Herba Echinaceae Purpureae

Definition

Herba Echinaceae Purpureae consists of the fresh or dried aerial parts of *Echinacea purpurea* (L.) Moench harvested in full bloom (Asteraceae) (*1*).

Synonyms

Brauneria purpurea (L.) Britt., *Echinacea intermedia* Lindl., *E. purpurea* (L.) Moench f., *E. purpurea* (L.) Moench var. *arkansana* Steyerm., *E. speciosa* Paxt., *Rudbeckia purpurea* L., *R. hispida* Hoffm., *R. serotina* Sweet (*2, 3*).

Asteraceae are also known as Compositae.

Selected vernacular names

Coneflower, purple coneflower herb, purpurfarbener Igelkopf, purpurfarbene Kegelblume, purpurfarbener Sonnenhut, red sunflower, roter Sonnenhut (*4–8*).

Description

A hardy, herbaceous perennial. Stems erect, stout, branched, hirsute or glabrous, 60–180 cm high; basal leaves ovate to ovate-lanceolate, acute, coarsely or sharply serrate, petioles up to 25 cm long, blades to 20 cm long and 15 cm wide, blade abruptly narrowing to base, often cordate, decurrent on petiole, 3–5 veined; cauline leaves petiolate below, sessile above, 7–20 cm long, 1.5–8 cm broad, coarsely serrate to entire, rough to the touch on both surfaces; phyllaries linear-lanceolate, attenuate, entire, pubescent on outer surface, ciliate, passing into the chaff; heads 1.5–3 cm long and 5–10 mm broad, purplish; pales 9–13 mm long, awn half as long as body; disc corollas 4.5–5.5 mm long, lobes 1 mm long; achene 4–4.5 mm long, pappus a low crown of equal teeth; pollen grains yellow, 19–21 μm in diameter; haploid chromosome number $n = 11$ (*2*).

Plant material of interest: fresh or dried aerial parts

General appearance

The macroscopic characteristics of Herba Echinaceae Purpureae are as described above under Description. An abbreviated description is currently unavailable.

Organoleptic properties

Mild, aromatic odour; initially sweet taste that quickly becomes bitter.

Microscopic characteristics

A description of the microscopic characteristics of a cross-section of the aerial parts of the plant is currently unavailable.

Powdered plant material

A description of the powdered plant material is currently unavailable.

Geographical distribution

Echinacea purpurea is native to the Atlantic drainage area of the United States of America and Canada, but not Mexico. Its distribution centres are in Arkansas, Kansas, Missouri, and Oklahoma in the United States of America (*2*). *Echinacea purpurea* has been introduced as a cultivated medicinal plant in parts of north and eastern Africa and in Europe (*9*).

General identity tests

Macroscopic examination *(2)* and thin-layer chromatography and high-performance liquid chromatography (*4*, *10–13*) of the lipophilic constituents and chicoric acid in methanol extracts.

Purity tests

Microbiology

The test for *Salmonella* spp. in Herba Echinaceae Purpureae should be negative. The maximum acceptable limits of other microorganisms are as follows (*14–16*). For preparation of decoction: aerobic bacteria—not more than 10^7/g; fungi—not more than 10^5/g; Escherichia *coli*—not more than 10^2/g. Preparations for internal use: aerobic bacteria—not more than 10^5/g or ml; fungi—not more than 10^4/g or ml; enterobacteria and certain Gram-negative bacteria—not more than 10^3/g or ml; Escherichia *coli*—0/g or ml. Preparations for external use: aerobic bacteria—not more than 10^2/g or ml; fungi—not more than 10^2/g or ml; enterobacteria and certain Gram-negative bacteria—not more than 10^1/g or ml.

Pesticide residues

To be established in accordance with national requirements. Normally, the maximum residue limit of aldrin and dieldrin in Herba Echinaceae Purpureae is not more than 0.05 mg/kg (*16*). For other pesticides, see WHO guidelines on quality control methods for medicinal plants (*14*) and guidelines for predicting dietary intake of pesticide residues (*17*).

Heavy metals

Recommended lead and cadmium levels are no more than 10 and 0.3 mg/kg, respectively, in the final dosage form of the plant material *(14)*.

Radioactive residues

For analysis of strontium-90, iodine-131, caesium-134, caesium-137, and plutonium-239, see WHO guidelines on quality control methods for medicinal plants (*14*).

Other purity tests

Chemical tests and tests for acid-insoluble ash, dilute ethanol-soluble extractive, foreign organic matter, moisture, total ash, and water-soluble extractive to be established in accordance with national requirements.

Chemical assays

For essential oil (0.08–0.32%); chicoric acid (1.2–3.1%) (*4*). Quantitative analysis of echinacoside, chicoric acid, isobutylamides, and other constituents by high-performance liquid chromatography (*4*). Quantitative analysis of alkamides and caffeic acid derivatives by thin-layer chromatography and high-performance liquid chromatography (*4, 12*).

