgesic and anti-inflammatory effects are exhibited by both the triterpene found in the herb and the triterpene extracted from effective preparations. The results of the study show that the plant parts contain the terpenoids scopadulcic acid B and betulinic acid, as well as the flavonoids luteolin, scutellarein, and apigenin.[8]

Rohmer et al. recently showed that a non-mevalonate route participates in the manufacture of terpenoid compounds. Eisenreich et al. confirmed that the mevalonate pathway was not involved in the production of the taxoid based on the t~C labeling patterns of taxuyunnanine C. It has been proposed that higher plants' chloroplasts biosynthesize mono- and diterpenoids from glucose via a non-mevalonate mechanism. Therefore, it is possible that SDB and SDC are biosynthesised from glucose via the non-mevalonate pathway, notwithstanding our earlier

suggestion that mevalonic acid is a biosynthetic precursor of these diterpenoids. because it has been determined that apapidicol is biosynthesised via the mevalonate pathway.[9]

The methanol extract fractions of Scoparia dulcis (Linn) contained phytochemical components such as alkaloids, balsams, cardiac glycosides, glycosides, phenols, tannins, and steroids, while extracts from Pulicaria crispa also contained these same compounds. phytochemical substances in addition to phenols, tannins, terpenoids, glycosides, and flavonoids. Although saponins were only found in the semi-polar fractions of Scoparia dulcis (Linn), they were found in the n-hexane fractions of both plants.[10]

Methods of extraction

Soxhlet extraction: 500 g of the coarsely powdered, shade-dried *Scoparia dulcis* entire plant were treated to successive hot extractions using 70% ethanol and water separately. After the extracts were filtered and dried, the yield percentage was computed using crude powder that had been air-dried.[11]

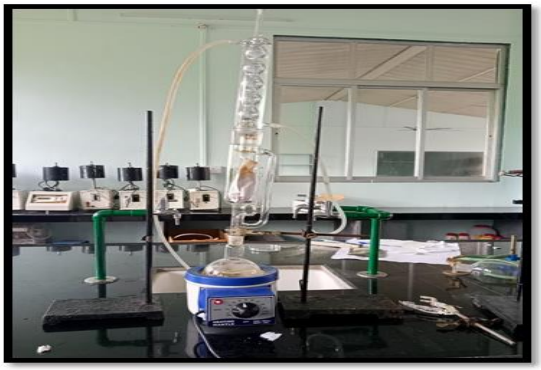

Figure 5: Soxhlet apparatus.

Maceration: The ground material was weighed, then macerated for 72 hours in three different solvents: methanol (MeOH), methylene chloride (MeC), and hexane (Hex). The process of maceration was carried out two times for each solvent. The mixture was filtered using a rotary evaporator (BUCHI Rotavapor R-200, Switzerland), and the filtrate was concentrated at the appropriate temperatures. After recovering the concentrates with methylene chloride, they were allowed to stay at room temperature until any leftover solvents had evaporated. Until they were needed for testing, the dehydrated raw materials were stored at -20 °C. The different plant extracts were made as stock solutions using 25 mg/ml of >99.8% dimethyl sulfoxide (DMSO) (Sigma, USA). Until they were tested biologically, these solutions were stored at -20 °C.[12]

Identification

Bersama abyssinica Fresen. and Scoparia dulcis L., two African medicinal plants, are extracted using methanol, water, and ethyl acetate. Enzyme inhibitory activities, antioxidant characteristics, and phytochemical profiles of α-amylase, α-glucosidase, acetyl- and Extracts from Bersama abyssinica and Scoparia dulcis were shown to contain butyrylcholinesterase, lipase, and tyrosinase. Both the aqueous (180.62 and 61.81 mg gallic acid equivalent/g extract, respectively) and methanolic (75.21 and 57.81 mg rutin equivalent/g extract, respectively) extracts of B. abyssinica and S. dulcis had high levels of phenolic and flavonoid compounds. Both plant extracts made from ethyl acetate demonstrated strong inhibition of α-glucosidase and tyrosinase. Using HPLC-MS/MS, several phytochemical groups were identified. Based on the available data, it appears that S. dulcis and B. abyssinica could be developed into novel medicinal medicines.[13]

