

Review Article***Fumaria parviflora* Lam. (Fumitory): A traditional herbal medicine with modern evidence**Suresh Kumar*^{1,2}, Anil Kumar Sharma³, Anjoo Kamboj⁴¹Lord Shiva College of Pharmacy Sirsa, Haryana, India-125055²Research Scholar, Department of Pharmacy, IK Gujral Punjab Technical University, Jalandhar, Punjab, India-144001³Formerly Director and Principal in CT Institute of Pharmaceutical Sciences, Jalandhar, Punjab, India-144020⁴Chandigarh College of Pharmacy, Landran, Mohali, Punjab, India-140110

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Abstract

Fumaria parviflora is an important medicinal herb which is used in various traditional medicines to cure many diseases. The herbal extracts have been reported to possess anti-inflammatory, antispasmodic, antidiarrheal, bronchodilator, hypoglycemic, anthelmintic, laxative, antiprotozoal, dermatological diseases, enhance male fertility and antinociceptive effect. Their biological activity is primarily associated with the presence of alkaloids such as protopine, cryptopine, parfumine, berberine, oxyberberine, fumarine, protocatechuic acid and caffeic acid. Some other bioactive are fatty acids, volatile oils and sesquiterpenoids and aromatic hydrocarbons in plant. The present review is therefore, an effort to give a detailed survey of the literature on its botany, phytochemistry and biological activities of *Fumaria parviflora*, chronologically.

Keywords: *Fumaria parviflora*, Protopine, fumitory, fatty acids

Introduction

Fumarioideae is a subfamily of the family Papaveraceae (the poppy family). It was formerly treated as a separate family, the Fumariaceae contains about 20 genera and more than 575 species, some of the genera contains biologically active compounds for example species of *Fumaria*, *Corydalis*, *Dicentra* and *Rupicapnos* which are reported for the treatment of variety of ailments. A species of *Fumaria*, indigenous to Europe, Africa and Asia, most diverse in the Mediterranean region, and introduced to North and South America and Australia had attracted great attention as an herbal medicine. The name of the genus is derived from the Latin fumus terrae, which means "smoke of the earth" (Orhan et al., 2012).

Occurrence, botanical description and ethnopharmacology

Fumaria parviflora (Fumariaceae) is a pale green, diffuse, much branched annual herb widely used in Ayurvedic medicine as well as in Traditional, Yunani system of medicine in throughout

of India. The name of the genus is derived from the Latin fumus terrae, which means "smoke of the earth". In India, it is known by its vernacular names, the most commonly used ones are Pitpapda, Pitpapra, Pitpapara, Shatra, Dhamgajra (Hindi), Araka, Charaka, Kalapanga, Katupatra, Krishnasakha, Ksheparpata, Nakra, Panshu, Panshuparyaya, Parpata, Parpatata, Pragandha, Pittari, Renu, Shita, Shitavallabha, Sutikta, Tikta, Trishnari, Triyashti, Varatikta, Varmakantaka (Sanskrit), Pitpapda (Marathi), Shahatra (Urdu), Khasuldio, Pitpapda, Pittpapdo (Gujrati), Tusa (Tamil), Chatarasi (Telugu), Bansulpha (Bengal), Fine-leaved Fumitory (English), Shahatra, Shatra (Sind), Baglatulmulk, Bukslatulmulik, Shahatraja (Arabic), Pitpapra, Shatra (Deccan), Tuy shat u chinh (Indochina), Khairuwa (Kumaon), Shahatra, Shatara (Persian), Papra, Pitpapra, Shahtara (Pushtu), Shatara (Quetta-Pishin) (Kirtikar and Basu, 2005). *Fumaria parviflora* has also known by other botanical names; fine leaf fumitory, fine-leaved fumitory and Indian fumitory (Orhan et al., 2012).

Previously, *Fumaria* in the Fumariaceae were recorded in Taiwan, and the *Fumaria officinalis* reported in north of Taiwan. This species was often found in farmland and is well established in cultivated field. The new species *F. parviflora* Lam., in central Taiwan and is now considered to

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be a naturalized plant. The morphological characters, line drawings, distribution maps, and photographs to aid in their identification (Wang et al., 2016).