Major chemical constituents

A number of chemical entities have been identified, including alkamides, polyalkenes, polyalkynes, caffeic acid derivatives, and polysaccharides (*3, 5–9*).

The volatile oil contains, among other compounds, borneol, bornyl acetate, pentadeca-8-(*Z*)-en-2-one, germacrene D, caryophyllene, and caryophyllene epoxide.

Isobutylamides of C_{11}–C_{16} straight-chain fatty acids with olefinic or acetylenic bonds (or both) are found in the aerial parts of Herba Echinaceae Purpureae, with the isomeric dodeca-(2*E*,4*E*,8*Z*,10*E*/*Z*)-tetraenoic acid isobutylamides.

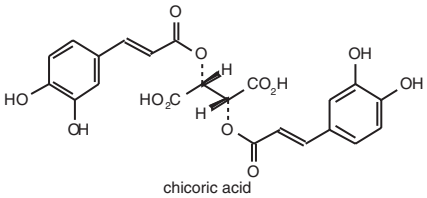
The caffeic acid ester derivative chicoric acid is the major active compound of this class found in the aerial parts of *Echinacea purpurea*, with a concentration range of 1.2–3.1%. Chicoric acid methyl ester and other derivatives are also present.

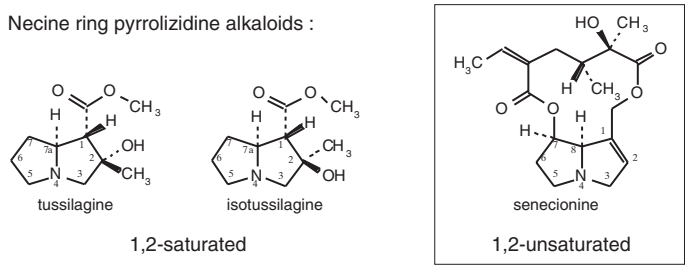
Polysaccharide constituents from Herba Echinaceae Purpureae are of two types: a heteroxylan of average relative molecular mass about 35 000 (e.g. PS-I), and an arabinorhamnogalactan of average relative molecular mass about 45 000 (e.g. PS-II).

Other constituents include trace amounts of pyrrolizidine alkaloids (tussilagine (0.006%) and isotussilagine). At these concentrations, the alkaloids

are considered to be non-toxic (*8*). Furthermore, because these alkaloids lack the 1,2-unsaturated necine ring of alkaloids such as senecionine (structure in box) from *Senecio* species, they are considered to be non-hepatotoxic (*3*).

Structures of representative constituents are presented below.





Dosage forms

Powdered aerial part, pressed juice and galenic preparations thereof for internal and external use *(1, 3)*.

Medicinal uses

Uses supported by clinical data

Herba Echinaceae Purpureae is administered orally in supportive therapy for colds and infections of the respiratory and urinary tract (*1, 3, 5, 7, 8, 18*). Beneficial effects in the treatment of these infections are generally thought to be brought about by stimulation of the immune response (*3, 5, 7*). External uses include promotion of wound healing and treatment of inflammatory skin conditions (*1, 3, 5, 7, 8, 9, 19*).

Uses described in pharmacopoeias and in traditional systems of medicine

None.

Uses described in folk medicine, not supported by experimental or clinical data

Other medical uses claimed for Herba Echinaceae Purpureae include treatment of yeast infections, side-effects of radiation therapy, rheumatoid arthritis, blood poisoning, and food poisoning (*1*, *5*, *7*, *9*).

Pharmacology

Experimental pharmacology

Current claims of the effectiveness of *Echinacea purpurea* as a stimulator of the immune system are based on numerous scientific studies. The immunostimulant effect is brought about by three mechanisms: activation of phagocytosis and stimulation of fibroblasts; increasing respiratory activity; and increased mobility of the leukocytes (*3*, *5*, *8*). Phagocytic activity of standardized extracts of the aerial parts of *E. purpurea* has been determined. A lyophylisate of the expressed juice of Herba Echinaceae Purpureae significantly increased the percentage of phagocytizing human granulocytes and stimulated the phagocytosis of yeast particles *in vitro* (*20*, *21*). Inhibition of hyaluronidase activity, stimulation of the activity of the adrenal cortex, stimulation of the production of properdin (a serum protein which can neutralize bacteria and viruses), and stimulation of interferon production have also been reported after *Echinacea* treatments (*22*). The pharmacological activity of *Echinacea* spp. has been attributed to five component fractions in addition to the essential oil, namely the alkylamides, caffeic acid derivatives, polyalkynes, polyalkenes, and polysaccharides (*7*). The lipophilic amides, alkamides, and caffeic acid derivatives appear to contribute to the immunostimulant activity of the alcoholic *Echinacea* extracts by stimulating phagocytosis of polymorphonuclear neutrophil granulocytes (*3*, *23*, *24*). High molecular weight polysaccharides, including heteroxylan, which activates phagocytosis, and arabinogalactan, which promotes the release of tumour necrosis factor and the production of interleukin-1 and interferon beta (*19*, *22*), have also been implicated in the activity of the aqueous extracts and the powdered drug when taken orally. The overall immunostimulant activity of the alcoholic and aqueous *Echinacea* extracts appears to depend on the combined effects of several constituents (*3*, *5*, *23*).

