

# European Goldenrod

## Summary and Pharmaceutical Comment

Phytochemical details have been documented for European goldenrod but no constituents have yet been identified to support its pharmacological actions. The traditional use of European goldenrod as a diuretic has been well documented but there is a lack of sufficient clinical data to support this use, or a possible mechanism of action. There is also a lack of clinical safety and toxicity data for European goldenrod and further investigation of these aspects is required.

## Species (Family)

*Solidago virgaurea* L. (Asteraceae)

## Synonym(s)

Goldenrod

## Part(s) Used

Flowering aerial parts

## Pharmacopoeial and Other Monographs

In *BPC 2006* (Goldenrod, European); *BPP 2006* (Goldenrod, European); *BP 2012* (European Goldenrod).

## PhEur 7.5

The whole or cut, dried, flowering aerial parts of *Solidago virgaurea* L.

European goldenrod is also included in the Complete German Commission E, ESCOP 2003, HMPC monographs and Martindale 37th edition.

## Constituents

The following is compiled from several sources, including general references.<sup>(1-3)</sup>

**Diterpenes.** Nine *cis*-clerodane diterpenes (cannachlorodanolide, (5*a*,8*a*)-3,13-clerodadien-16,15:18,19-diolide, and solidagoic acids C–f) have been identified from plant material harvested in southeastern Bulgaria.<sup>(1)</sup> *cis*-Clerodane lactones, including solidagolactones II, III, V, VII, VIII and seven related compounds have been isolated from plant material of Indian origin (Khasi Hills, Meghalaya).<sup>(2)</sup>

**Essential oils.** The main components found in steam-distilled oil from fresh flowering tops collected in the Russian Altai at 290 m (0.21% pure yellow light oil) were  $\alpha$ -pinene (36.5%), myrcene (14.8%),  $\beta$ -caryophyllene (10.5%), germacrene D (8.2%),  $\beta$ -pinene (7.1%), and limonene+ $\beta$ -phellandrene (6.4%). Similarly at 650 m (0.07% pure yellow light oil) the main components included benzyl benzoate (37.0%),  $\beta$ -caryophyllene (6.3%), germacrene D (6.0%),  $\alpha$ -pinene (4.4%), and  $\alpha$ -humulene (4.4%).<sup>(1)</sup> The aerial parts at flowering stage collected from three sites in Poland yielded 0.32–0.38% essential oil described as 'intense and spicy, with a wormwood note'. Among 60 constituents identified,

germacrene D, limonene, myrcene,  $\alpha$ - and  $\beta$ -pinene, and sabinene were major components.<sup>(3)</sup> Essential oil yield and composition of aerial parts differs slightly between micropropagated and wild harvested material.<sup>(1)</sup>

**Flavonoids.** The following flavonol aglycones have been found: kaempferol, quercetin, and isorhamnetin; also flavonol glycosides: 3-arabinosides, 3-galactosides, 3-glucosides, 3-rabinobiosides, and 3-rutinosides of kaempferol and quercetin, 3-galactoside, 3-glucoside, and 3-rutinoside of isorhamnetin, rhamnetin 3-rhamnoglycoside (glycosidic linkage unspecified).<sup>(4,5)</sup> Kaempferol 3-rabinobioside, kaempferol 3-rutinoside, quercetin 3-rutinoside (rutin), isorhamnetin 3-rutinoside, and trace amounts of quercetin 3-rhamnoside (quercitrin) have been detected using HPLC.<sup>(10)</sup> Flavonoid content of the leaves is 1.44–1.98%, buds 0.67%, flowers 1.14%, and the fruits 0.56%.<sup>(11)</sup>

**Other phenolics.** Chlorogenic acids: 5-caffoyl-, *cis*-5-caffoyl-, 5-*p*-coumaroyl-, *cis*-5-*p*-coumaroyl-, and 3,5-dicaffoyl- (3 isomers) quinic acids detected in LC-MS/MS analysis of leaf extracts.<sup>(12)</sup> Phenolic and hydrocinnamic acids: caffeic, *p*-coumaric, ferulic, gentisic, *p*-hydroxybenzoic, protocatechuic, salicylic, sinapic, and vanillic acids as minor constituents.<sup>(13)</sup> Phenolic glycosides<sup>(14,15)</sup> (content in different above-ground tissues): leucocarposide (0.07–0.52% by photometric methods; 0.13–2.07% by HPLC) and virgaureoside A (0.01–0.14% by photometric methods).<sup>(16,17)</sup> Tannins (catechin based) mentioned in early literature.<sup>(1)</sup>

**Polysaccharides.** Preliminary data indicates polysaccharide content of 5–8% in material of Russian origin collected at different flowering stages. Monosaccharide composition: galacturonic acid (43–45%), galactose (13–17%), glucose (7–12%), arabinose (5–8%), rhamnose (4–7%), xylose (1–1.5%).<sup>(18)</sup>

**Saponins.** Major saponins of aerial parts (material sourced from the Botanical Garden, Berlin-Blankenfelde) comprise four acylated 3,28-bisdesmosides of polygalactic acid including solidagosaponins XIV and XVIII (also referred to as virgaureasaponins B–E, although these names not widely adopted); all were also present in roots.<sup>(1,19)</sup> Note that virgaureasaponins 1–3 (3,28-bisdesmosides of polygalactic acid) reported in earlier studies are deacylated saponins isolated from alkaline hydrolysis of aerial parts. Solidagosaponins 1–XXIX, virgaureasaponins 1 and 2, and bellasaponin BA<sub>2</sub>, obtained from hot water extracts of fresh whole plants (collected Shizuoka, Japan), comprise a 3-mono-desmoside, 3,28-bisdesmosides, 3,16,28-tridesmosides, 16-mono-desmosides, and 16,28-bisdesmosides of polygalactic acid, with many acylated examples.<sup>(20–22)</sup>

**Other plant parts.** Polyacytylenes have been found in the roots. Fresh material collected in Norway (Trondheim) contained 8 g/kg matricaria ester (methyl ester of 2,2',8,2'-decardiene-4,6-dioic acid), however the above-ground parts lacked these compounds.<sup>(23)</sup> Levels of polyacytylenes in Danish material (collected Marselisborg and Sverbak) showed seasonal variation with a maximum average amount of matricaria ester 0.56 g/kg fresh roots in December. Four other polyacytylenes were also identified.<sup>(24)</sup>

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**Lei Shi**



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**Pharmacopoeia of the People's Republic of China**, 1997 This English version is edited from Pharmacopoeia of the People's Republic of China 1995 edition



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