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EXPLORING THE SEVERAL BIOLOGICAL ACTIVITIES OF *GENUS SCROPHULARIA* : A NARRATIVE REVIEW

Medicinal Plants

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ABSTRACT

There are over 200 species of herbaceous flowering plants in the genus Scrophularia of the family Scrophulariaceae that are usually referred to as figworts. Herbal medicine practitioners utilise various species of Scrophularia, including the Ningpo figwort (S. ningpoensis), since they are known to contain potentially beneficial chemicals including iridoids. The objective of this study was to perform narrative review on various biological activities of different scrophularia species. A search of literature on Scrophularia and biological activities was conducted by using electronic databases like google scholar, pubmed, researchgate. The article included the information on their biological function. Among these, iridoids that resemble scropolioside have demonstrated the ability to have anti-inflammatory, hepatoprotective, and wound-healing properties. Resin glycosides, like crypthophilic acids, are among the less commonly isolated chemicals that have demonstrated strong antiprotozoal and antibacterial activity. This narrative review conclude that some of the species have been used for a long time as traditional or local therapeutic remedies, particularly in Asia and Europe, where their efficacy and safety have been established and it has significant therapeutic role in management of diseases.

KEYWORDS

Alkaloids, Biological Activities, Experimental studies, Scrophularia, Species, Therapeutic potential.

INTRODUCTION :

The Scrophulariaceae family comprises approximately 220 genera. One of the larger genera in the Scrophulariaceae is the Scrophularia genus. These taxa are primarily found in mountainous areas (such as Scrophularia farinosa Boiss. and Scrophularia amplexicaulis Benth.), with a smaller distribution in desert areas (such as Scrophularia deserti Delile). Iran's flora contains 60 species of this genus, which has diuretic, circulatory stimulant, and heart stimulant properties. Antipyretic, febrifuge, antibacterial, anti-erythematous, anti-constipation, antifurunculosis, ulcerous stomatitis, and tonsillitis treatment are some more traditional uses of this species.

The use of medicinal plants emerges as an alternative to synthetic products, which are used not only in traditional medicine but also in a number of food and pharmaceutical industries, due to their nutritional properties and bioactivity[1]. Higher plants produce a great variety of secondary products. Although, some of the natural products have been replaced by synthetic substitutes because of cost considerations, a number of commercially important high value chemicals are still being extracted from plants[2,3] . The modern pharmaceutical industry is thus still looking for new active compounds from plant secondary metabolites[4].

Scrophularianodosais one of the homeopathic medicines used for the various disorders. It belongs to family Scrophulariaceae and genus Scrophularia.More than 200 species, mostly perennials, make up the genus. The upright stems often resemble those of the Lamiaceae family because they carry lobed blooms and have square, opposite leaves. The terminal branched flowerheads with larger staminodes (non-fertile stamens) and distinctive seed casings are characteristics of Scrophularia species.Various species from this genus have been used for traditional medicine. These species were Scrophularianingpoensis, Scrophulariavariegate, Scrophularianodosa, Scrophulariagrossheimii, Scrophulariacanina, Scrophulariaoldhamii, etc. ScrophularianingpoensisHemsl., is extensively used for many inflammatory diseases in traditional Chinese medicine[6,7,8]. It is also registered in the Chinese Pharmacopeia against febrile diseases with excessive thirst or eruptions, skin disorders, cough due to exhaustion, constipation, and conjunctivitis[9]. Similar activities were reported by other species of Scrophularia such as Scrophulariaauriculata L. or Scrophulariacanina L. from the Mediterranean area[10,11,12].In the traditional Iranian medicine,Scrophulariavariegata M. Bieb.AndScrophulariastriataBoiss.were used since long time[13,14].

In Turkish traditional medicine, Scrophularianodosa L. was reported to have diuretic properties, use to treat hemorrhoids, psoriasis, pruritus, wound healing, eruptive skin diseases, and eczema[17,18]. Similar activity were also reported for ScrophulariadepauperataBoiss., ScrophulariacryptophilaBoiss. et. Heldr.Boiss., and Scrophularia floribundaBoiss. et. Bal. in Turkish traditional medicine[19]. ScrophulariaoldhamiiOliv.and as a diuretic for ScrophulariagrossheimiiSchischkin were evaluated as antipyretic and anti-inflammatory agent[15]. The active components were detected by various methods from Scrophularia species [23]. Phenylpropanoidverbascoside were detected in many species of the Scrophulariaceae family[20,21,22,23]. The above mentioned evidences conclude about the pharmaceutical important of Scphularis species.