Topical applications of *Echinacea* extracts have been traditionally used to promote wound healing. The first published work on the mechanism of this action was by Büsing (*25*), who investigated the effect of *Echinacea* spp. on streptococcal and tissue hyaluronidase. Inhibition of tissue and bacterial hyaluronidase is thought to localize the infection and prevent the spread of causative agents to other parts of the body. In addition to the direct antihyaluronidase activity, an indirect effect on the hyaluronic acid–hyaluronidase system has been reported (*26*). Stimulation of new tissue production by increasing fibroblast activity, and stimulation of both blood- and tissue-produced phagocytosis, appear to be involved in this mechanism (*26*). The polysaccharide

fraction (echinacin B) appears to promote wound healing by forming a hyaluronic acid–polysaccharide complex that indirectly leads to the inhibition of hyaluronidase (*27*).

In *in vitro* experiments, an ethanol extract (65% by volume) of Herba Echinaceae Purpureae inhibited the contraction of collagen by mouse fibroblasts, measured by the collagen lattice diameter (*28*).

Mouse macrophages pretreated with polysaccharides that were isolated from the supernatant of Herba Echinaceae Purpureae cell culture increased production of tumour necrosis factor alpha, interleukin-1, and interferon beta-2 and increased cytotoxicity against tumour cells and microorganisms (*Leishmania enreittii*) (*29–31*).

Purified polysaccharides isolated from large-scale cell cultures of *E. purpurea* enhanced the spontaneous motility of human polymorphonuclear leukocytes under soft agar and increased the ability of these cells to kill *Staphylococcus aureus*. Human monocytes were activated to secrete tumour necrosis factor alpha, interleukin-1, and interleukin-6 while the expression of class II human leukocyte antigens was unaffected (*32*).

For purified caffeic acid derivatives, antiviral activities have been demonstrated (*33*). Incubation of vesicular stomatitis virus (VSV) with 125 μg/ml of chicoric acid for 4 hours reduced the number of viral particles in mouse L-929 murine cells by more than 50% (*34*).

Clinical pharmacology

Recently 26 controlled clinical trials (18 randomized, 11 double-blind) were systematically reviewed in Germany (*24*), Nineteen trials studied the prophylaxis or curative treatment of infections, four trials studied the reduction of side-effects of chemotherapy, and three investigated the modulation of specific immune parameters. The review concluded that *Echinacea*-containing preparations are efficacious immunomodulators (*24*). However, it also concluded that there was insufficient evidence for clear therapeutic recommendations as to which preparation or dosage to use for a specific indication (*24*).

A large-scale longitudinal trial (4598 patients) studied the effects of an ointment containing a lyophylisate of the expressed juice of Herba Echinaceae Purpureae. The ointment was used to treat inflammatory skin conditions, wounds, eczema, burns, herpes simplex, and varicose ulcerations of the legs (*19*). Therapeutic benefit from the ointment was observed in 85.5% of the cases. The treatment periods ranged from 7.1 to 15.5 days (*19*).

Contraindications

External use

Allergy to the plant.

Internal use

Should not be used in serious conditions such as tuberculosis, leukosis, collagenosis, multiple sclerosis, AIDS, HIV infection, and autoimmune disorders.

Echinacea preparations should not be administered to people with a known allergy to any plant of the Asteraceae (*1*).

Warnings

No information available.

Precautions

General

Internal or external use should not exceed a period of 8 successive weeks (*1*).

Carcinogenesis, mutagenesis, impairment of fertility

Mutagenicity and carcinogenicity test results were negative (*3*, *5*, *35*). Doses up to a polysaccharide concentration of 500 mg/ml caused no increase in sister chromatid exchange or structural chromosome aberrations (*35*).

Pregnancy: teratogenic effects

There are no reliable studies on this subject. Therefore, administration of the drug during pregnancy is not recommended (*1*).

Nursing mothers

There are no reliable studies on this subject. Nursing mothers should not take the drug without consulting a physician (*1*).

Paediatric use

Oral administration of *Echinacea* preparations is not recommended for small children, except on the advice of a physician. Herba Echinaceae Purpureae may be used for external treatment of small superficial wounds.

Other precautions

No information available concerning drug interactions, drug and laboratory test interactions, or non-teratogenic effects on pregnancy.

Adverse reactions

Occasionally allergic reactions may occur owing to allergy to plants in the Asteraceae (Compositae).

Posology

Oral daily dosage of Herba Echinaceae Purpureae, 6–9 ml expressed juice (*1*) for no longer than 8 successive weeks (*1*). External use of semisolid preparations containing at least 15% pressed juice (*1*) for no longer than 8 successive weeks (*1*). Information on dosages for children is not available (*7*).

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