The recommended high-performance liquid chromatographic method was shown to be useful and effective for the quality control of alpha-amyrin in plants after being evaluated for linearity, precision, accuracy, and application. passages. Having a 0.9997 correlation coefficient, it. The observed signal was found to be linear, precise, and accurate across the investigated concentration range (0.008–0.032 mg/mL).The suggested HPLC method for determining alpha-amyrin has been demonstrated to be linear, exact, accurate, and selective, supporting its use in routine quality control analysis.[14] Alpha amyrin and beta amyrin are triterpenoids which acts as anti-depressant agent.[15] Mixture of alpha amyrin and beta amyrin is present in the extract of *Scoparia dulcis.*[16]

Phytochemical analysis

Tests for coumarins: One milliliter of glacial acetic acid plus FeCl3 plus strong sulfuric acid must be used to treat the extracts. The presence of cardiac glycosides is indicated by the formation of a green-blue color.

Test for phenolic: The extract was dissolved in five milliliters of distilled water. This was mixed with a tiny quantity of a neutral 5% ferric chloride solution. Dark green tints were used to identify phenolic compounds.

Test for alkaloids: Warming both the methanolic and aqueous extracts took two minutes using 2% H2SO4. After filtering and adding a few drops of Mayer's reagents, the presence of alkaloids is indicated by the production of a yellow-cream precipitate.

Test for flavonoids: Extracts must be treated with a few drops of a solution containing sodium hydroxide. Falvonoids are indicated by the formation of a bright yellow color that turns colorless when diluted acid is added.

Test for vitamin-C: Dinitrophenyl hydrazine, dissolved in strong sulfuric acid, was applied to the test solution. The presence of vitamin C would be suggested by the production of a yellow precipitate.

Test for saponins: Four milliliters of distilled water were used to dilute a small amount of a separate extract. After giving the combination a good shake, the mixture was seen to be stable.

Detection of glycosides: One milliliter of glacial acetic acid plus FeCl3 plus strong sulfuric acid must be used to treat the extracts. The presence of cardiac glycosides is indicated by the formation of a green-blue color.[16]

Pharmacological effects

Anti-bacterial activity: Petroleum ether, chloroform, ethanol, and an aqueous extract of *Scoparia dulcis* L stems and leaves have pathogen-opposing antibacterial activity. When it came to Staphylococcus, the pathogen-resistant zones of ethanol and chloroform were 9 mm and 10 mm, respectively. The pathogen-resistant zones of the ethanol and aqueous extract against Klebsiela pneumonia were 8 mm apiece.[10]

Hypoglycemic activity: The effects of various *Scoparia dulcis* L. extracts were investigated in order to assess the degree of effectiveness of each extract. In order to determine the efficacy of different extracts as an in vivo antidiabetic, blood glucose levels in male Swiss albino mice (20–25 gm) that were given an injection of 150 mg/kg body weight of hourly for six, twenty-four, and forty-eight hours of streptozotocin (STZ). The acetone extract of Scoparia dulcis L. exhibits a stronger and more noticeable hypoglycemic effect than the other extracts. When this plant extract was administered to diabetic mice, the high biochemical parameters were recovered. The activity was discovered to be time-dependent, as the glucose level gradually decreased after six, twenty-four, and forty-eight hours.[17]

Anti-microbial activity: At specific doses, the zones of inhibition were seen against specific microorganisms. The *Scoparia dulcis* leaf methanolic extract exhibited greater efficacy against E. coli. The extract exhibited good inhibitions against the other bacteria at concentrations of 400 µg and 500 µg/disk. However, the extract had little to no effect on the Gram-negative S. dysenteriae bacterium. According to the findings of our current

investigation and other studies of antibacterial activity, the crude plant extract is noticeably more efficient against gram-positive bacteria than gram-negative ones. This suggests that a broad-spectrum antibiotic may be suggested by the extract.

Cytotoxic activity: The percentage of death in the cytotoxic test activity grew progressively as the test sample concentration rose. The best-fit line slope yielded LC50 values of 24.879 µg/ml for vincristine sulfate and 29.868 µg/ml for S. dulcis, respectively. When it comes to mice's paw edema brought on by carrageenan, both the ethanol extract of S. dulcis and a substance known as betulinic acid have demonstrated anti-inflammatory effectiveness. This chemical exhibited cytotoxic and anticancer properties as well. Additionally, the diterpenes extracted from S. dulcis have the capacity to be cytotoxic.

