RESEARCH PAPERS

THE POISONOUS PRINCIPLE AND HISTOLOGY OF *GLORIOSA VIRESCENS* LINDL.

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In recent years many instances of poisoning have been examined by these laboratories which have been received from the Police and Medical Authorities of Equatoria. In this Province of the Sudan, native witch-doctors are very active, and certain articles of their *materia medica* occasionally find their way into the hands of unscrupulous persons who use them for criminal purposes. From the viscera of several persons who died, the alkaloid colchicine has been isolated, and in connection with a recent death a specimen of plant material was submitted which was identified as a corm of *Gloriosa virescens* Lindl. Although the alkaloid of the related species *G. superba* has been isolated and identified as colchicine, the active principle of *G. virescens* has hitherto been referred to as an unknown compound. We have now shown that the principal alkaloid present in this species is colchicine.

Pharmacognosy

Gloriosa virescens Lindl, is an attractive Liliaceous plant widespread in southern Sudan, extending westwards to Darfur, and also found in the Red Sea Hills. In habit it is a climbing or semi-climbing plant, with long slender stems. The leaves are usually oblong to oblong-lanceolate, acuminate, with cirrhose tips which assist in climbing. The lower leaves may be verticillate or opposite, while the upper ones are often alternate. The flowers form a lax terminal corymb, with long pedicels, cernuous at the tip. The perianth is $1\frac{1}{2}$ to $2\frac{1}{2}$ in. in length, strongly reflexed, the segments lanceolate-cuspidate, scarcely at all crisped, and $\frac{1}{3}$ to $\frac{1}{2}$ in. broad at the middle. The colour is variable, bright red to yellow, or in the type specimens yellow tinged with green on the outside. The filaments of the stamens are about half as long as the perianth, the anthers linear, $\frac{1}{3}$ in. long. The style is 1 to $1\frac{1}{2}$ in. long, branched in the upper third. The capsule is 2 to $2\frac{1}{2}$ in. long. The species closely resembles *Gloriosa superba* Linn., from which it differs by being smaller in all its parts, with terminal corymbs, not axillary as in that species. The perianth segments of *G. superba* are markedly crisped, while those of *G. virescens* are scarcely so if at all.

The tubers, which are of importance in the present studies, are fleshy root tubers, 4 to 6 in. long, $\frac{3}{4}$ to 1 in. in diameter, tapering very slightly from the tip. Forking may occur in the upper 2 in., so that the root is bifid, or occasionally trifid. The tubers are free from secondary roots in the lower portions, but the remains of adventitious roots are frequently

to be found attached at the apex, as the growing plant appears to be stem rooting. The cuticle of the storage root is comparatively thin, but may thicken with age, while the colour of the freshly-dug tuber is pale yellowish-white, darkening slightly with age.

Anatomically the tubers show the features of a fleshy, monocotyledenous storage root. The ground tissue, forming the bulk of the tuber, consists

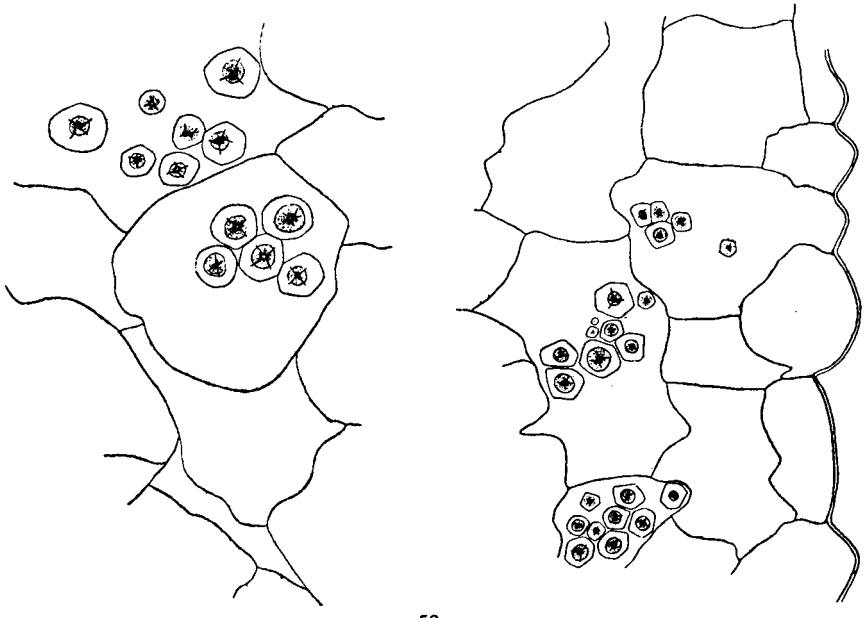

FIG. 1A. Transverse section of root tuber of *Gloriosa* showing ground tissue with laminated starch grain.

FIG. 1B. Transverse section of the root tuber of *Gloriosa* showing epidermis and ground tissue.

of thin-walled, isodiametric, parenchymatous cells, many of which contain starch grains. (Fig. 1 A). These starch grains show a characteristic lamination and are especially frequent near the epidermis (Fig. 1 B) and near the vascular bundles (Fig. 1 C). It is in the ground tissue that food-storage takes place. The epidermal layer is more regularly rectangular in shape, and has a comparatively thin cuticle, but it is possible that in old tubers it may be much thicker.

