Ethno-botanical, Bioactivities and Medicinal Mysteries of Fumaria officinalis (Common Fumitory)

**ABSTRACT**

*Fumaria officinalis* (of *Fumariaceae* family) is a well-known traditional herb rich in biochemically active components. *F. officinalis* (common fumitory or earth smoke) is the most common species of the genus *Fumaria* in Western and Central Europe. Fumitory was officially recognised in 1986 by the French Health authorities as an herbal medicine which was traditionally used in renal and digestive elimination functions. By accurately looking to the name of fumitory, it is said to be derived either from the fact that its whitish, blue-green colour gives it the appearance of smoke rising from the ground, or according to Pliny and Olivier de Serres (XIV century) because the juice of the plant brings on such a flow of tears that the sight becomes dim as with smoke and hence its reputed use in affections of the eye. This herb has been known since antiquity and was described in herbals from the Middle-Ages. It was mainly the Mediterranean genus which was once used as medicine and wound healing. In a meanwhile traditionally fumarity has been used as digestive and diuretic.

**KEYWORDS** *Fumaria officinalis*, *Fumariaceae*, ethno-botanical, herbal medicine, fumarity, pharmacological effects

**INTRODUCTION**

Fumitory is on the United Kingdom General Sales List (GSL) and is approved by the German Commission E Monograph. It has been used in Europe and universal, as a traditional medicine for more than 30 years without safety problems. Phytochemical studies revealed the attendance of several alkaloids such as adlumidine, coticine, fumarline, perfumine, protopine1, fumarane, fumaritine, paprafumicin and paparine, the chemical structures of which are shown in Table 2. Fumarity has also been evaluated for pharmacologically effects (Table 1), therapeutic effects and shown to possess antihelminntic1, antipyretic2 and hypoglycemic3 properties (Table 2). It was usually thought to be good and causes healing effects for the eyes, and to remove skin blemishes. Nowadays herbalists use it to treat skin diseases and conjunctivitis; as well as to cleanse and pure the kidneys. This plant has been extremely valued since at least Roman times for its tonic and blood cleansing effect upon the body, the “smoky” or “fumy” origin of its name comes from the translucent colour of its flowers, giving them the appearance of smoke or of hanging in smoke, and the slightly grey-blue haze colour of its foliage, also resembling smoke coming from the ground, particularly after morning dew1. In this article we have gathered a briefly and targeted pack of information about *Fumaria officinalis* which hope to be useful in near future for scientist society.

**ALKALOIDS**

The main alkaloid of *F. officinalis* is protopine. It is the major secondary metabolite extracted from *F. officinalis* and purified by column chromatography. Urine samples were composed from horses and a human volunteer that had been administered with either *F. officinalis* or protopine free base. In other hand, urine and plant samples were acetylated and analysed by GC-MS after solid-phase extraction. It was recognised that the urinary metabolites of
Table 1: The pharmacological effects of *F. officinalis*.

<table>
<thead>
<tr>
<th>System</th>
<th>Effect</th>
<th>Description</th>
<th>Active compounds</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Anti-malaria</td>
<td>Bactericidal activity against the Gram-positive organisms <em>Bacillus anthracis</em> and <em>Staphylococcus</em> has been reported</td>
<td>Drank different types of decoctions</td>
<td>Lombardi Satriani (1951)(^{12})</td>
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<td>Anti-bacterial</td>
<td></td>
<td></td>
<td></td>
<td>Preining (1975)(^{13})</td>
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<td>Digestive</td>
<td>Amphocholeretic activity</td>
<td></td>
<td>Extract</td>
<td>Dulger et al. (2004)(^{14})</td>
</tr>
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<td></td>
<td>Fumitory extract inhibited the formation of gall bladder calculi in animals</td>
<td></td>
<td>Extract</td>
<td>Lagrange E et al. (1973)(^{17})</td>
</tr>
<tr>
<td></td>
<td>Management of disorders of hepatobiliary tract, spastic discomfort in the area of the gallbladder bile ducts as well as gastrointestinal tract</td>
<td></td>
<td>Extract</td>
<td>Gruenwald et al. (2007)(^{15}); Duke (2002)(^{10})</td>
</tr>
<tr>
<td></td>
<td>Antiallergic and choleretic</td>
<td>Plantago major with <em>F. officinalis</em> ethanolic extracts together (Ethanolic extract)</td>
<td>Extract</td>
<td>Denden S et al. (2010)(^{19}), Ali Nazarizadeh et al. (2013)(^{20})</td>
</tr>
<tr>
<td></td>
<td>Ameliorate bile duct blockage in animals and assist in the management of similar disorders in humans. Biliary dyskinesia</td>
<td></td>
<td>Extract</td>
<td>Zacharewicz et al. (1979)(^{21}); Boucard et al. (1966)(^{15})</td>
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<td></td>
<td>Antibilious, the alkaloid in it increases the secretion of bile, and also at times of increased pathologic bile, reduces its secretion</td>
<td></td>
<td>Alkaloid</td>
<td>Bisset et al. (2001)(^{22})</td>
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<td></td>
<td>Antispasmodic</td>
<td></td>
<td></td>
<td>Ivancheva et al. (1999)(^{23})</td>
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<td></td>
<td>Colicky pain affecting the gallbladder and biliary system, together with the gastrointestinal tract</td>
<td></td>
<td></td>
<td>Hentschol et al. (1995)(^{24})</td>
</tr>
<tr>
<td></td>
<td>Extracts inhibited formation of gallbladder calculi in animals</td>
<td></td>
<td>Extracts</td>
<td>Lagrange et al. (1973)(^{17})</td>
</tr>
<tr>
<td>Liver</td>
<td>Hepatoprotective activity</td>
<td>Effect from each side of his body</td>
<td>Ethanolic extract</td>
<td>Uday Raj Sharma et al. (2012)(^{25})</td>
</tr>
<tr>
<td></td>
<td>Cytoprotective effect</td>
<td></td>
<td>Alkaloids</td>
<td>Taborska et al. (1996)(^{16})</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Cardiovascular activity</td>
<td></td>
<td>Alkaloid fractions</td>
<td>Gorbunov et al. (1980)(^{27})</td>
</tr>
<tr>
<td></td>
<td>In dogs reduced ischaemia caused by experimental ligation of the circumflex artery</td>
<td></td>
<td></td>
<td>Rao et al. (1998)(^{28})</td>
</tr>
</tbody>
</table>