It is found as a common weed over the greater parts of India, mostly in wheat field growing in the winter season and all over the plains of Haryana, Punjab, and some region of Himachal Pradesh in lower warmer areas up to 1400 m. (Gupta et al., 2012). Grows profusely as a weed in wheat fields, where its density often outnumbers the population of the main crop and in such cases has to be uprooted manually. Propagation of plant occurs through seeds and harvesting is done in month of February-March (Chauhan, 1999). Root is buff or cream coloured, branched, about 3 mm thick, cylindrical; and bitter taste. Stem is light green, smooth, diffused, hollow, about 2 to 4 mm thick; bitter and slightly acrid taste. Leaves are compound, pinnatifid, 5 to 7 cm long, divided into narrow segments; segments are 5 mm long and about 1 mm broad, linear or oblong, more or less glaucous, apex acute or subacute; petiole is very thin, 2.5 to 4.0 cm long; taste, bitter. Inflorescence raceme with 10 to 15 flowers, peduncle up to 3 mm, pedicels about 2 mm, flowers about 7 mm long, bract much longer than the pedicels; sepals 2, white, minute, about 0.5 mm long, triangular ovate, acuminate; corolla in 2 whorls with very small 4 petals, each about 4 mm long; inner petals with a purple or green tip; outer petals with 96 narrow spur, without purple spots stamens 3+3, staminal sheath subulate above, about 4 mm long, stigma 2 lipped. Fruits Capsule, are 2 mm long and slightly broader, subrotund, obovate, obtuse or subtruncate, obscurely apiculate, rugose when dry; nutlets globose, upto 2 mm long, single seeded (Kirtikar and Basu, 2005; API, 2004).

The plant has been widely used in Ayurvedic medicine system is bitter; cooling, expectorant, constipating, increases “vata” removes biliousness, fever, burning of the body, tired feeling, wandering of the mind, intoxication, urinary discharge, vomiting, thirst, enriches the blood, good in leprosy (API, 2004).

In Unani traditional medicine, the plant is prescribed for the treatment of diuretic, stomachic disorder and purifies the blood

in skin diseases, strengthens the lungs, the teeth and gives luster to the eyes, stops vomiting, good in diseases of the spleen (Kirtikar and Basu, 2005; Jameel et al., 2014).

The plant flowers are pink in colour, sour in taste and without smell. These small flowers are laxative and antipoisonous (Akbari et al., 2011). It helps the reduction of poison. This plant has relaxing and styptic characteristics and it is also found laxative and diuretic (Pearson, et al., 1996).

Phytochemistry

The important phytoconstituents reported include glycosides, tannins, saponins, triterpenoids, sterols (Figure 1) such as β -sitosterol, stigmasterol and campesterol and alkaloids (Figure 2) like protopine, adlumidicine, parfumine, oxyberberine, berberine, palmatine, dihydrosanguinarine, fumaricine, 8-oxocoptisine, protocatechuic acid and caffeic acid. Some other chemical constituents were found as essential oils, fatty acids, sesquiterpenoids and aromatic hydrocarbon etc in plant. The estimate protopine isoquinoline alkaloid and β -sitosterol in *F. parviflora* by using HPTLC method. The percentage of protopine and β -sitosterol were found to be 0.47–0.50% w/w and 0.23–0.26% w/w respectively (Modi et al., 2016).

The pharmacognostic and phytochemical biomarkers to distinguish between *Fumaria parviflora* Lam. and its adulterant, *Rungia repens* (L.) were studied for the plant materials in fresh form, powder form and extract form. Phytochemical analysis of the plants indicated the presence of two flavonols in *F. parviflora* and three in *R. repens*. Phenolic acid content also varied in both plants. The HPTLC fingerprints of both the plants showed enough variation for identification of adulteration (Gohil et al., (2014).