The vascular bundles are scattered throughout the ground tissue in a manner typical of monocotyledons, but as the tubers are storage roots the bundles are widely spaced and reduced in structure. Vessels appear to be absent, and the number of tracheids per bundle is 1 to 3, rarely more. In longitudinal section these tracheids are seen to be annular or spiral, scalariform or reticulate pitting being absent (Fig. 2). This is as might be expected in a storage root, where the xylem elements are needed only to conduct foodstuffs to the young growing shoot, absorption of mineral nutrients from the soil being carried out by the adventitious roots as soon

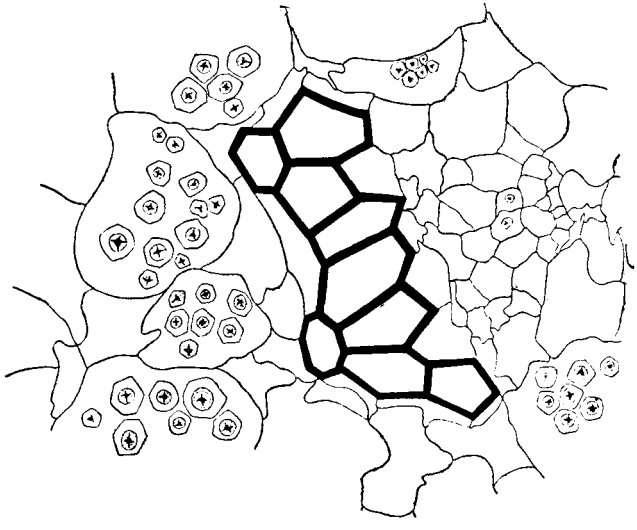

FIG. 1C. Transverse section of root tuber of *Gloriosa* showing stele and starch grains.

as they appear. The phloem appears to be scanty, although a little more abundant than the xylem. The phloem cells are narrow, elongate and nucleated (Fig. 2), while wider sieve tubes have not been seen in any of the material examined. This again is what might be expected in a fleshy root tuber, where the distance through which built-up foodstuffs have to be carried is small.

CHEMICAL EXAMINATION

The specimens used for examination were collected by Mr. J. K. Jackson, Government Silviculturist, from Gilo, Imatong mountains, Equatoria Province, Southern Sudan.

Only a small quantity of the roots (about 25 g.) was available for examination. A part was extracted with ethanol and separated into fractions using the well-known Stas-Otto procedure, when the following results were obtained: (*a*) light petroleum extract from acid solution—no visible residue, (*b*) ether extract from acid solution—a minute amount of long needle crystals soluble in ammonia but giving no colour with ferric chloride solution. This probably contained an organic acid, (*c*) chloroform extract from acid solution—a yellow residue representing 0·12 per cent. of the roots was obtained which after purification gave the following reactions.

General alkaloidal reagents. Wagner's reagent, Sonnenschein's reagent, Dragendorff's reagent, and Meyer's reagent, all gave positive results. Picric acid reagent and Marmé's reagent gave negative results.

Colour reagents. (i) Concentrated sulphuric acid—orange to yellow, (ii) Mandelin's reagent—green, changing to violet, changing to brown, (iii) Marquis' reagent—orange, (iv) Mecke's reagent—green yellow

changing to brown, (v) Fröhde's reagent—deep yellow brown, (vi) Vitali's test—violet in the cold, turning to brown on evaporating to dryness, giving a deep brown and violet with alcoholic potash, (vii) Sulphuric acid-potassium nitrate test—green, changing to blue and violet changing to brown then fading to colour-less. These reactions indicate that the alkaloid is colchicine. Unfortunately there was insufficient remaining to recrystallise from ethyl acetate to obtain a melting point. It should be noted that colchicine is most unusual if not unique among the alkaloids, in that it is extracted by chloroform from a solution acidified with sulphuric acid.

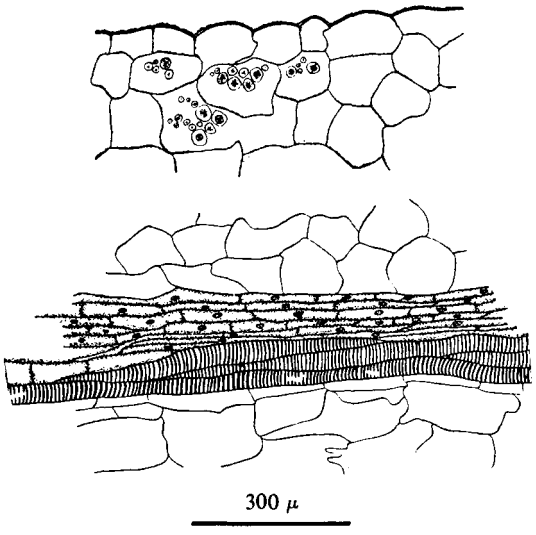

FIG. 2. Longitudinal section of the root tuber of *Gloriosa.*

(*d*) Chloroform extract from a solution made alkaline with caustic soda—a yellow residue representing 0·014 per cent. of the roots which gave reactions similar to those given by the alkaloid in fraction (*c*). (*e*) Chloroform extract from ammoniacal methanolic solution—the slight residue gave negative reactions for alkaloids. (*f*) The aqueous solution remaining from the above extractions gave negative reactions for alkaloids.

The remainder of the roots was examined for colchicine content using the B.P. 1953 Assay for Colchicum, when 0·066 per cent. was found (equivalent to 0·22 per cent. on dried roots). When examined the roots contained 69·5 per cent. moisture.

It is clear from the above results that the toxic properties of the root reported in the literature is due to the presence of colchicine.

SUMMARY

An illustrated description of the plant *Gloriosa virescens* Lindl, is given, and the toxic principle is identified as colchicine.

We would like to thank Mr. J. K. Jackson, Government Silviculturist, for collecting the roots.

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