METHODOLOGY :

A systemic search of literature on Scrophularia was conducted. For the literature search electronic database like Pubmed, Google scholar, researchgate was used. The search was done using keywords like Scrophularia Genus, Biological Activity, Antibacterial, Experimental studies. In this article only Experimental studies were included. In vivo studies and unpublished articles are excluded from article.

DISCUSSION :

The *Scrophularianodosa* plant was reported to have many health beneficiary and therapeutic compounds[4].Giner et al., (1998) reported scrovalentinoside was major iridoid found in the *Scrophularialucida* L based on the MS and NMR studies. Many authors'published spectroscopic data onScrophularia species i.e. *S. auriculata* L. ssp. *pseudoauriculata* (Senn.)[24]; *S. nodosa* L.[26]; Scrophulariabuergeriana (Miquel)[29]; Scrophulariascopolii [Hoppe ex] Pers. var. scopolii[30]; etc.Bhandari et al.(1992) and Lewenhofer et al. (2018) reported koelzioside as a major iridoid from *Scrophulariakoelzii* L. Similar report was published for *Scrophulariadeserti* Del[28]. Our results are accordance with these reports.

The content assessment of the main active compounds in different powder fractions of *Hedera helix* (L.) and *Scrophularianodosa* (L.) revealed that intermediate and fine powders contained the highest concentrations of the active components[31].The quantitative determination by HPLC of the major compounds in the methanolic extract discoveredhomoplantaginin (3%), scrovalentinoside (1.4%), and koelzioside (0.7%)[34].

Sesterhenn et al., (2007) reported many medicinal properties of *Scrophularianodosa* (L.). The plant was used to treat ulcers and joint pains, wounds, and eczema. It also exhibits anti-inflammatory property[35,36,37]. In folk medicine, this plant can be used against skin rashes as a laxative and diuretic agent. The principle secondary

metabolites include polyphenols such as phenolic acids, and flavonoids and glycosides such asiridoid glycosides and harpagoside. In the present study also, many polyphenols were identified. Our results are accordance with this report.Among phenolic acids, caffeic acid has hypoglycemic properties and a strong antioxidant activity[37].Quercetin glycosides identified in this plant are quercetin-O-rhamnoside, quercetin-O-glucoside, and rutin, known for their antioxidant properties[38]. The plant known to have antioxidative[40,41], anti-inflammatory, antibacterial, antiviral[42], anti-cancer properties[39,40] and neuroprotective therapeutic effects[36]. Many secondary compounds identified in the present study reported to have the above mentioned therapeutic effects.

Table 1. Biological Activities of different species belongs to Genus *Scrophularia*

Sr. No	Species	Biological Activities
1	**S. amplexicaulis**	Antibacterial (aginest S. aureus) Antimalarial Free radical scavengering activities and general toxicity
2	**S. dentate**	Anti-inflammatory activity significantly inhibited CoA-induced splenocyte proliferation
3	**S. auriculata**	Antibacterial Anti-inflammatory
4	**S. buergeriana**	Neuroprotective & Anti-amnestic Hepatoprotective Anti-inflammatory Insecticidal activity
5	**S. cryptophila**	Antiprotozoal and antimycobacterial activities
6	**S. deserti**	inhibiting an enzyme or enzymes of Type II fatty acid synthesis (FAS) Anti-inflammatory Antidiabetic
7	**S. frutescens**	Antibacterial Anti-inflammatory Cytostatic activity
8	**S. grossheimi**	Hepatoprotective
9	**S. koelzii**	Hepatoprotective & immunostimulant
10	**S. lepidota**	Anti-protozoal & Antiplasmodial
11	**S. ningpoensis**	Cardioprotective Anti-inflammatory Antibacterial
12	**S. nodosa**	Wound healing activity
13	**S. oxysepala**	Insecticidal activity Apoptosis Cytotoxic Free radical scavenging
14	**S. striata**	Wound healing and Anti-inflammatory Antibacterial Antioxidant
15	**S. scorodonia**	Anti-inflammatory Antiviral
16	**S. takesimensis**	Strong aldose reductase (AR) inhibitory activity

CONCLUSION :

The quantity of studies on the diverse Scrophularia species metabolites, pharmacological properties, and traditional use has greatly expanded recently. Several factors, including the fact that some of the species have been used for a long time as traditional or local therapeutic remedies, particularly in Asia and Europe, where their efficacy and safety have been established, could lead to the screening of this genus, according to reviewed literature. As a result, there is a lot of interest in and a new field for the simpler search for possible compounds attributable to these sources. The diverse chemical compounds and biological activities of this genus will motivate further investigation on Scrophularia genus as a source of new therapeutic medications.

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