

Review

Phytopharmacological profile of *Gratiola officinalis* Linn.: A review

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***Gratiola officinalis* Linn. (*Plantaginaceae*), commonly known as common Hedgehyssop or “Herb of Grace” is well-known for its pharmacological properties. Various parts of this plant (root and herb) are being used in phytomedicines. This review focuses on the classification, etymology, habitat and distribution, botanical description, medicinal, food and miscellaneous uses and structures of various bioactive constituents of its multipurpose fruit. Being a rich source of bioactive constituents of therapeutic value, *G. officinalis* is used as a potent medicine to treat gout, mild dropsy, sciatica, external ulcers, intestinal worms, chronic eczema, and persistent itching skin.**

Key words: *Gratiola officinalis* Linn., pharmacological activities, Pakistan.

INTRODUCTION

Pakistan is considered as paragon of valuable medicinal and aromatic plants and crops sometimes called botanical garden of Asia, thanks to its comprehensive latitudinal spread and immense altitudinal range. Magnificent mountain tops in Northern areas to fertile plain areas irrigated by rivers in Punjab and Sindh, Arid regions of Thal, Thar and Baluchistan to the coastal mangrove forests of the Arabian Sea supports an extensive array of exotic plant species including *Gratiola officinalis* Linn. As part of our studies of documenting the indigenous flora of Pakistan (Zia-UI-Haq et al., 2007a, b; 2008 a, b; 2009; 2010; 2011 a, b, c, d and e) this review has been written on *G. officinalis* Linn (Figure 1). *G. officinalis* Linn. is a glabrous perennial herb and is native to the south of Europe, and its favourable habitat is damp grounds (Hooker, 1982). The plant is harvested whilst in

flower in the summer and dried for later use (Bown, 1995; Launert, 1981).

It is employed in the herbal medicines for the treatment of a variety of ailments like scrofula, cystitis, colic, certain stomach and menstrual disorder, skin and liver diseases as well as enlargement of the spleen, dropsy, jaundice, intestinal worms, etc. The dried top of the *G. officinalis* is diuretic and emetic. *G. officinalis* is also used as biostimulating tablet in hematopoietic, liver and respiratory disorders in human. The root and the flowering herb are cardiac tonic, diuretic, violently purgative and vermifuge. It is well known to its toxicity but still used in homoeopathy and in medicines as an anthelmintic. The herb apparently tastes very bitter and the bitter principles are due to glycosides of cucurbitacin (Grayer and Tomas, 1995). Side effects of the its over-use include nausea, acrid poisoning, nymphomania, leanness, abortion, kidney damage and bowel haemorrhage (Ali, 1974; Bown,1995; Graves,1996; Grieve,1983; Launert,1981; Lust,1983; Nasir et al.,1994).

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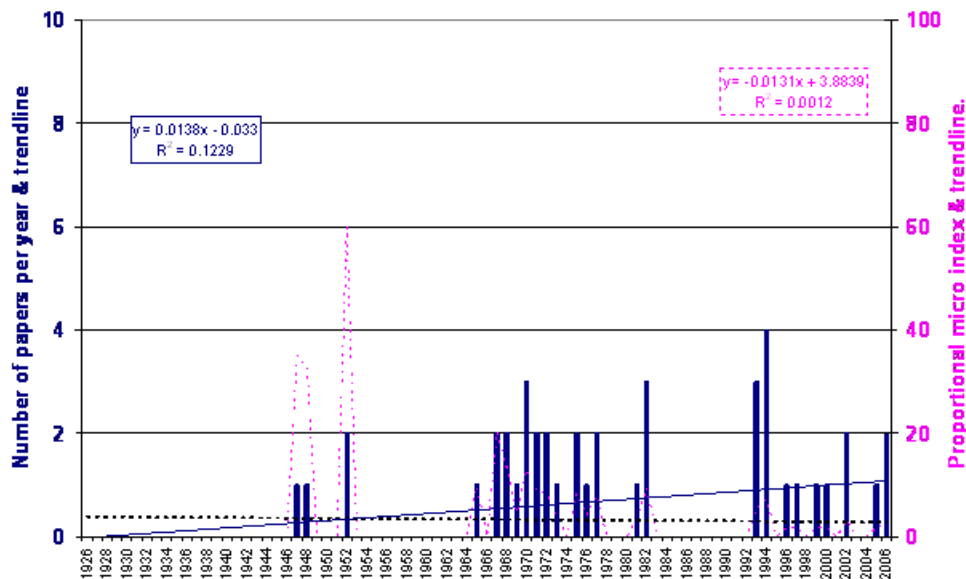


Figure 1. Popularity of *G. officinalis* over time (Australian New Crops Website, 2011).



