

Calamus

Species (Family)

Acorus calamus L. (Araceae)

Various genetic species ($n=12$): diploid North American, triploid European, tetraploid Asian, Eastern, Indian.

Synonym(s)

Sweet Flag

Part(s) Used

Rhizome

Pharmacopoeial and Other Monographs

BHP 1996^(G9)

Martindale 32nd edition^(G43)

PDR for Herbal Medicines 2nd edition^(G36)

Legal Category (Licensed Products)

GSL^(G37)

Constituents^(G19,G22,G41,G58)

Amines Dimethylamine, methylamine, trimethylamine and choline.

Volatile oil 1.5–3.5%. β -Asarone content varies between genetic species: 96% in tetraploid (Indian), 5% in triploid (European) and 0% in the diploid (North American) species.^(1–4) Other identified components include calamenol (5%), calamene (4%), calamone (1%), methyl eugenol (1%), eugenol (0.3%) and the sesquiterpenes acolamone, acoragermacrone and isoacolamone. Considerable qualitative and quantitative differences have been reported between the volatile oil from different genetic species, and between the volatile fraction of an alcoholic extract and the essential oil from the same variety (European).^(3,4)

Tannin 1.5%.

Other constituents Bitter principles (e.g. acorin), acoric and palmitic acids, resin (2.5%), mucilage, starch (25–40%), sugars.

Food Use

The level of β -asarone permitted in foods is restricted to 0.1 mg/kg in foods and beverages, 1 mg/kg in alcoholic beverages and in foods containing *Acorus calamus* or *Asarum europaeum*.^(G16) Calamus is listed by the Council of Europe as a source of natural food flavouring (category N3). This category indicates that calamus can be added to foodstuffs in the traditionally accepted manner, although there is insufficient information available for an adequate assessment of potential toxicity.^(G16) Calamus is classified as an 'unsafe herb' by the US Food and Drugs Administration (FDA),^(G22) and the use of the rhizome and its derivatives (oil, extracts) are prohibited from use in human food.^(G41)

Herbal Use

Calamus is stated to act as a carminative, spasmolytic and diaphoretic. Traditionally it has been indicated for acute and chronic dyspepsia, gastritis and gastric ulcer, intestinal colic and anorexia.^(G7)

Dosage

Rhizome 1–3 g or by infusion three times daily.^(G7)

Liquid extract 1–3 mL (1:1 in 60% alcohol) three times daily.^(G7)

Tincture 2–4 mL (1:5 in 60% alcohol) three times daily.^(G7)

Pharmacological Actions

In vitro and animal studies

Numerous documented studies have concentrated on activities associated with the oil. The pharmacology and toxicology of calamus oil have been reviewed.⁽⁵⁾ Unless specified, all of the following actions refer to those exhibited by the oil.

Spasmolytic action *in vitro* versus various spasmogens in different smooth muscle preparations including tracheal, intestinal, uterine, bronchial and vascular has been reported for European and Indian varieties.^(5–8) In one study activity was associated with a lack of β -asarone,⁽⁶⁾ whereas oils with either low or high levels of β -asarone have also exhibited

activity.^(5,7) The pattern of spasmolytic activity has been compared to that of papaverine, and a direct musculotropic action has been proposed.⁽⁸⁾ Unlike papaverine an acetylcholine-like action has also been observed with low dilutions of the oil and asarone.⁽⁸⁾

Inhibition of monoamine oxidase activity and a stimulation of D- and L-amino oxidase has been reported.⁽⁵⁾ The mechanism for this activity, involving serotonin and adrenaline, has been disputed, and an alternative mechanism involving depression of hypothalamic function has been proposed.⁽⁹⁾

In vitro oil rich in β -asarone has been reported to reduce phenylbutazone-induced ulcers in the rat by 5–60%, although no effect was observed on stress- or ethanol-induced ulcers.⁽⁷⁾ No spasmolytic activity was reported for oil free from or with low levels of β -asarone.

A sedative action and a potentiation of barbiturate effect (increased sleeping time, reduction in body temperature) have been described in a number of small animals (mice, rats, rabbits and cats) following intravenous or intraperitoneal administration of European (alcoholic and aqueous extracts) and Indian varieties.⁽⁵⁾ Dexamphetamine has been found to block the potentiating action of the Indian variety on barbiturate sleeping time.⁽⁵⁾ Potentiation of morphine activity has been reported for the European variety.

