



Prota 11(1): Medicinal plants/Plantes médicinales 1

Record display

Aloe ferox Mill.

Protologue

Gard. dict. ed. 8: *Aloe* n. 22 (1768).

Family

Asphodelaceae

Chromosome number

$2n = 14$

Synonyms

Aloe candelabrum A. Berger (1906).

Vernacular names

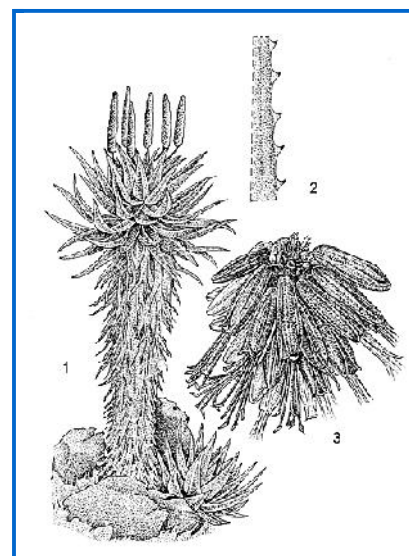
Cape aloe, bitter aloe, red aloe (En). Aloès du Cap (Fr).

Origin and geographic distribution

Aloe ferox is indigenous in South Africa. From the Dutch East India Company's garden in the Cape it was distributed throughout the tropics and subtropics, where it is grown as an ornamental and medicinal plant. Although not treated or mentioned in regional floras, its occurrence in several countries of tropical Africa is probable.

Uses

In southern Africa the thickened, red leaf exudate, called 'Cape aloe', is used as a purgative in human and veterinary medicine and fresh exudate is applied in cases of ophthalmia and syphilis. The gel from the core of the leaves has a similar use as the gel from the leaves of *Aloe vera* (L.) Burm.f. and is used to treat skin afflictions (burns, wounds, abrasions, irritations), and is applied as a poultice on contusions or as a general



1, plant habit; 2, leaf margin; 3, top of inflorescence.

Redrawn and adapted by Achmad Satiri Nurhaman



leaf

refrigerant. It is furthermore used as a hair wash to promote hair growth and against dandruff and as a cosmetic to improve the complexion and to smooth the skin. Aloe gel is also widely used as a hydrating and skin-protecting agent in creams and liquids such as sun lotion, shaving cream, lip balm and healing ointments. An infusion of crushed leaves in water is given to cattle to treat jaundice and redwater and to expel worms. The gel has been used in South Africa to make a jam that tastes like watermelon jam; it is also gaining importance as a refreshing and nutritive ingredient in food and drinks. The gel, leaf powder and drinks are produced in South Africa for both domestic and international markets. Dry leaves are harvested and crushed, after which a decoction is used to make a herbal tea. The leaf ash is used as an insect repellent. In South Africa *Aloe ferox* is planted as a live fence. It is readily browsed by goats.

Production and international trade

Though considerable quantities of 'Cape aloe' are marketed and used locally, most of the exudate produced in South Africa is exported. Total legal harvest is approximately 400 t/year, although an additional 300 t is presumed to go undocumented. Exports are destined for Europe, Asia and North America, with the main importing countries being the United States, Japan and Germany. Production of *Aloe ferox* gel has been hampered by lack of processing facilities in South Africa. Most gel is bought by the cosmetic industry, which demands high quality.

Properties

The exudate of *Aloe ferox* contains 15–40%



inflorescences



inflorescences

anthrone 10-C-glucosides (anthraquinone derivatives) such as aloin and hydroxyaloin. Aloin is a mixture of the stereoisomers aloin A (barbaloin) and aloin B (isobarbaloin). Furthermore, the exudate contains the pyrone derivative aloenin and free and glucosylated 2-acetyl-7-hydroxy-5-methylchromones (e.g. aloesone, furoaloesone, aloeresin A, aloeresin B (aloesin) and aloeresin C). *Aloe ferox* also contains free or glycosylated feroxidin (a tetralin) and feralolide (a dihydroisocoumarin). 'Cape aloe' drugs should contain at least 18% hydroxy-anthraquinone derivatives, not more than 12% moisture and 2% ash, and a water-soluble fraction of at least 45%. The compound responsible for the laxative properties is aloin, which itself is inactive as a laxative, but is activated to aloe-emodin anthrone, by *Eubacterium* sp. Although some observations indicate that in diarrhoea induced by aloin, increased water content might be more important than stimulated peristalsis, the side effects of prolonged use point to a griping effect on the colon. Anthraquinone laxatives should not be used for longer than 8–10 days, or by children younger than 12 years. Contra-indications include pregnancy, breastfeeding, intestinal inflammations and haemorrhoids. In 2002 the United States Food and Drug Administration withdrew the 'generally recognized as safe and effective (GRASE)' status for over-the-counter drugs based on aloe exudates. Aloin should be administered preferably in combination with an antispasmodic to moderate its griping action. Possible side effects of aloin include congestion and irritation of the pelvic organs. Anthraquinone