G. officinalis flower



G. officinalis whole plant

Figure 2. *G. officinalis* plant and flower.

GRATIOLA OFFICINALIS LINN. (PLANTAGINACEAE)

Morphology

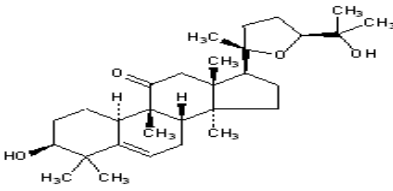
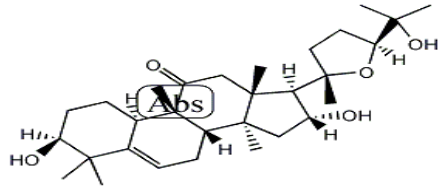
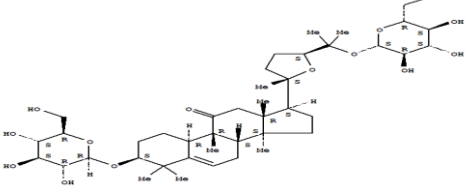
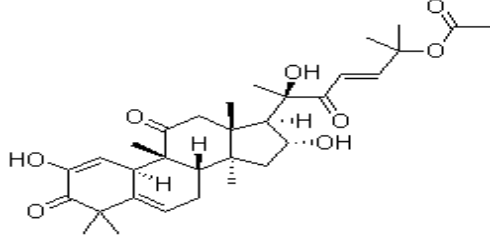
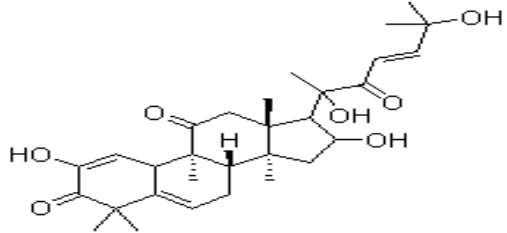
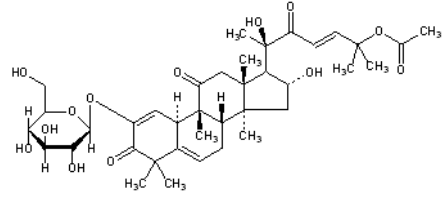
G. officinalis Linn. (*Plantaginaceae*) commonly known as hedge hyssop is an herb of great medicinal uses. It is mostly found in Europe, having a smooth, 4-angled stem, and lanceolate, 3 or 5-nerved leaves. The stem may have height of 6 to 12 inches having smooth, pale-green leaves, with whitish flowers. The corolla is yellow with purple strips.

The calyx is often 7 lobed. Single pedicled flowers are arranged in the axils of the leaf pairs and are a pale red or whitish in colour. The calyx is only fused at the base and has 5 tips.

The corolla has a distinct tube and a bilabiate border. The upper lip is margined, and the lower lip is divided into 3. There are 4 stamens, 2 sterile and 2 fertile and 1 superior ovaries.

The fruit has 4 lids, which burst open. The plant is odorless, but tastes bitter (Figure 2).

Table 1. Active constituents isolated from *G. officinalis*.

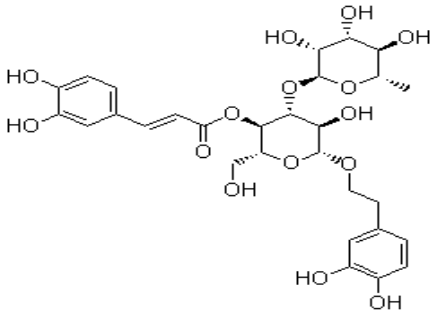
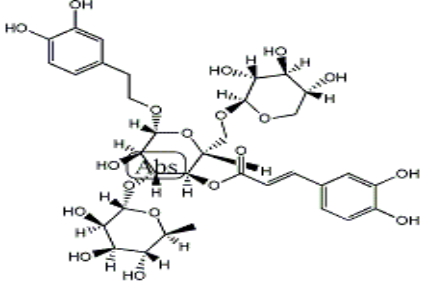
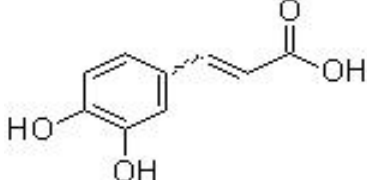
Structural formula of compound	Name
	Gratiogenin
	16-Hydroxygratiogenin
	Gratioside
	Cucurbitacin-E
	Cucurbitacin-I
	Elaterinide

