



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

Record display

***Strophanthus gratus* (Wall. & Hook.) Baill.**

Protologue

Hist. pl. 10: 171 (1889).

Family

Apocynaceae

Chromosome number

$2n = 18$

Vernacular names

Spider tresses, poison arrow vine (En). Strophanthus glabre du Gabon (Fr). Estrofanto (Po).

Origin and geographic distribution

Strophanthus gratus occurs in the forest area of West Africa and western Central Africa, from Senegal east to south-western Central African Republic and north-western DR Congo and south to Gabon.

Uses

Seeds of *Strophanthus gratus* are very toxic and have been used extensively in the preparation of arrow poison throughout its distribution area. The seeds are mostly ground with the sticky plant juice and the arrow tip is dipped into the mixture. In the rainforest area of Central Africa, the stem bark or roots are used similarly; they are often mixed with other plant products, especially the latex of *Periploca nigrescens* Afzel., but also of *Rauvolfia* spp. Game wounded by a poisoned arrow dies quickly, and the flesh can be eaten without problem, although the flesh immediately surrounding the wound is discarded. The seeds are also used as fish poison. In southern Nigeria *Strophanthus gratus* is cultivated by hunters for the seeds.

A leaf and stem decoction is taken in Sierra Leone and Côte d'Ivoire to treat gonorrhoea. In Ghana a decoction of bark is taken to treat weakness, and a leaf paste is applied to snakebites. In Côte d'Ivoire, Ghana and Nigeria a leaf paste is put onto sores, including guinea worm sores. In Nigeria a leaf infusion is taken to treat constipation, and is rubbed on the body to cure fever. A root decoction is said to be an aphrodisiac.

The glycoside ouabain is extracted from the seed ('Semen strophanthi') and used in a number of pharmaceuticals in several European countries, especially in Germany, as a rapid cardiac and vascular stimulant.



wild

In West Africa the plant has many magic uses, e.g. as a good luck charm. *Strophanthus gratus* is widely planted in gardens in the tropics and in greenhouses in the temperate zones as an ornamental.

Production and international trade

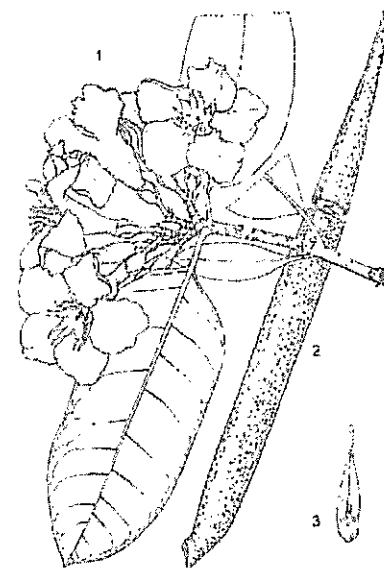
Strophanthus gratus is locally cultivated in Nigeria, Cameroon and Gabon, mainly for export to Europe. In the early 1990s, 2700 t/year of *Strophanthus* fruit were licensed for export from Cameroon; much of this would be *Strophanthus gratus*.

Properties

A large number of cardiac glycosides (cardenolides) have been isolated from *Strophanthus gratus*. The seeds contain the highest concentration of glycosides characterized by highly oxygenated aglycones. They have no smell but are extremely bitter. The seeds contain 4–8% of a glycoside mixture with predominantly ouabagenin as aglycone: 90–95% is ouabain (g-strophanthin), followed by acolongifloroside K, and strogoside, which has strogogenin as aglycone. Minor components with different aglycones are sarnovide and several sarmentosides. The leaves also contain the lignans pinoresinol, 8-hydroxypinoresinol and olivil.

Strophanthus gratus fulfils all conditions for a perfect hunting poison: extremely high toxicity, fast and sure effect, unusually high concentrations of the active principle in the seeds, and very easily water-soluble and thus easily extracted from the seed. Acolongifloroside K is comparable to ouabain in its toxic properties; strogoside is less toxic. The sarmentosides are highly toxic but because of their very low concentration they play only a small role.