New phytoconstituents isolated from the aerial parts of *Fumaria parviflora* Lam and the name of these five new

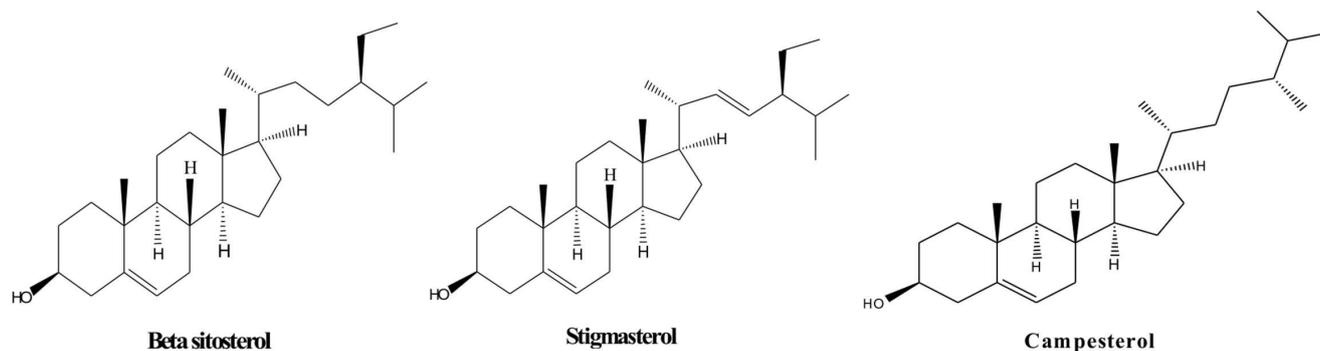


Figure 1. Sterol from the *Fumaria parviflora* plant

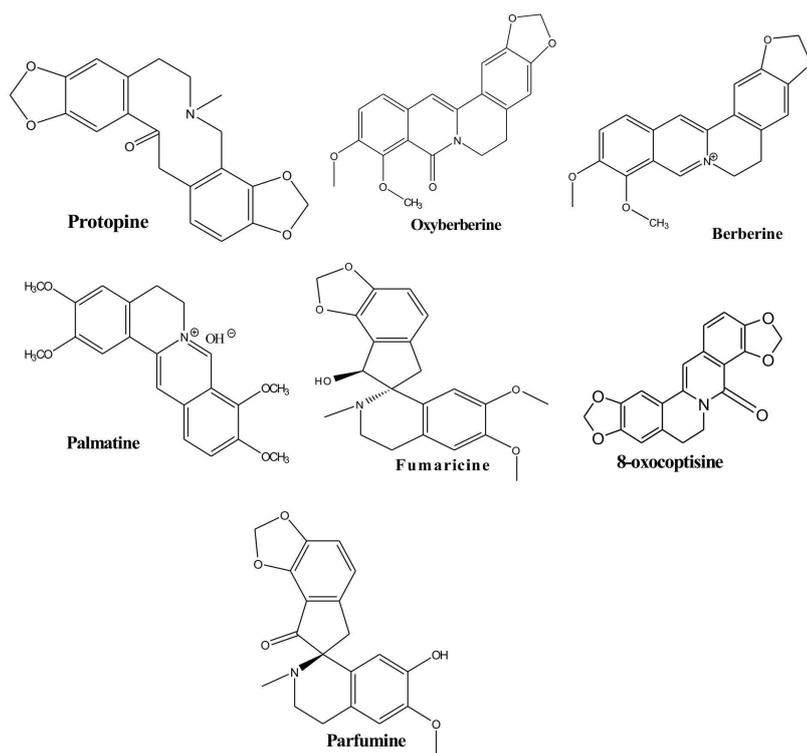


Figure 2. Alkaloids from the *Fumaria parviflora* plant

compounds characterized as (5 α H,11 α H)-8-oxo-homoiridolide, *n*-docosanyl-2-*O*- β -*D*-glucopyranosylsalicylate, 2-methyl-6-hydroxymethylenedodecan-10-oyl-12,15-olide 14-*O*- β -*D*-xylopyranoside, 4-oxostigmast-5-en-3 β -*ol*-*D*-glucopyranoside and salicylic acid-*O*- β -*D*-xylopyranoside along with the known compounds α -*D*-glucopyranosyl hexadecanoate and α -*D*-glucopyranosyl-(2 \rightarrow 1')- α -*D*-glucopyranoside. Apart from this, the three new isolated compounds from aerial parts characterized as *n*-propyl-3,4-dioxymethylene benzene, 5 β , 6, 7, 8, 9, 10 β -hexahydrocoumarin and 2,6-dimethyl dodecan-10-oyl-12,15-olide along with *n*-tetradecanyl *n*-octadec-9-enoate, propanyl triol- 3, 2- *n*-di-octadecanoyl-1-*n*-octadeca-9',12'-dienoate, and *n*-tetradecanyl *n*-octadec-9,12-dienoate. The isolated compounds are useful as they will provide essential data and information for the further researchers and development of effective analytical marker for identity, purity and quality control of this traditional plant in future (Jameel et al., 2014).

