

Harpagophytum procumbens

Devil's Claw

For thousands of years the Khoisan people of the Kalahari Desert have used *Harpagophytum procumbens*, in remedies for treating pain and complications of pregnancy and in topical ointments for treating skin problems. More recently, health care providers have found it useful in the treatment of anorexia, rheumatism, arthritis, fever, myalgia, tendonitis, gastrointestinal problems, and liver and gallbladder problems. *Harpagophytum procumbens* is also an effective therapy for degenerative musculoskeletal conditions, and it is also used as a pain reliever, sedative, and diuretic.

Botanical Name: *Harpagophytum procumbens*

Family: Pedaliaceae

Common Name: Devil's Claw

Synonyms: Grapple plant (English), Harpagophyti radix (Latin), Teufelskralle, Trampelklette, Sudafrikanische (German), tubercule de griffe du diable (French), venustorn (Danish), duiwelsklou (Africana) (Mills et al 2000)

Parts Used: Secondary Tubers (Byrne 1993; Mars 1997; Weiss et al 2000)



Description

A perennial herbaceous plant, *Harpagophytum* produces a very deep taproot, which can grow up to 1.5 m into the ground. At intervals, secondary roots develop and spread out for up to 1.5 m in all directions. Fleshy white tubers that are shaped like elongated sweet potatoes grow off these secondary roots. The greyish-green leaves are large and heart-shaped, and are placed either alternately or directly opposite each other. Tubular red-violet, yellow-violet or violet flowers emerge from the leaf axils. From the flowers grow woody, sharply curved, sticky, barbed fruits, which give *Harpagophytum* its common name, Devil's Claw. (Byrne 1993; Mills et al 2000; Weiss et al 2000)

Distribution

Harpagophytum is a desert plant that is found in large parts of Southern Africa, primarily in the Kalahari Sands of Namibia, Botswana, South Africa, Angola and to a lesser extent, Zambia and Zimbabwe. It has been wildcrafted and imported into Europe since 1953.

Cultivation

Harpagophytum usually grows in very arid conditions. It thrives in clay or sandy soil, and is commonly seen along roadsides and wastegrounds, and other places which have been stripped of natural vegetation. Grown from seeds in spring, the young tubers are carefully unearthed from the soil at the end of the rainy season in autumn. After collection, the tubers are thinly sliced and quickly dried so that they do not rot or become mouldy. To ensure a quality product, it is important not to mix the tubers, which contain the active constituents, with the inactive roots. (Chevallier 2001; Hoffman 1993; Weiss et al 2000)

Historical Uses

Harpagophytum has long been part of the native medicines of Southern Africa. Traditionally, it has been used for its purgative action and as a bitter tonic for digestive disturbances. An infusion of the tuber is taken to alleviate all kinds of fevers, including malaria, and for blood diseases. It has also been used to treat allergic reactions, migraine, arthritis and rheumatism. Topically, it is used in the form of an ointment for sores, ulcers, boils, cutaneous lesions and wounds. The ointment is also applied to the abdomen of pregnant women during labour to reduce pain. (Chevallier 2001; Duke 1986; Mills et al 2000)

In the 1920s, a German farmer named GH Mehnert, who was living in Namibia, learnt about the miraculous properties of *Harpagophytum* from the natives. He studied its cultivation and drug preparation methods, and sent samples back to Germany for investigation. From there, the herb became popular among British, European and Canadian herbalists in the treatment of degenerative or rheumatic joint diseases, tendonitis, and all types of pain like headache, backache and menstrual pain. (Byrne 1993; Kemper 1999)

Chemistry / Active Constituents

- ♦ Iridoid glycosides – harpagoside, harpagide, procumbide, procumboside
- ♦ Flavonoids – mainly kaempferol and luteolin
- ♦ Phenolic acids – chlorogenic and cinnamic acid
- ♦ Quinone – harpagoquinone
- ♦ Phytosterols – beta-sitosterol, stigmasterol
- ♦ Triterpenes
- ♦ Oleanolic and ursolic acid derivatives
- ♦ Unsaturated fats
- ♦ Amino acids
- ♦ Minerals – Ca, Cr, Fe, Mg, Mn, K, P, Se, Si, Zn
- ♦ Sugars – stachyose, raffinose, and a tetrasaccharide consisting of glucose, fructose, galactose and manninotriose
- ♦ Esters (Chevallier 2001; Mills et al 2000; Kemper 1999; Weiss et al 2000)