Antioxidant activity: The effects of an oral 200 mg/kg body weight aqueous extract of the Scoparia dulcis plant on blood glucose, plasma insulin, and thiobarbituric acid reactive substances (TBARS) levels in rats with diabetes caused by streptozotocin (STZ) Measurements were made of hydroperoxides, reduced glutathione (GSH), glutathione-S-transferase (GST), glutathione peroxidase (GPx), catalase (CAT), and superoxide dismutase (SOD). The usual reference drug used was glibenclamide. The brain showed a significant increase in the activities of plasma insulin, superoxide dismutase, catalase, glutathione peroxidase, glutathione-S-transferase, and reduced glutathione after a 6-week course of treatment with 200 mg/kg body weight of Scoparia dulcis plant extract (SPEt) and glibenclamide. The brains of both treated groups exhibited a noteworthy reduction in TBARS and hydroperoxide production, indicating its potential protective effect against membrane damage caused by lipid peroxidation. Since studies on the induction of antioxidant enzymes are considered to be a reliable indicator for assessing the antiperoxidative efficacy of the medicinal plant, these findings suggest a possible antiperoxidative role for the plant extract Scoparia dulcis. Therefore, *Scoparia dulcis* has the potential to be employed therapeutically for its antioxidant properties in addition to its antidiabetic effect.[18]

The activities of ceruloplasmin, SOD, CAT, GPx, GST, GSH, and vitamins C and E were measured in order to examine the effects of SPEt on antioxidants and the production of free radicals. Ceruloplasmin levels sharply rose and then significantly decreased. In the amounts of enzymatic and non-enzymatic antioxidants in diabetic control rats. Antioxidant levels were noticeably higher in diabetic mice after receiving SPEt. Rats treated with *Scoparia dulcis* showed a greater degree of growth than rats treated with glibenclamide.[19]

Analgesic and anti-inflammatory activity: The mice experienced bodily discomfort and irritation after receiving acetic acid administration. When given to rats, carrageenan resulted in paw edema. The ethanolic decoction of leaves reduced the discomfort in both cases after treatment. Consequently, it was determined that the administration of triterpene glutinol and diterpene scoparinol strongly suggested the presence of analgesic activity. An inflammatory response is brought on by some irritants, infections, or harm to live cells. The anti-inflammatory effect was induced by the ethanolic extract. Menstrual discomfort and pain were treated using medications made from these infusions. Both labor pains and the use of the extract as medication are avoided.[20][6]

Protective role in alzheimer's disease: Neurodegenerative diseases associated with aging, such Alzheimer's disease (AD), might appear at the same time. The etiology of AD is oxidative stress, which leads to the oxidation of macromolecules such as proteins, lipids, and DNA. In light of *Scoparia dulcis*'s potential role in AD therapy, the current study set out to assess how well proteins and lipids are protected against damage from free radicals and anticholinesterase activity. Moreover, the phytochemical profile of the phytochemical profile of *Scoparia dulcis* extract was noted The methanol, butanol, and ethyl acetate fraction components in Scoparia dulcis were subjected to quantitative phytochemical (phenolic, flavonoid, and tannin concentrations) analysis using standard spectrophotometric techniques. Phytochemical concentrations at their maximum, in butanolic extracts, including phenolics, flavonoids, and tannins. Along with showing the greatest dose-dependent inhibition of acetylcholinesterase potential and DPPH radical scavenging, the butanolic extract also had IC50 values of 93.24 and 22.8 µg/mL, respectively. Additionally, lipid peroxidation caused by FeSO4 was significantly suppressed in the butanol fraction.Methanol samples exhibited the highest level of free-radical-induced inhibitory effect against protein oxidation. This study's findings indicate that S. dulcis may be a useful ingredient in the creation of anti-AD medications.[21]