Bioactivity

The plant is showed many biological properties such as anti-inflammatory, antispasmodic, antidiarrheal, bronchodilator, hypoglycemic, anthelmintic, laxative, antiprotozoal, dermatological diseases, hepatoprotective, enhance male fertility and antinociceptive effect.

Anti-inflammatory activity

The ethanolic and aqueous extract of leaves of *Fumaria*

parviflora showed significant anti-inflammatory activity by using *in vivo* models of inflammation. Leaves of *F. parviflora* possess anti-inflammatory activity as they inhibit various cytokines and have antioxidant effects and free radical scavenging activity (Rizvi et al., 2017).

Hepatoprotective activity

Fumaria parviflora Lam. leaves extract has significant hepatoprotective activity against INH (Isoniazid) and RMP (Rifampicin) induced hepatotoxicity and it has shown comparable efficacy with silymarin at dose of 200 mg/kg. Therefore, this plant extract used as a dietary supplement to antitubercular therapy to protect against the hepatotoxicity of isoniazid and rifampicin (Khan et al., 2017).

The effect of long-term administration of *Fumaria parviflora* extract on some serum biochemical parameters of rats. The result of this study confirmed that the *F. parviflora* affects the hepatic function, however, our results are partially different from the previous researches (Tajik et al., 2011).

Another study compare the hepatoprotective effect of ethanol extract of the aerial part of *Fumaria parviflora* and the leaves of *Momordica balsamina* against experimentally induced liver injury in rats. Based on the results of the biochemical parameters measurements, histopathological study was performed on the liver of rats treated with two extracts. The normal appearance of hepatocytes indicated a

good protection of the *Fumaria parviflora* extracts from carbon tetrachloride hepatotoxicity (Alqasoumi et al., 2009).

The hydro alcoholic extract of *Fumaria parviflora* showed significant hepatoprotective activity against carbon tetrachloride (CCl₄) caused severe liver damage. The extract of the plant with doses higher than 100 mg/kg prevented CCl₄ induced liver damage. The results of this study support the traditional beliefs on hepatoprotective effects of *Fumaria parviflora* (Jamshidzadeh et al., 2006).

Antipruritic activity

The Effects of *Fumaria parviflora* (FP) on uremic pruritus (UP) in hemodialysis (HD) patients: a randomized, double-blind, and placebo-controlled trial. On this study shows that FP is safe and could decrease the severity of UP in HD patients. FP may be interpreted as a supporter of the immunohypothesis explanation for uremic pruritus (Akrami et al., 2016).

Antifeedant activity

The Efficiency of volatile oil of *Satureja hortensis* and *Fumaria parviflora* plant was tested against the Indian meal moth, *Plodia interpunctella* Hubner for its antifeedant activity. Results indicated that *Satureja hortensis* oil was highly effective compared to *Fumaria parviflora* and significantly decreased the relative growth rate and relative consumption rate. The *Satureja hortensis* oil was more effective on feeding deterrence index than *Fumaria parviflora* (Shahab et al., 2015).

Antiprotozoal activity

The ethanol extracts obtained from five *Fumaria* species (*Fumaria densiflora*, *Fumaria cilicica*, *Fumaria rostellata*, *Fumaria kralikii*, and *Fumaria parviflora*) was investigated against the parasites; *Plasmodium falciparum* (malaria) and *Trypanosoma bruceirhodesiense* (human African trypanosomiasis) at 0.81 and 4.85 µg/ml concentrations. Among them, *Fumaria densiflora* extract exerted the highest antiplasmodial (93.80%) and antitrypanosomal effect (55.40%). *Fumaria* species against malaria can be confirmed on a scientific base and the plant deserve further studies to be evaluated as promising antimalarial agent (Orhan et al., 2015).