Active constituents

The constituents which are present in the *G. officinalis* are gratiogenin, 16-hydroxygratiogenin, cucurbitacins-E and I, glycosides gratiogenin-3 β -D-glucoside, gratioside, elaterinide, lignans, which have many

medicinal uses. According to the research performed there is the presence of alkaloids, flavonoids, saponins, and glycoside-like substances in *G. officinalis* and of flavonoids, saponins, glycoside like substances, traces of alkaloids, coumarin derivatives and mannitol is also found in this plant (Borodin et al., 1970) (Table 1). This paper

Table 2. Glycoside esters isolated from *G. officinalis*.

Structural formula of compound	Name
	Verbascoside
	Arenarioside
	Caffeic acid

aim to review the published literature on *G. officinalis*. Relevant articles were searched using the terms *G. officinalis* active constituents, research study. The active ingredients present in *G. officinalis* which have medicinal worth are discussed as follows:

Source of cucurbitacin

Cucurbitacin are the chemical compounds which have the action of purgative and also work as an anticarcinogen. Among the active compounds found in *G. officinalis*, is rich in cucurbitacines which are mainly consisting of triterpenoid substances which are highly toxic and bitter. Eight new cucurbitacin glycosides were isolated from *G. officinalis* and their structures were determined by (Rothenburger and Haslinger, 1995).

Antiacne agent

The extracts of *G. officinalis* have been used in the ointments and creams used for treating acne. Pharmaceutical compositions for treatment of acne comprise 0.5 to 40% of an extract of *propolis* in a pharmaceutical dispersant, which comprises a neutral-

buffered, plant extract-based emollient comprising an extract of verbascum and optionally an extract selected from the group consisting of *G. officinalis* (Paunescu and Paunescu, 1995).

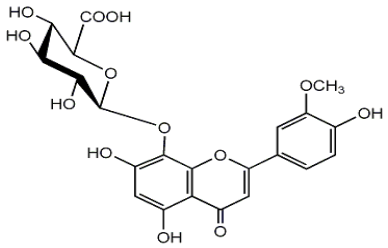
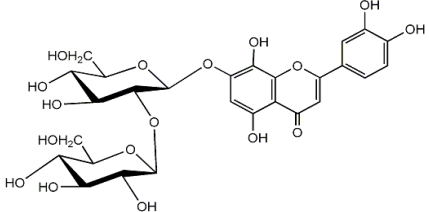
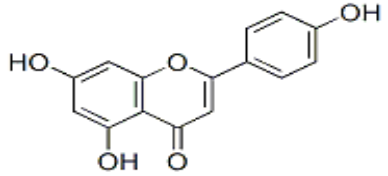
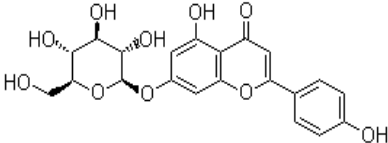
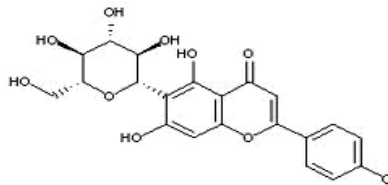
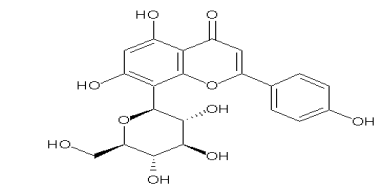
Homeopathic remedy

The extracts of "Hedgehyssop" *G. officinalis* are present as an ingredient in homeopathic remedies. Another research was performed to study the active components of *G. officinalis* by using high-performance liquid chromatography (HPLC) method and gratiola mother tincture and the results showed that there are the contents of cucurbitacin E, cucurbitacin I, cucurbitacin E glycoside and cucurbitacin I glycoside are found as 0.0065, 0.0031, 0.0011 and 0.0006%, respectively (Kaya and Melzig, 2008).