Anti-Onchocercal properties: The butanolic extract also showed the greatest dose-dependent inhibition of acetylcholinesterase potential and DPPH radical scavenging, with its respective IC50 values of 93.24 and 22.8 µg/mL. Moreover, there was a significant inhibition of the butanol fraction's lipid peroxidation brought on by FeSO4. The strongest inhibitory effect of free radicals on protein oxidation was seen in methanol samples. According to the study's findings, S. dulcis could be a valuable component of anti-AD drugs. The butanolic

extract also showed the highest dose-dependent reduction of phosphorylcholinesterase potential and DPPH radical scavenging, with IC50 values of 93.24 and 22.8 µg/mL, respectively. Additionally, lipid peroxidation caused by FeSO4 was significantly suppressed in the butanol fraction. Methanol samples exhibited the highest level of free-radical-induced inhibitory effect against protein oxidation. This study's findings indicate that S. dulcis may be a useful ingredient in the creation of anti-AD medications.[12]

Anti-sicking activity: Utilizing a modified version of Moody and colleagues' approach, we evaluated the anti-sickling qualities of Scoparia dulcis leaf extract and fractions. Patients with sickle cell anemia had venipuncture blood samples placed in EDTA containers. weren't in any kind of crisis.To extract the serum, the collected samples were centrifuged. Following this, the packed erythrocytes were centrifuged three times to extract the supernatant after washing them with sterile normal saline.[22] Each of the three aqueous methanol extract or fraction strengths (100, 300, and 500 mg/ml) was mixed with half a milliliter of the erythrocytes that had been cleansed. (5 mg/ml) in not-coated test tubes. From the different mixes, five duplicates of each sample were taken at 0 minutes and then every 30 minutes until seven readings were obtained. Each sample was dried, fixed with 95% methanol, and stained with Giemsa dye after being spread out on a small slide. We used an oil immersion lamp to examine each slide. a microscope, and 100 red blood cells from each sample.

We counted the cells. The percentage of red blood cells without sickles was computed by counting the cells with and without sickles. Throughout the entire test period, there was a considerable percentage of sickling inhibition at each of the different dosages of S. dulcis extracts. The antisickling activity shown at 100 and 200 did not differ significantly. as well as 300 mg/ml. The n-butanol and petroleum ether fractions showed no inhibitory effects.[23]

Anti-ulcer activity: The mice received oral dosages of 25, 50, 100, and 200 mg/kg of Scoparia dulcis water extract. An oral dose of indomethacin (50 mg/kg body weight) was administered to all mice five minutes after the aqueous extract from Scopaia dulcis was administered.Animals were killed six hours after beginning all treatments. Rats' guts were taken out and split apart along the larger curve and cleaned with a physiological serum solution. The cumulative sum of the lengths of the stomach lesions was used to calculate the ulcer index.[24]

Sedative and Hypnotic activity: Following the maceration process, ethanol was used to extract the complete Scoparia dulcis plant, and the phytochemical composition was analyzed. Next, tests for determining sleeping times caused by thiopental sodium (hole cross, open field, hole-board, Rota-rod, and others) were employed to investigate the hypnotic and sedative effects of EESD at dosages of 50, 100, and 200 mg/kg in mice. Diazepam, a reference drug, was used in all assays at a dosage of 1 mg/kg. We found that EESD substantially and dose-dependently decreased the mice's locomotor activity in both the hole-cross and open-field tests ($P < 0.05$). Additionally, it reduced the number of head dips in the hole-board test as well as rota-rod performances.[25]

Anxiolytic activity: Crude hydroalcoholic extract of *Scoparia dulcis*.'s anti-anxiety effects using a range of behavioral models. Phenols and flavonoids were found based on preliminary phytochemical analysis. The anti-anxiety activity of the extract at dosages of 100 and 200 mg/kg was assessed using the open-field test (OFT), the elevated plus maze test (EPM), the elevated zero maze test (EZM), and the social interaction test (SI). Additionally, the findings of behavioral tests and the novely-induced suppressed feeling latency test [FL] demonstrated that *Scoparia dulcis* has standard-level anti-anxiety activity that is dose-dependent. The crude hydroalcoholoic extract was found to have anti-anxiety properties. To determine the anxiolytic mechanism or mechanisms and phytochemicals underlying the hydroalcoholic extract of Scoparia dulcis's apparent anxiolytic action, more research is required.[26]

Commonly found on wastelands and fallow fields, Scoparia dulcis is a glabrous undershrub with tiny white blooms. The indigenous medical system makes extensive use of this plant to treat liver conditions.

