



Review

Devil's Claw—A review of the ethnobotany, phytochemistry and biological activity of *Harpagophytum procumbens*

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Abstract

Ethnopharmacological relevance

Harpagophytum procumbens subsp. *procumbens* (Burch.) DC. ex Meisn. (Pedaliaceae) is an important traditional medicine growing in the Kalahari region of southern Africa where it is consumed as a general health tonic and for treating diverse ailments including arthritis, pain, fever, ulcers and boils.

Aim of the review

To provide a comprehensive overview of the ethnobotany, phytochemistry and biological activity of *H. procumbens* and possibly make recommendations for further research.

Materials and methods

Peer-reviewed articles on *H. procumbens* were acquired on Scopus, ScienceDirect and SciFinder, there was no specific timeline set for the search. A focus group discussion was held with different communities in Botswana to further understand ethnobotanical uses of the plant.

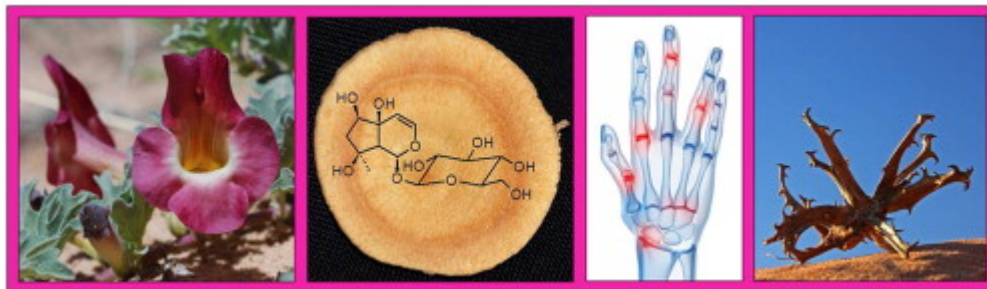
Results

Harpagophytum procumbens is used for a wide variety of health conditions in the form of infusions, decoctions, tinctures, powders and extracts. In addition to the common local use for arthritis and pain, other ethnomedicinal uses include dyspepsia, fever, blood diseases, urinary tract infections, postpartum pain, sprains, sores, ulcers and boils. Scientific studies revealed that *H. procumbens* exhibits analgesic, anti-oxidant, anti-diabetic, anti-epileptic, antimicrobial and antimalarial activities amongst others. Iridoid glycosides and phenylpropanoid glycosides have been the focus of phytochemical investigations as the biological activity has been ascribed to the iridoid glycosides (such as harpagoside and harpagide), which are common in nature and are known to possess anti-inflammatory activity. In addition, it has been shown that the hydrolysed products of harpagoside and harpagide have more pronounced anti-inflammatory activity when compared to the unhydrolysed compounds. *Harpagophytum zeyheri* is a close taxonomic ally of *H. procumbens* but *H. procumbens* is the favoured species of commerce, and contains higher levels of the pharmacologically active constituents. The two are used interchangeably and *H. procumbens* raw material is often intentionally adulterated with *H. zeyheri* and this may impact on the efficacy of inadequately controlled health products. The main exporter of this highly commercialised plant is Namibia. In 2009 alone, *Harpagophytum* exports were worth approximately €1.06 million. The high demand for health products based on this plant has led to over-harvesting, raising concerns about sustainability. Although only the secondary tubers are utilised commercially, the whole plant is often destroyed during harvesting.

Conclusions

Harpagophytum procumbens is used to treat a wide range of ailments. Some of the ethnobotanical claims have been confirmed through *in vitro* studies, however, when the constituents deemed to be the biologically active compounds were isolated the efficacy was lower than that of the whole extract. This necessitates the use of a different approach where all the metabolites are considered using a robust method such as spectroscopy; the phytochemical data can then be superimposed on the biological activity. Furthermore, there is a need to develop rapid and efficient quality control methods for both raw materials and products because the orthodox methods in current use are time-consuming and labour intensive.

Graphical abstract



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Abbreviations

5-LOX, 5-lipo-oxygenase; 6'-PCHG, 6'-O-*p*-coumaroylharpagide; 8-PCHG, 8-*p*-coumaroylharpagide; BCL, Bicuculline; COX-2, cyclooxygenase-2; CREB, cAMP response element-binding; CYP, cytochrome P450; DAD, diode array detection; DPPH, 2, 2-diphenyl-1-picrylhydrazyl; EMEA, European Medicines Agency; ESCOP, European Scientific Cooperative on Phytotherapy; FT, Fourier transform; GABA, gamma-aminobutyric acid; GC, gas chromatography; HPLC, high performance liquid chromatography; HPTLC, high performance thin layer chromatography; HSV-1, Herpes simplex virus type 1; HVA, hyperkinetic ventricular arrhythmias; IL, interleukin; iNOS, inducible nitric oxide; IR, infrared; LD, lethal dose; LPS, lipopolysaccharide; LTB₄, leukotriene B₄; MIC, minimum inhibitory concentration; mRNA, messenger ribonucleic acid; MTT, 3-(4, 5-dimethyl-thiazol-2-yl)-2,5-diphenyl tetrazolium bromide; MS, mass spectrometry; NF-κB, nuclear factor kappa B; NMR, nuclear magnetic resonance; NO, nitrous oxide; NSAIDs, non-steroidal anti-inflammatory drugs; ORAC, oxygen radical anti-oxidant capacity; PCT, picrotoxin; P-gp, permeability glycoprotein; pLDH, parasite lactate dehydrogenase; PG, prostaglandin; PGE₂, prostaglandin E₂; PTZ, pentylenetetrazole; QC, quality control; SPE, solid phase extraction; STZ, streptozocin; TEAC, Trolox[®] equivalent anti-oxidant capacity; TNF, tumour necrosis factor; TPA, 12-O-tetradecanoylphorbol-13-acetate; TXB₂, thromboxane B₂; UV, ultraviolet; VSV, vesicular stomatitis virus; WHO, World Health Organisation

Keywords

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Biological activity; Devil's Claw; Ethnobotany; *Harpagophytum procumbens*; Harpagoside; Iridoids; Phenylpropanoid glycosides; Phytochemistry

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