Continued
Medicinal mysteries of Fumaria officinalis

<table>
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<th>Effect</th>
<th>Description</th>
<th>Active compounds</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypotensive, bradycardic and sedative activities in small doses in animals</td>
<td>Protopine</td>
<td>Goetz et al. (2009)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Larger doses cause excitation and convulsions</td>
<td>Protopine</td>
<td>Preininger et al. (1975)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cytotoxicity effects</td>
<td>Protopine</td>
<td>Sağlam et al. (2003)</td>
<td></td>
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<td>The use as an eye lotion in conjunctivitis</td>
<td>British Herbal Pharmacopoeia (BHP)</td>
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<td>Has been used in Afghanistan for the treatment of asthma</td>
<td>Delaveau (1980)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Antispasmodic activity on smooth muscle has been reported</td>
<td>Reynier et al. (1977)</td>
<td></td>
<td></td>
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<tr>
<td>Valuable agent in cutaneous eruptions such as eczema and psoriasis, in scabies and also in syphilis.</td>
<td>Syrup</td>
<td>Mir Heidari (1993)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Iranian folk medicine in skin diseases. Anti-scabies, anti-scorbite, anti-bronchite</td>
<td>Juice or syrup or seed</td>
<td>Amin (1991)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The immunocompromised condition of chronic alcoholics</td>
<td>Chronic alcoholics</td>
<td>Baker et al. (1993); Blank et al. (1993)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significant antioxidant activity</td>
<td>Syrup</td>
<td>Memnune et al. (2009); Howard (1987)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Some important alkaloids which have discovered and identified by gas chromatography mass spectrophotometry method from the *F. agraria*, *F. bastardii*, *F. capreolata*, *F. sepium*, *F. densitona*, *F. laevii*, *F. officinalis* subsp. *officinalis*, *F. pavillons*, *F. peteri* subsp. *calcata* and *F. macrospula*, are the isoquinoline alkaloids such as protopine, cryptopine, sinactine, stylopine, bicineelline, adlumine, parfumine, fumariline, fumaroplyline, fumaramine, dihydrofumariline, parfumidine and dihydrohongsangainarine (Sharma et al., 2012).

The isoquinoline alkaloids in *F. officinalis* mostly have shown the biological activity. Traditionally, the juices of *F. officinalis*, after undergoing evaporation process, could be used to treat chronic eczema, dermatological problems and cutaneous eruptions.

Internal usage of fumarity against stomach complaints and disorders for the topical treatment of hemorrhoids have been mentioned in this text. *F. officinalis* has shown the antihypertensive activity, this shows that it has effects on vessel walls.

### Cardiovacular effects

Herbal medicinal study of Fumaria has shown that it used for the treatment of diabetes mellitus, hypertension diseases and cardiac disorders in the south-east region of Morocco. On the other hand, the essential oils from *Melissa officinalis* and *Rosmarinus officinalis* have been described to inhibit erythrocyte AChE in vitro. *F. officinalis* has shown the antihypertensive activity, this shows that it has effects on vessel walls.

### Skin protection activity

The traditional preparation involved expressing the juice and evaporating forms. Fumaria also used to treat chronic eczema, cutaneous eruptions and other dermatological circumstances. A renowned remedy against Herpes is reported by dried roots of *Rumex crispus*, dried rhizomes of *Rheum palmatum* L.,
dried roots of Salsola kali L. This decoction has proved itself as an appreciated agent in cutaneous eruptions such as eczema and psoriasis and other skin disorders, in scabies and similarly in syphilis. The fumaric acid esters have used as an action for psoriasis for nearly 30 years. This management is regaining interest by some dermatologists as more active compounds and by-products are being developed. Monomethyl fumarate is the most active metabolite in a German antipsoriasis drug, Fumaderm.