The first glycoside to be isolated from *Harpagophytum procumbens* in 1962 is Harpagoside, which has come to be widely regarded as the main active constituent of *Harpagophytum*. Another glycoside discovered at the same time was named harpagide. Two years later, a third glycoside procumbine was isolated in 1964. In 1983, three additional iridoid glycosides with similar names but different linkages, were also discovered. (Weiss et al 2000)

Iridoids are produced through the mevalonic acid pathway and are known as cyclopentan-[c]-pyran monoterpenoids. They occur mainly as glycosides, although non-glycosidic iridoids also occur. (Pengelly 1997). The aglycones of harpagoside, harpagide and procumbine have a furane or pyrane structure. Through dehydration of natural pentoses to furfuol, furane is obtained via furane-2-carbonic acid. The pyranes α -pyrane and gamma pyrane in their reactions resemble unsaturated aliphatic compounds, but the pyrylium salts derived from them are trebly unsaturated and so are aromatic in character. It is thought that the therapeutic effects of *Harpagophytum* are attributable to the furane and pyrane, the latter accepting hydrogen and thus producing oxidation of the substrate, such as a toxin. (Seeger 1973)

* The European Pharmacopoeia proposes that *Harpagophytum procumbens* should contain at least 1.2% of harpagoside, calculated with reference to the dried herb.

* In spite of its small amount of active constituents, *Harpagophytum zeyheri*, which is physically similar to *Harpagophytum procumbens*, has become an inferior substitution species. (Mills et al 2000)

Pharmacology

Over the last few decades, a lot of studies have been conducted in vitro and in vivo to scientifically validate the effectiveness of *Harpagophytum* and its main iridoid glycoside harpagoside as an anti-inflammatory, anti-rheumatic and analgesic agent. While the results of these studies have been conflicting, one result has been consistent. Research has constantly shown that harpagoside when used solely did not render as good results as when the whole plant was used.

Anti-inflammatory, Analgesic and Anti-rheumatic Activity

One of the earliest studies done to test the anti-rheumatic effects of *Harpagophytum* was conducted by a noted European scientist Professor Zorn in 1957. After a sub-cutaneous injection and oral ingestion of an infusion of *Harpagophytum*, white rats with formaldehyde induced arthritis showed significant reductions in swelling of arthritic joints. Furthermore, the healing process continued even after the treatment has ceased. Thus Zorn concluded that *Harpagophytum* contained a potent anti-inflammatory or anti-rheumatic substance. In 1970, scientists Eichler and Koch conducted further tests to determine whether the isolated constituent, harpagoside yielded the same results. While the results with the isolated harpagoside were good, they found that it was not as effective as when the whole plant extract was used. In addition, they found very little analgesic effect from the herb. From that, they concluded that the anti-rheumatic effects of *Harpagophytum* were not just the result of a decrease in discomfort, but because of real improvement in the condition. (Byrne 1993)

From 1961 to 1972, positive results were also reported with *Harpagophytum* in the treatment of over 350 patients. The studies done covered a variety of disorders ranging from rheumatic disease, arthritis and arthrosis to diseases of the liver, gall bladder, stomach, intestines and kidneys. Among the researchers was Dr. F Schmidt, who reported favourable results treating 200 rheumatic patients with infusions of *Harpagophytum* root taken over long periods of time. He found that the herb was able to stimulate the detoxifying and protective mechanisms of the body. He also personally benefited from the herb, experiencing considerable pain relief and mobility through injections of *Harpagophytum* extract into his own arthritic knee joint. (Byrne 1993)