Source of caffeic acid

Caffeic acid glycoside esters, which have been isolated from *G. officinalis* are verbascoside and arenarioside (Rothenburger and Haslinger, 1994) (Table 2). Caffeic acid has been shown to inhibit carcinogenesis, although

Table 3. Natural products isolated from *G. officinalis*.

Structural formula of compound	Name
	8-hydroxychrysoeriol 8-O-glucuronide
	Hypolaetin 7-O-sophoroside
	Apigenin
	Cosmosiin
	Saponaretin
	Vitexin (Apigenin-8-c-glucoside)

($C_{21}H_{20}O_{10}$, m. 221-3°), and a form of vitexin ($C_{21}H_{20}O_{10}$, m. 264-6°) were among the nine found (Litvinenko et al., 1969).

other experiments show possible carcinogenic effects. Caffeic acid also shows immunomodulatory and anti-inflammatory activity.

Source of flavonoid

Flavonoids are the substances which work as an anti-thrombotic vasodilator, antibacterial, anti-inflammatory, and as an anti-allergic. In one research two distinct flavonoid patterns were found in *G. officinalis*. One of the

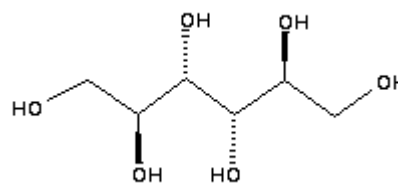
chemotypes is characterized by the production of 8-hydroxylated flavone O-glycosides, among which are the new plant substances 8-hydroxychrysoeriol 8-O-glucuronide, hypolaetin 7-O-sophoroside, 8-hydroxychrysoeriol 7-O-sophoroside, and isoscutellarein 8-O-sophoroside (Grayer-Barkmeijer and Tomas-Barberan, 1993). According to other researches done new flavonoid named ligniside and C-glycosyl derivatives were also extracted from *G. officinalis* (Borodin et al., 1970). Apigenin (4, 5, 7-trihydroxyflavone) a yellow crystalline solid is a flavone of several glycosides. It is used to dye wool. Apigenin is also used as a chemopreventive for vegetables and fruits (Ferreira et al., 2006). Nine flavonoids were obtained from *G. officinalis* using paper chromatography and capron chromatography. Apigenin ($C_{15}H_{10}O_5$, m. 346 to 8°), Cosmosiin ($C_{21}H_{20}O_{10}$, m. 254 to 6°), one form of saponaretin (Table 3). ($C_{21}H_{20}O_{10}$, m. 221° to 3°), and a form of vitexin ($C_{21}H_{20}O_{10}$, m. 264 to 6°) were among the nine found (Litvinenko et al., 1969).

Source of cardiac glycoside

G. officinalis was tested for cardenolides or glycosides with cardiac activity, both by phytochemical methods and biperfusion at the isolated guinea pig heart. No cardiac glucosidal activity was detected. The substance gratiotoxin formerly interpreted as cardiac glycoside is identical with the cucurbitacin glycoside elaterinide, about 1.5% of which is contained in the *Herba Gratiolae*, tested on isolated heart preparations it showed only relatively low cardio-toxicity (Mueller and Wichtl, 1979).

Source of mannitol

Mannitol is used after head trauma to reduce the intracranial pressure until more definitive treatment can be applied, for example, .g, It is administered intravenously, and is filtered by the glomeruli of the kidney, but it is from the renal tubule, resulting in decreased water and Na^+ reabsorption. Consequently, mannitol increases water and Na^+ excretion, thereby decreasing extracellular fluid volume. The foliage of *G. officinalis* contained 0.22 and 3.1% D-mannitol which have been used in the medicines to cure diseases (Borodin and Degot, 1969).



D-mannitol

CONCLUSION

G. officinalis Linn. is highly valued in indigenous communities of Pakistan due to wide spectrum of medicinal activities possessed thanks to variety of bioactive constituents having diverse chemical structure present in it. Detailed studies should be carried out to decipher and discern mechanisms involved in various bioactivities exhibited by extracts by conducting *in vivo* clinical trials involving safety and efficacy studies. *G. officinalis* is enriched with the chemicals which are antibacterial, anti-inflammatory, antiallergic, anticarcinogenic and which help in osmoregulation. As a conclusion it can be said that *G. officinalis* can be used to cure such types of illness with least side effects. Further research on this medicinal plant should be carried out to exploit their therapeutic utility to combat diseases.

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