Hepatoprotective activity: Three distinct forms of diterpenoids were identified by phytochemical screening of the plant: aphidicolin-type, scopadulin; labdane-type, scopadulcic acids A, B, and C, and scopadiol; and scopadulan-type, scopadulcic acids A and B, and scopadiol. Additionally, it is said to contain amellin, an antidiabetic molecule, flavonoids, and 7-O-methyl scutellarein. In the present study, the terpenoid extract of the plant was prepared using PDM and evaluated for its hepatoprotective activity against CCl_4-induced acute liver injury in mice and in vitro free radical scavenging activity.[27]

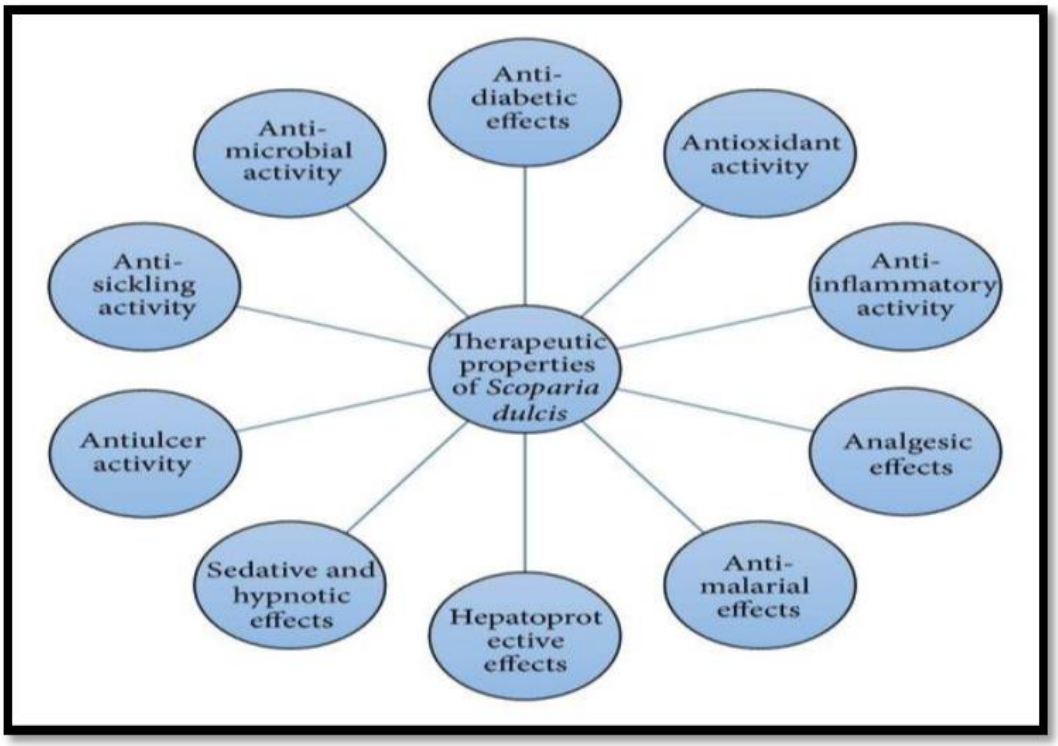

Figure 6: Therapeutic properties of *scoparia dulcis.*

CONCLUSION

In this review, we provided brief information about the *Scoparia dulcis* plant. We discussed the the morphology of *Scoparia dulcis* as well as phytochemistry. According to previous studies, *Scoparia dulcis* contains various medicinally important phytochemicals such as scopadulcinol, scoparic acid, apigenin,betulinic acid, alpha amyrin, and beta amyrin. Due to the presence of these physiologically ative compounds, Numerous pharmacological effects, including antibacterial, hypoglycemic, antimicrobial, cytotoxic, antioxidant, analgesic, antiulcer, and anxiolytic properties, are demonstrated by Scoparia dulcis.There is a need for more studies about other pharmacological activities of *Scoparia dulcis*.

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