In medicine, ouabain is used as a remedy for congestive heart failure, like digitalis glycosides. Congestive heart failure is a disease characterized by impaired blood circulation, due to a decrease in the force with which the heart muscle contracts. Cardiac glycosides such as ouabain have a direct cardiotoxic action on the myocardium, resulting in an increase in the force of contraction. The increased contractility is caused by inhibition of the membrane-bound enzyme $\text{Na}^+\text{K}^+\text{ATPase}$, leading to an increase in the intracellular stores of calcium. When the cardiac glycoside is given to a patient suffering from congestive heart failure, the stroke volume of the heart is increased, causing a more effective emptying of the ventricles, and a lowering of the diastolic pressure. In higher doses, cardiac glycosides have a direct inhibiting action on atrioventricular conduction together with a decrease of the heart rate, and are especially employed in the treatment of atrial flutter and atrial fibrillation. The effects of cardiac glycosides are particularly dramatic in patients suffering from a combination of congestive heart failure and atrial fibrillation. When ouabain is applied, its actions are of rapid onset, but of short duration; furthermore, there is little risk of accumulation. It is mainly administered by injection, because it is poorly absorbed orally, contrary to digitalis glycosides. Its major disadvantage is its narrow therapeutic range, which is the margin between the therapeutically effective and toxic doses. Toxic effects include vomiting and convulsions, while larger doses lead to cardiac arrest and death, which explains its



1, flowering branch; 2, follicle, with middle section removed; 3, seed, with part of beak and tuft of hairs removed. Redrawn and adapted by Iskak Syamsudin



flowering branch

success as arrow poison. Ouabain has recently been identified as a steroid hormone in mammals. A remarkable interaction occurs between ouabain and reserpine obtained from *Rauwolfia* spp. Pretreatment with reserpine reduces the toxicity of ouabain, while simultaneous treatment increases it. This may well explain the success of the mixture in hunting poisons.

Leaves of *Strophanthus gratus* are a folk medicine against snakebite in Africa. Aqueous leaf extracts show a dose-related delay of clotting of blood in animals treated with a standardized dose of venom of the saw-scaled viper (*Echis carinatus*). This venom causes rapid intra-arterial clotting of blood, resulting in death in small animals, while death in larger animals and in man occurs as a result of depletion of fibrinogen reserves and internal haemorrhage.

Preliminary tests found a novel activity for ouabain that could prove relevant to the treatment of metastatic prostate cancer. The compound induces programmed cell death in androgen-independent human prostate cancer cell lines in vitro.

Adulterations and substitutes

The seeds of *Strophanthus gratus* are often mixed with those of *Strophanthus hispidus* DC.; both contain toxic and bio-active glycosides, though in different proportions. Ouabain is also found in the wood and bark of *Acokanthera schimperi* (A.DC.) Schweinf., a famous arrow-poison plant from East Africa. *Digitalis* glycosides are used as a remedy for congestive heart failure, in the same way as ouabain.

Description

Liana up to 25 m long or less often a shrub, with clear or white exudate; stem up to 10 cm in diameter, in older plants often with corky ridges; branches with many lenticels, dark brown to purplish brown. Leaves decussately opposite, simple and entire; stipules absent; petiole 5–17 mm long; blade ovate or elliptical to obovate, 5–18 cm × 2–9 cm, base rounded or cuneate, apex acuminate, margins entire, often somewhat revolute, thinly leathery, glabrous. Inflorescence a terminal dichasial cyme, on long or short branches or in the forks, congested, few- to many-flowered; peduncle 0–6(–15) mm long; bracts ovate or triangular, 2–9 mm long. Flowers bisexual, regular, 5-merous, fragrant; pedicel 4–13 mm long; sepals free, unequal, obovate or broadly obovate, 7–18 mm long, emarginate, rounded or apiculate; corolla tube 25–45 mm long, widening at 33–55% of its length into a cylindrical upper part, at the mouth 13–22 mm wide, glabrous outside, papillose or slightly scabrid near the apex, white and turning yellow near the base outside, reddish or purple near the mouth outside, white and red- or purple-streaked inside, corona lobes 10, subulate or narrowly triangular, 5–15 mm long, with acute tip, fleshy, hairy or almost glabrous, pink, turning purple, corolla lobes orbicular, 14–35 mm × 15–32 mm, apex emarginate or rounded and apiculate, glabrous on both sides, white often with a stripe of purple on the right side outside, turning reddish or purple all over, white and turning yellow inside; stamens inserted at 14–21 mm from the base of the corolla tube, exserted; ovary half-inferior, 2-celled, style 16–22 mm