containing laxatives such as aloe may play a role in colorectal cancer as they have genotoxic potential, and tumorigenic potential in rodents. Aloe-emodin, chrysophanol and aloin A, all isolated from *Aloe ferox* leaf extract, have significant antibacterial activity in vitro. Aloeresin A and B both reduce the oedematous response induced by croton oil in the mouse ear by 40%. Aloeresin B also modulates melanogenesis via competitive inhibition of tyrosinase, thus showing promise as a pigmentation-altering agent for cosmetic or therapeutic applications.

Adulterations and substitutes

Psyllium (*Plantago* spp.), which is a natural bulk laxative, is one of the substitutes for anthraquinone-containing laxative drugs such as *Aloe*, and has the advantage that it does not cause dependency and/or cathartic colon. Anthraquinone-containing preparations from *Senna alata* (L.) Roxb. and other *Senna* and *Cassia* species are also sometimes recommended as substitutes for aloe.

Centella asiatica (L.) Urb. is recommended as a substitute for aloe gels in wound treatments; its triterpenes have exhibited both wound healing and antibacterial activities.

Description

Succulent shrub up to 3(–5 m) tall; stem solitary, up to 30 cm in diameter, rarely branching from above the base, with persistent dead leaves. Leaves 50–60 in a dense rosette, spreading or recurved; stipules absent; petiole absent; blade lanceolate-oblong, up to 100 cm × 15 cm, apex long-acuminate, margin with sharp, reddish (-brown) teeth c. 6 mm long, 1–2 cm apart, blade dull green, sometimes reddish tinged;

exudate yellow, drying red. Inflorescence consisting of large, dense, elongated racemes 50–80 cm long; peduncle with 5–8 spreading branches; bracts broadly ovate, 2–5 mm × 2–4 mm. Flowers bisexual, regular, 3-merous; pedicel 1–1.5 cm long; perianth tubular, 2.5–3.5 cm long, lobes 6, 12–17 mm long, red or deep orange, sometimes white or yellow; stamens 6, exserted; ovary superior, 3-celled, style filiform, stigma head-shaped, exserted. Fruit an ovoid capsule up to 3 cm long, dehiscent loculicidally, many-seeded. Seeds c. 9 mm long, broadly winged.

Other botanical information

Aloe comprises about 450 species in Africa and Arabia, of which c. 315 occur in mainland Africa, c. 100 are endemic to Madagascar or the Indian Ocean islands (including the former *Lomatophyllum*) and c. 50 occur in Arabia.

Another South African species with medicinal uses is *Aloe maculata* All. (synonym: *Aloe saponaria* (Aiton) Haw.). It has been planted in the drier parts of Mauritius, Rodrigues and Comoros as an ornamental, but is also used medicinally. An infusion of the leaves is used as eye drops to treat conjunctivitis, and rubbed on boils, sores, bruises and rheumatic joints. It is also taken to treat stomach-ache and headache. In South Africa a leaf infusion is taken to treat cardiac problems and as an anthelmintic. The pulverized flower infusion is drunk or given as an enema to treat colds with fever in children. The leaves contain anthraquinones, as well as aloesaponarin I and II, and aloin. The leaves yield a yellow dye. The plant is readily browsed by goats.

Growth and development

Aloe species follow the Crassulacean acid metabolism (CAM). CAM plants are able to fix CO₂ at night and to photosynthesize with closed stomata during the day, thus minimizing water loss. This, plus their succulent leaves and stems and the presence of a thick cuticle, makes them well adapted to dry conditions. Severe drought, though, stops exudate production. *Aloe ferox* has a stem surrounded with a persistent layer of dead leaves that insulate the stem in the case of bush fires. Harvesting of *Aloe ferox* leaves for medicinal purposes could thus result in significant mortality due to fires. The flower morphology of *Aloe ferox* suggests pollination by birds. However, honey bees also play a role in the pollination. *Aloe ferox* is self-incompatible and only a few flowers per raceme flower simultaneously. The stamens produce pollen in the morning and wither in the afternoon, whereas the style is exerted on the second day of anthesis.