Antiparasitic activity

The Control of root knot nematode *Meloidogyne incognita* (Kofoid and White) Chitwood on tomato using green manure and extracts of the plant *F. parviflora* have demonstrated nematicidal properties and it is a potential novel control agent against plant parasitic nematodes. The root portion of *F. parviflora* showed higher nematicidal activity than the tops of the plant. These data suggest that *F. parviflora* could be used alone or as part of an integrated pest management strategy as a novel management tool for *M. incognita* (Naz et al., 2015).

Anthelmintic activity

The efficacy of *Fumaria parviflora* leaves and *Caesalpinia crista* seeds in comparison with oxclozanide (Standard drug) against fasciolosis in sheep. The efficacy of oxclozanide in terms of reduction in faecal egg count was found 100% on 18th day post treatment. *Fumaria parviflora* and *Caesalpinia crista* showed 59.4%, 91.8% and 58.7%, 87.3% efficacy at the dose of 80 mg/kg on 18th and 28th day post treatment, respectively. It was concluded that *Fumaria parviflora* and *Caesalpinia crista* were comparable with that of standard drug oxclozanide possessing significant ($p < 0.01$) anthelmintic activity against ovine fasciolosis (Mushtaq et al., 2015).

The different type of extracts of root and stem of *Fumaria parviflora* showed strong nematicidal activity against *Meloidogyne incognita* in *in vitro* and in planta experiments. The n-hexane extract of root and stem at concentrations of 3.12, 6.24, 12.5, 25.0 and 50.0 mg/ml significantly inhibited hatching and increased mortality of second-stage juveniles (J2s) compared with water controls. The n-hexane extracts from the root and stem were the most active, followed that two bioactive nematicidal phytochemicals, viz., nonacosane-10-ol and 23a-homostigmast-5-en-3β-ol, were isolated from the n-hexane fraction of the roots of *Fumaria parviflora* through activity-guided isolation. These compounds could provide new insight in the search for novel nematicides against *Meloidogyne incognita* (Naza et al., 2013).

In vitro screening of crude aqueous and ethanol extracts of *Fumaria parviflora* exhibited anthelmintic activity against the gastrointestinal nematodes of sheep through egg hatch and larval development. This study showed that *F. parviflora* whole plant extracts possess anthelmintic activity, thus justifying their use in traditional veterinary practices (Al-Shaibani et al., 2009).

Antidiabetic activity

The Oral administration of *Fumaria Parviflora* Lam. powder to streptozocin-induced diabetic rats improved triglyceride, total cholesterol and HDL serum levels, but no significant effect on serum glucose and LDL (Moghadam et al., 2014).

In another study evaluate the hypoglycaemic effects of methanolic extract of *Fumaria parviflora* in normal and streptozotocin-induced diabetic rats. Administration of *Fumaria parviflora* extract showed a potent glucose lowering effect only on streptozotocin induced diabetic rats below 100 mg/dl ($P < 0.001$). However, no significant differences in the blood glucose levels were recorded between diabetic rats received 125 or 250 mg/kg of plant

extracts (Fathiazad et al., 2013).

Antimicrobial activity

One antimicrobial active novel compound N-octacosan-7 β -ol was isolated from methanolic extract of whole plant of *Fumaria parviflora* Lam. The isolated compound proved to be more potent antibacterial and antifungal activities against *S. epidermidis*, *E. coli*, *C. albicans* and *A. niger*. These results indicate that the compound might be a practical application in the prevention and protection against bacterial (gram + and gram-), fungal and leishmanial infections in animals and humans (Jameel et al., 2014).

Protective effect

The protective effect of ethanol extract of *Fumaria parviflora* leaves on lead induced testicular toxicity in adult Wistar rats. Lead acetate treatment resulted in significant reduction in testis weight, seminiferous tubules diameter, epididymal sperm count, serum testosterone level, testicular content of superoxide dismutase (SOD) and glutathione peroxidase (GPx). Moreover, significant elevation was observed in content of malondialdehyde (MDA) in lead treated rats. However, co-administration of *Fumaria parviflora* extract showed a significant increase in selected reproductive parameters in lead treated rats (Dorostghoal et al., 2014).