The Indian oil has been reported to deplete levels of serotonin and noradrenaline in the rat brain following intraperitoneal administration.⁽⁵⁾ The mechanism of action was suggested as similar to that of reserpine, and a potentiation of the amphetamine-detoxifying effect of reserpine has also been described.⁽⁵⁾ In contrast, the central action of the European variety has been stated to not resemble that of reserpine.⁽⁵⁾ Anti-adrenergic activity demonstrated by antagonism of dexamphetamine-induced agitational symptoms has been reported for the Indian variety in various small animals.⁽⁵⁾

Anticonvulsant, anti-arrhythmic (like quinidine) and hypotensive (apparently not due to a nervous mechanism) activities in small animals have also been reported for the Indian variety.⁽⁵⁾

α -Asarone, isolated from *Asarum europaeum* (Aristolochiaceae), has a local anaesthetic activity similar to that of benzocaine.⁽¹⁰⁾

Antifungal activity has been documented for β -asarone⁽¹¹⁾ and for the oil (weak).⁽⁵⁾ Insecticidal and leech repellent properties have been reported for the oil and may be synergised by synthetic pine oil.⁽⁵⁾ Antibacterial activity primarily versus organisms responsible for gut and throat infections has been documented,⁽¹²⁾ although a lack of antibacterial activity has also been reported.⁽⁵⁾

Side-Effects, Toxicity^(G19,G58)

Concerns over the toxicity of calamus centre around the volatile oil and in particular on the β -asarone content. The level of β -asarone in the oil varies considerably between the different genetic species of calamus (*see* Constituents).

Feeding studies (rat) using the Indian oil (high β -asarone) have shown death, growth depression, hepatic and heart abnormalities, and serous effusion in abdominal and/or peritoneal cavities.^(13,14) A two-year study involving diet supplemented with calamus oil at 0, 500, 1000, 2500 and 5000 ppm, reported growth depression, and malignant duodenal tumours after 59 weeks at all levels of dietary supplementation.^(13,14) Tumours of the same type were not noted in the controls.

Genotoxic activity (strong induction of chromosomal aberrations, slight increase in the rate of sister chromatid exchanges) has been exhibited by β -asarone in human lymphocyte cultures in the presence of microsomal activation.⁽¹⁵⁾ Mutagenic activity (Ames) has been documented for root extracts, a tincture and β -asarone in one (TA100) of the various *Salmonella typhimurium* strains (TA98, 100, 1535, 1537, 1538) tested, but only in the presence of a microsomal activation mix.⁽¹⁶⁾ Lack of mutagenicity has also been reported for an organic extract, when tested in the above *Salmonella typhimurium* strains (except TA1538) with and without activation.⁽¹⁷⁾

Acute toxicities (LD₅₀) quoted for the volatile oil from the Indian variety (high β -asarone content) include 777 mg/kg (rat, oral), >5 g/kg (guinea-pig, dermal), 221 mg/kg (rat, intraperitoneal).⁽⁵⁾ The oleoresin is stated to be toxic at 400 and 800 mg/kg (mouse, intraperitoneal).⁽⁵⁾ The LD₅₀ of asarone in mice is stated to be 417 mg/kg (oral) and 310 mg/kg (intraperitoneal).⁽⁹⁾

Generally the oil is considered to be non-irritant, non-sensitising and non-phototoxic.^(5,G58) However, bath preparations containing the oil have reportedly caused erythema, and dermatitis has been reported in hypersensitive individuals.⁽⁵⁾

Contra-indications, Warnings

The toxicity of calamus oil has been associated with the β -asarone content.⁽¹⁶⁾ It has therefore been advised that only roots free from, or with a low content of β -asarone should be used in human phytotherapy.⁽¹⁶⁾ In foods and beverages, the level of β -asarone permitted in the final product is restricted (*see* Food use).

Use of the isolated oil is not recommended.^(G49,G58) External contact with the oil may cause an irritant reaction in sensitive individuals.

Calamus may potentiate monoamine oxidase inhibitor (MAOI) therapy (*in vitro* MAOI activity, amine constituents), although the clinical significance of the *in vitro* action has not been established.

Pregnancy and lactation In view of the toxic properties associated with calamus, it should not be used during pregnancy or lactation. It is not known whether β -asarone is excreted into the breast milk. In general, the topical application of any undiluted oil is not recommended. Application of preparations containing calamus oil may provoke an irritant reaction and is therefore best avoided.

Pharmaceutical Comment

The phytochemistry of calamus, especially the oil, has been extensively investigated. Three genotypes (diploid, triploid and tetraploid) have been identified which are chemically distinct with respect to the β -asarone content. Spasmolytic and anti-ulcer effects documented for the oil support the traditional herbal uses of calamus. In addition, bitter principles documented as constituents may account for the use of the root in anorexia. However, in view of the toxic properties documented for the oil and associated with β -asarone, it has been recommended that only β -asarone-free calamus root should be used in phytotherapy. Use of the oil is not recommended due to its carcinogenic activity and its ability to cause kidney damage, tremors and convulsions.^(G58) Studies carried out to investigate the mutagenic potential of calamus have produced conflicting results.

References

See also General References G2, G9, G10, G16, G18, G19, G22, G29, G31, G32, G36, G37, G41, G43 and G58.

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