Ecology

Aloe ferox is one of the dominant species in the 'succulent bushland' vegetation in South Africa. It grows in a wide range of climatic conditions. It is especially abundant on arid rocky hillsides up to 1000 m altitude, where mean temperatures range from 27–31°C. Annual rainfall ranges from 50–300 mm. Though the root system is shallow, the plant can grow under such dry conditions. Waterlogging should be avoided and *Aloe ferox* thrives on well-drained, rich soils. It withstands light frost, although the flowers may be damaged.

Propagation and planting

Aloe ferox does not produce suckers but can be propagated by seed and planting of the

tops of old plants. Plant regeneration from root and embryo tissue is successful as well.

Management

Commercial cultivation becomes a profitable option now that not only the exudate but also the gel has become interesting. Details on cultivation have not been published.

Diseases and pests

A leaf-mining insect affects yields of natural populations of *Aloe ferox*.

Harvesting

Harvesting of leaves from wild plants of *Aloe ferox* is thought to be sustainable. Rural populations have been harvesting for generations and a fee is paid to the landowner. *Aloe ferox* exudate is often collected by cutting off the leaves transversely close to the stem and positioning them in such a way that the exudate drains into pots, tubs, vessels or even a simple canvas placed over a depression in the ground. The exudate may also be obtained by squeezing the leaves or by warm or cold water retting. In South Africa *Aloe ferox* is preferably tapped during the rainy season, because then the exudate is more abundant, but tapping is also carried out in other periods of the year, except for the driest months. The leaves are usually cut in the morning and it takes 4–5 hours for the exudate to drain from a pile of leaves. Only older leaves are cut; younger ones and growing tips are spared.

Yield

Two tonnes of *Aloe ferox* leaves yield about 1 kg of gel powder, which is a higher ratio than for *Aloe vera*.

Handling after harvest

Collected exudate is usually concentrated by

boiling and then cooling. On cooling, a solid, amorphous extract is formed and this constitutes the drug. Its appearance varies with the concentration process used. If the exudate has been concentrated slowly, in the sun or over a low fire, the cooled extract is opaque, waxy and liver-coloured ('hepatic aloe') and aloin crystals are visible under the microscope. If, on the other hand, the juice has been concentrated rapidly, for instance over a fierce fire, the cooled extract is semi-transparent ('glassy aloe') and no aloin crystals are visible under the microscope.

An option for adding value is to produce dried and ground leaf powder. After the leaf exudate is extracted, the leaves are pulped and squeezed dry under high pressure. The liquid is settled and treated with chemicals to flocculate the jelly fraction.

The gel can be obtained by removing the outer tissues of the leaf. In Aruba, gel is obtained by cutting open the leaves lengthwise and scraping the gel from the leaf blade. The youngest leaves (< 25 cm) are not suitable because of the small amount of gel, but the leaves should not be too old, because gel quantity and quality may decline.

Genetic resources

Because of their popularity as a garden and greenhouse plant, various *Aloe* species are potentially at risk of extinction as a result of plant collection from the wild. *Aloe ferox* is cultivated widely as an ornamental.

Harvesting from the wild is still considered sustainable but warrants monitoring. An export permit is compulsory because apart from *Aloe vera*, all *Aloe* species are listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora

(CITES) Appendices.

Breeding

No breeding programmes are known to exist for *Aloe ferox*. High-yielding plants may be selected and propagated for commercial cultivation. In *Aloe ferox* in South Africa, the aloin content of the leaf exudate was found to differ markedly between provenances. Many *Aloe* species hybridize in the wild if their area of distribution and period of flowering overlap, and it is easy to produce hybrids in cultivation. The scope for breeding and selection is therefore enormous.

Prospects

Aloe ferox is a potential crop in arid regions. It will remain beneficial as a household remedy: fresh gel can easily be prepared and applied to wounds. In its use as a laxative, however, there is a tendency for the drug to be replaced by other laxatives such as those from *Plantago* spp. The gel industry has a bright future. Other *Aloe* species producing suckers, such as *Aloe turkanensis* Christian and *Aloe flexilifolia* Christian from East Africa, may prove better candidates for commercial cultivation.

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