Another research the ethanol extract of leaves of *Fumaria parviflora* plant to improve male reproductive function and consequently promote fertility. No significant changes were observed in seminal vesicle and ventral prostate weight between experiment groups. Significant increase was found in epididymal sperm density and percent of morphologically normal sperm in extract-treated rats. The Serum testosterone levels were significantly higher in rats received 200 and 400 mg/kg/day of *Fumaria parviflora* leaves extract (Dorostghoal et al., 2013).

In this study, the *Fumaria parviflora* alcoholic extract indicate positive effect on male rat reproductive system because the number of spermatogonium, spermatocytes, spermatozooids and Leydig cells ($P < 0.001$) has increased significantly (Nasrabadi et al., 2012).

Antibacterial activity

The antibacterial activity of the plant extracts and three previously isolated known compounds viz., nonacosane-10-ol (alcohol), 23a-homostigmast-5-en-3 β -ol (homolog of β -sterol) and *cis*- and *trans*-protopinium (alkaloid) of *Fumaria parviflora*. Plant extracts and pure compounds were *in vitro* assessed against seven clinical Gram (-) and Gram (+) bacterial species. The *cis*- and *trans*-protopinium was the most potent antibacterial compound against all the strains tested at the highest concentration of 300 μ g/ml. The three compounds were

completely bactericidal as measured by the viable cell count studies. *Fumaria parviflora* derived extracts and the phytochemicals particularly the *cis*- and *trans*-protopinium possess antibiotic properties and these compounds could be used in the development of novel chemotherapeutic agents (Naz et al., 2013).

Gastrointestinal activity

The aqueous-methanol (30:70) extract of *Fumaria parviflora* protected against diarrhea caused by castor oil in rats and mice, similar to loperamide and dicyclomine. The presence of antidiarrheal and antispasmodic activities in *Fumaria parviflora* possibly mediated through dual blockade of muscarinic receptors and Ca²⁺ channels, provides sound basis for its medicinal uses in diarrhea and abdominal cramps (Rehman et al., 2012).

In another study, the active principal of *Fumaria parviflora* plant extract showed the prokinetic, laxative and spasmodic effects of partially mediated through cholinergic pathways with species and tissue-selectivity, and provides a sound rationale for the medicinal use of *Fumaria parviflora* in gut motility disorders such as, indigestion and constipation. This study also suggests using different species to know better picture of pharmacological profile of the test material (Rehman et al., 2012).

Anti-eczema activity

The *Fumaria Parviflora* alcoholic extract reduction of eczema (dermatitis) area and severity index score before and two weeks after therapy was statistically significant between vehicle treated and in treated group. *Fumaria parviflora* appears to be tolerated by most patients and the result showed that its extract may be considered as an effective agent for treatment of chronic hand eczema (Jowkar et al., 2011).

Antioxidant activity

The ethanol (50%) extract of *Fumaria parviflora* showed significant effect against nimesulide induced oxidative stress. It caused rapid generation of reactive oxygen species (ROS), depletion of GSH (glutathione), alteration in antioxidant genes, massive depolarization of mitochondrial membrane leading to apoptosis. This study concludes that nimesulide causes hepatotoxicity in rats through the involvement of mitochondria and the possible use of herbal supplement which can reduce the oxidative stress generated by drug that are compelled to take high doses of nimesulide due to severe ailment (Tripathi et al., 2011). In another study, aqueous alcoholic extract of *Fumaria parviflora* abrogated nimesulide induced cell death in primary rat hepatocyte cultures. The toxicity caused by nimesulide was

abrogated by *Fumaria parviflora* extract without altering its therapeutic effect by modulating key steps of apoptosis (Tripathi et al., 2010).

Antinociceptive activity

The methanolic extract of *Fumaria parviflora* Lam. possess significant antinociceptive activity. The extracts of *Fumaria parviflora* have in formalin test, especially at the late phase and hot-plate test, and this effect may not be mediated by opioids receptors. It is proposed that this plant is a good candidate for further investigation in other models, especially models of inflammation (Heidari et al., 2004).

Conclusion

It can be conclude that studies with *Fumaria parviflora* (Fumariaceae) have been shown many bioactive constituents. These bioactive constituents of plant have many medicinal activities. In this type of study with medicinal plants are helpful for the population's health care. Thus, it is the wish of authors that this review article will stimulate the interests in further investigations in to natural products for new ailments.

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