While the earlier findings about *Harpagophytum* were largely positive, the results from recent pharmacological studies are more conflicting. On the one hand, there are studies that conclude that its anti-inflammatory effects are similar to or greater than potent non-steroidal anti-inflammatory agents (NSAIDs) such as phenylbutazone and indomethacin, and its analgesic effects comparable to acetylsalicylic acid. Two double-blind, placebo-controlled studies have shown that *Harpagophytum* is effective as an anti-rheumatic agent. In both studies, volunteers suffering from arthrosis or articular pain experienced a significant reduction in pain and increase in spinal mobility after a course of *Harpagophytum*. (Guyader et al 1984; Lecomte et al 1996)

On the other, studies have found *Harpagophytum* to possess little if any anti-inflammatory, anti-rheumatic or analgesic activity. (Lanthers et al 1992; Murray et al 1990; Grahame et al 1981) Studies conducted on both rats and humans using oral administration of *Harpagophytum* proved ineffective in reducing inflammation and reported no significant improvement in the majority of arthritis sufferers. In a study conducted on 118 patients with back pain, orally administered *Harpagophytum* only produced borderline statistical significance in its ability to relieve back pain when compared to a placebo. (Whitehouse 1983)

One reason for these conflicting results could stem from the inactivation of *Harpagophytum* extracts when administered orally. One study showed that when exposed to an acid treatment that was similar to the physio-chemical conditions found in the stomach, the anti-inflammatory and analgesic effects of *Harpagophytum* were absent. The same treatment also abolished the analgesic effects of harpagoside, suggesting that it is also degraded by gastric acid. (Lanhers et al 1992) A later study confirmed the loss of anti-inflammatory activity following passage through the stomach. (Soulimani et al 1994)

However, the researchers agree on one thing – the isolated iridoid glycoside harpagoside does not appear to be involved in the anti-inflammatory properties of *Harpagophytum*. While it was found that pre-treatment with *Harpagophytum* significantly reduced carrageenan-induced oedema, harpagoside did not protect against carrageenan inflammatory effects at levels corresponding to the dried root. In addition, while harpagoside does appear to exhibit some analgesic activity, this effect was less than the whole plant extract at double the dosage. This indicates that the analgesic effects of *Harpagophytum* are also attributable to other unidentified compounds in the herb. (Lanhers et al 1992)

Ultimately, the mechanism underlying the anti-inflammatory and anti-rheumatic action of *Harpagophytum* remains unclear. Research conducted in the early seventies indicated that *Harpagophytum*'s anti-arthritic action was due to the redox potential of the iridoid glycosides. Contemporary studies have indicated that unlike most conventional NSAIDs that act by inhibiting prostaglandin biosynthesis, the anti-inflammatory action of *Harpagophytum* does not appear to involve the arachadonic acid cascade and prostaglandins. It is believed that the analgesic action of *Harpagophytum* may be due a complex interaction between *Harpagophytum*'s various active principles.

Anti-oxidant Activity



In response to the unexplained mode of action behind *Harpagophytum*'s anti-inflammatory and anti-rheumatic actions, recent research has turned to the possibility that *Harpagophytum* possesses significant antioxidant action that brings about the above-mentioned effects. More and more evidence indicates that the induction of inflammation may be caused by oxidative free radicals. As such, they may be an important etiological factor of inflammatory diseases, including rheumatoid arthritis.

Rheumatoid arthritis has been found to possess many characteristics of a free-radical induced disease. Oxidative free radicals produced by polymorphonuclear leukocytes and other sources activate prostaglandin synthesis, and cause direct cellular injury. This leads to changes in the biochemical biophysical and structural properties of cellular proteins, including elastin, collagen and polysaccharides. Indirectly, free radicals also break down cartilage and decrease the viscosity of synovial fluid. The human synovial tissue does not have antioxidant protection in the form of superoxide dismutase, catalase or glutathione peroxidase. These are vital to defend against potential damage caused by oxygen free radicals. (Battacharya et al 1998)

In a study conducted in rats to investigate the anti-oxidant activity of *Harpagophytum*, *Harpagophytum* extract was administered intra-peritoneally for 14 days and the results were compared with those elicited from a standard antioxidant Deprenyl. The results showed that *Harpagophytum* exhibited a dose-related increase in superoxide dismutase, catalase and glutathione peroxidase activities in both the frontal cortex and striatum of the rats' brains. There was also a simultaneous reduction in lipid peroxidase activity; similar to the results produced by Deprenyl. These findings indicate that *Harpagophytum* exhibits significant antioxidant activity, which may be responsible for its reported experimental and clinical anti-inflammatory and anti-rheumatic activity. (Battacharya et al 1998)