inflorescence



flowers

long, ending in a ringlike pistil head surrounding the minute stigma. Fruit consisting of 2 ellipsoid follicles 2.3–4.1 cm × 3–4.5 cm, tapering into a narrow and obtuse apex and ending in a large knob, 2-valved, divergent at 180°, wall thick and hard, slightly grooved, glabrous, with many lenticels, many-seeded. Seeds spindle-shaped, 12–20 mm × 2.5–4.5 mm, glabrous, slightly rough, at apex with a long beak up to 6 cm long, in upper 2.5–4.5 cm with long hairs up to 13 cm long. Seedling with epigeal germination; cotyledons elliptical to obovate, 17–25 mm long, apex rounded.

Other botanical information

Strophanthus comprises 38 species, of which 30 occur in continental Africa, 1 in Madagascar and 7 in Asia, from India to South-East Asia.

Only 2 other *Strophanthus* spp. contain the important compound ouabain, *Strophanthus thollonii* Franch. and *Strophanthus sarmentosus* DC., but only traces.

Growth and development

Strophanthus gratus possibly flowers throughout the year in humid parts of West Africa, but with a peak in November–December. In areas with distinct dry and rainy seasons, it flowers towards the end of the dry season and the beginning of the rainy season; fruits are mature in the dry season. *Strophanthus gratus* is an obligate cross pollinator. Fruit maturation takes about 1 year.

Ecology

Strophanthus gratus occurs in primary and secondary moist forest, often at forest margins or on river banks, from sea-level up to 650 m altitude.

Propagation and planting

The 1000-seed weight of *Strophanthus gratus* is 20–30 g. Under glasshouse conditions in temperate climates ripewood cuttings are rooted in early spring in moist sand in a closed case with bottom heat. *Strophanthus gratus* should preferably be grown in full light in a fertile, moist but well-drained loam rich in organic matter and with additional leaf mould.

Management

Domestication of *Strophanthus gratus* is being attempted at the Plantecam compound at Mutengene, Cameroon. Plants grow spontaneously around Pygmy villages in western Cameroon. *Spondias* trees are sometimes used as support.

Handling after harvest

Before exportation the tuft of hair is often removed from the seed. However, the preferred method for exporting seed is inside the fruit and with the tuft of hairs attached, to limit adulteration. For arrow-poison use, almost mature fruits are kept in a pot until they open. The seeds are then cleaned by removing the tuft of hair by stirring or burning, and they are roasted to preserve their chemical properties by destroying the enzyme,



inflorescence



inflorescence

which can convert the glycosides into biologically inactive compounds when the seeds are stored for a long time or become damp.

Genetic resources

Because of its wide distribution, *Strophanthus gratus* is not threatened by genetic erosion. No concerted efforts to conserve genetic resources or breeding programmes are known.

Prospects

At present in medicine, cardiac glycosides are only applied in special cases, e.g. the combination of congestive heart failure and atrial fibrillation. In the Western world, the drug of choice is in general digoxin (from *Digitalis lanata* Ehrh.), but in acute situations ouabain is often preferred. At present ouabain is only applied to treat acute congestive heart failure combined with atrial fibrillation. Given its toxicity it is unlikely that it will become of more general use.

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Sources of illustration

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