**Immune system effect**

In one study, researcher showed the antioxidant activity and ethanol-induced immunosuppression effect of alcoholic extract of Fumaria. *F. officinalis* Linn. (FO) has been reported to hold a significant antioxidant activity in vitro. Nevertheless, that is not known whether it is equally effective in vivo. Furthermore, a study has shown that *F. officinalis* can also prevent immunosuppression. Whether it can lessen the ethanol-induced immunosuppression has not yet been evaluated. Henceforward, it was suggested to evaluate the efficiency of *F. officinalis* to stop the ethanol induced immunosuppression and to understand whether it is related to its antioxidant activity in vivo.

A study in 1986 has revealed that chronic treatment with ethanol short the glutathione, reduced the digestion and lessened phagocytosis. Additionally it observed which alcoholic extract of *F. officinalis* or the combination of vitamin E and C prevented the beyond influences of ethanol on glutathione planes, digestion index and phagocytosis.

**Toxicological effect**

In one study an acute hepatitis which was induced by parallel use of Fumaria and *Vitis vinifera* plant therapy products, has been reported by Bonnet et al. (2007). This plant has not been allied with acute toxicity. Monomethyl fumarate was found to be non-hepatic cytotoxic in doses up to 1 mg/mL in vitro and up to 50 mg/kg in in vivo studies in albino rats. Another side of this matter showed that alkaloids found in other members of the *Fumariaceae* family have caused trembling, seizures and death when taken in great quantities.

Some alkaloids from Fumaria such as protopine have shown cytotoxic activities. The n-hexane extract of *F. officinalis* L. has shown cytotoxic effect against the brine shrimp. The water extracts showed no cytotoxic activity. These results showed that herbal traditional uses of *F. officinalis* and *Herba F. densiflorae* were safe.

**ANTISPASMODIC ACTIVITY**

Reiner has reported the antispasmodic activity on smooth muscle of Fumaria.

**Antibacterial effects**

A study by Preininger et al. and Dulger et al. reported a significant bactericidal activity against the Gram-positive organisms like *Staphylococcus* and *Bacillus anthracis*.

**Gastrointestinal effects**

*F. officinalis* L. has been used as amphocholeretic, mild antispasmodic, mild diuretic and laxative. *E officinalis* L. comprises isoquinoline alkaloids protopine and allocryptopine. However both of them increased CYP1A1 and CYP1A2 mRNA levels in human hepatocyte cells.

A study in 2012 has shown significant results of hepatoprotective activity of *F. officinalis*, in a meanwhile ethanolic extract of this plant showed more powerful hepatoprotective effects. The cytoprotective effect of *F. densiflora* and *F. officinalis* extracts were revealed. Hepatocytes that intoxicated with carbon tetrachloride (CCL4) were related with their alkaloids. In another study it is said that the Fumaria composition combination causes great effect in cutaneous diseases, liver complaints, such as scurry, jaundice, costiveness and in debility of the stomach (The Complete Herbalist book).
Urinary system effects

Amphoocholeretic activity. The amphoocholeretic activity which outcomes from Fumaria that verified in animals, have shown no effect on normal choleresis. Nevertheless, it adapted the bile flow when it was artificially increased or decreased15,16. Fumitory extract have inhibited the construction of gall bladder calculi17.

Antiallergic and choleretic activity. F. officinalis ethanolic extracts with plantago major have shown antiallergic and choleretic properties in a study in the Tunisian population19.

One study has shown that fumitory extracts showed the ameliorate bile duct blockage in animals and contribute in the running of similar disorders in humans21.

This plant is approved in Germany for the colicky pain affecting the gallbladder and biliary system, in addition to the gastrointestinal (GI) tract15.

F. officinalis has shown antihelliculous activity. Meanwhile it showed that the alkaloid in Fumaria increases the secretion of bile, and likewise at times of increased pathologic bile, lessens its secretion22.

F. officinalis is a constituent of several phytopharmaceuticals, mostly used to treat functional diseases and disorders of the hepatobiliary system visible as colicky pains affecting the gallbladder, the gastrointestinal tract and biliary. These biological activities of Fumariae are mostly related to the presence of isooquinoline alkaloids51.

Clinical trials

One clinical study which chlolethiasis, hepatopathy and post operation cholecystectomy syndrome were dimensioned and shown that fumarity water extract could have therapeutic aspects on them49. Another test showed very positive amphoocholeretic effects on biliary syndrome by F. officinalis extract52.

The effect of water extract of fumitory on choleretic activity has been measured by a clinical trial on 1969 by Heully et al31.

CONCLUSION

Finally, the review presents up to date findings about F. officinalis based on scientific certificate that can confirm its traditional use. Our data about responsible constituents is scarce and further research is needed. As we mentioned F. officinalis have shown to possess anthelminthic, antipyretic and hypoglycemic properties. It was usually thought to be good and causes healing effects for the eyes, and to remove skin blemishes and many other effects that we discussed about it as above. There is hope to work more on F. officinalis in future, its therapeutic aspects, pharmaco logical effects and its side effects.

REFERENCES