Digestive Activity

In line with its traditional use, recent results have been published expounding the beneficial results of *Harpagophytum* in the treatment of a range of digestive disturbances including dyspeptic conditions of the upper epigastrium, intestinal upsets, and liver and gall bladder complaints. Its action as an appetite stimulant is believed to be attributable to its bitter action. The iridoid glycosides have a bittering value of 6000 (equivalent to that of *Gentiana lutea*) and is thought to cause reflex stimulation of the digestive processes. Studies have also shown that it promotes liver function, increasing detoxification of toxins such as urea. Furthermore, it has proven useful for reducing raised cholesterol and neutral fat levels in patients with metabolic disorders. (Bradley 1992; Occhiuto 1985; Seeger 1973; Weiss et al 2000)

Actions

- ♦ Analgesic
- ♦ Anti-inflammatory
- ♦ Anti-rheumatic
- ♦ Anodyne
- ♦ Alterative
- ♦ Liver and gallbladder tonic
- ♦ Sedative
- ♦ Antipyretic
- ♦ Anti-diabetic
- ♦ Appetite stimulant
- ♦ Bitter tonic
- ♦ Vulnerary (Chevallier 2001; Hoffman 1990; Mars 1997; Mills et al 2000; Weiss et al 2000)

Indications for Use

Internally:

- ♦ Arthritis
- ♦ Rheumatism
- ♦ Back pain due to spondylosis
- ♦ Chronic inflammatory polyarthritis
- ♦ Gout
- ♦ Fibrositis
- ♦ Neuralgia
- ♦ Lumbago
- ♦ Headache
- ♦ Dysmenorrhoea
- ♦ Anorexia
- ♦ Indigestion
- ♦ Heartburn
- ♦ Liver and gallbladder conditions
- ♦ Allergies
- ♦ Diabetes
- ♦ Rinitis
- ♦ Cystitis
- ♦ Fevers



Topically:

- ♦ Sores
- ♦ Ulcers
- ♦ Boils
- ♦ Skin lacerations
- ♦ Wounds

(Chevallier 2001; Hoffman 1990; Mars 1997; Mills et al 2000; Weiss et al 2000)



Contraindications / Precautions

- ♦ The toxicology of *Harpagophytum* is considered very low. To date, there have been no reported side effects following its use. (Grahaem et al 1981)
- ♦ *Harpagophytum* is said to have oxytocic properties and should be avoided in pregnancy. (Kemper 1999)
- ♦ Due to its presumed stimulation of gastric acid secretion, *Harpagophytum* is traditionally contraindicated in patients with gastric or duodenal ulcers. (Weiss et al 2000)
- ♦ In light of its potential anti-arrhythmic effects, potential interactions with anti-arrhythmic drugs should be considered. (Kemper 1999)
- ♦ In one study investigating *Harpagophytum* as a treatment of arthritis, one patient withdrew after four days, complaining of morning headache, tinnitus, severe anorexia and loss of taste for food. (Grahaem et al 1981)
- ♦ *Harpagophytum* is occasionally adulterated with primary roots that are low in harpagoside, or with other bitter African plants like *Elephantorrhiza* and *Acanthiosicyos*. (Kemper 1999)

Typical Dosages

Pediatric

To date, there are no reports about the use of *Harpagophytum* in children.

Adults

Dried root – for pain relief: 3 – 4.5 g mixed in boiling water, steeped for eight hours, take 3 times a day
– for anorexia: 0.5 – 1.5 g mixed in boiling water, steeped for eight hours, take 3 times a day

Liquid extract: 0.1 – 0.25 ml 3 times a day (Kemper 1999)

Tincture: 1 – 2 ml 3 times a day (Hoffman 1990)

Herbal Combinations

Arthritis – Combine with *Apium graveolens*, *Filipendula ulmaria* and *Menyanthes trifoliata*.
(Hoffman 1990)

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