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Dichrostachys cinerea (L.) Wight and Arn. (Fabaceae), a plant used in the traditional treatment of lymphatic filariasis in Côte d'Ivoire: Ethnopharmacological characteristics

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Abstract

Dichrostachys cinerea (L.) Wight & Arn. (Fabaceae) is a plant used in the traditional treatment of lymphatic filariasis. It was revealed following a recent ethnomedicinal survey.

The present study aims to highlight the distinctive ethnopharmacological characteristics of *Dichrostachys cinerea*.

The aim was to identify some groups of chemical compounds by thin layer chromatography, to assay some minerals and finally to characterise the specific anatomical and micrographic features of the plant.

Terpenes and sterols, saponosides, flavonoids and tannins are the main phytocompounds revealed. Magnesium with 110.4 mg/100 g dry matter is the most abundant mineral. Anatomical sections revealed from the periphery to the interior of the organs, epidermis, collenchyma, cortical parenchyma, sclerenchyma, liber or phloem, the wood or xylem and the medullary parenchyma. In the plant powder, it was observed starch grains and calcium oxalate crystals.

These results add to the data on *Dichrostachys cinerea*, a taxon much used in traditional Ivorian medicine for the treatment of lymphatic filariasis.

Keywords: *Dichrostachys cinerea*; Ethnopharmacological characteristics; Lymphatic filariasis; Côte d'Ivoire

1. Introduction

A common condition in the intertropical zone, lymphatic filariasis is a neglected tropical disease that can attack the upper and lower limbs but also the external genitalia. This is related to obstruction of lymphatic vessels by adult worms or by inflammation and subsequent fibrosis or by external compression [1]. The chemoprevention recommended by the WHO [2] remains the main way to fight against this pathology despite many limitations including the recrudescence of drug resistance, serious side effects, prolonged treatment duration [3]. To overcome all these constraints, medicinal plants offer a promising alternative to be explored and an asset for poor communities affected by NTD. It is in this context that a recent study revealed *Dichrostachys cinerea* (Fabaceae) as a plant used for the traditional treatment of lymphatic filariasis [4]. The present study aims to highlight the distinctive ethnopharmacological characteristics of *Dichrostachys cinerea*. Several studies have been carried out on *Dichrostachys cinerea*. It is important to compare all

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these data obtained from the plant with that found in Côte d'Ivoire. *D. cinerea* is a semi-deciduous tree up to 7 m tall with an open crown. The literature reveals multiple therapeutic uses of the plant. For instance, the bark of *D. cinerea* is used to prepare concoction tradition ally used to treat dysentery, headache and elephantiasis. Its root infusions are used to treat syphilis, gonorrhea coughs and sore eye and also serve as an anthelmintic, laxative and strong diuretic [5]. Moreover, *D. cinerea* is wildely use as a source of food, fuel, fibre and timber. In medicine, its bark is use to treat dysentery, headaches, toothaches, and elephantiasis [6].

2. Material and methods

2.1. Material

The parts of *Dichrostachys cinerea* used were the young stem and the bark. These organs were harvested on the Yakasse-Attobrou (Adzope, Côte d'Ivoire). The geographic coordinates are 6°10'51" N and 3°39'26" W.

2.2. Methods

2.2.1. Phytochemistry

This phase started with the extraction of the different phytochemicals. The plant powder was introduced into a 50 mL Falcon tube and cold macerated for 24 hours in the extraction solvent (96% ethanol). The filtrate obtained was used for phytochemical screening.

Phytochemical screening of the extracts was performed on HPTLC plates (20 cm × 10 cm) silica gel〖60 F〗_254 (Merck, Darmstadt, Germany).

10 µL of extract were deposited in a 1 cm strip with a semi-automatic sample dispenser (CAMAG, Linomat 5, Switzerland) along the baseline 8 mm from the bottom edge of the plate. The distance between the spots is 3.4 mm. The distance between the first spot and the left edge of the plate and between the last spot and the right edge of the plate is 20 mm. A constant application rate of 100 nL/s was used. Linear upward development with 10 mL mobile phase was performed in a CAMAG double-trough glass chamber lined with filter paper and previously saturated with mobile phase vapour for 20 minutes. The development distance was approximately 70 mm. The plates were dried after development using a hair dryer. In the double trough chamber, the mobile phases were:

- Terpenoids, eluted with hexane/ethyl acetate system 20:4, v/v and revealed by Liebermann Bürchard reagent;
- Saponosides, eluted with ethyl acetate/petroleum ether 2:1, v/v revealed with sulphuric anisaldehyde;
- Flavonoids and tannins: ethyl acetate/formic acid/acetic acid/water 100:11:11:26, v/v/v. Flavonoids were revealed by Neu's reagent, tannins by $FeCl_3$ (2%).

2.2.2. Mineralogy

For the determination of mineral elements, the Analist Pinaacle 900T air-acetylene flame atomic adsorption spectrometer (Perkin Elmer) was used. The wavelengths of the elements to be analysed were first defined on the instrument (324.75 nm for copper, 213.86 nm for zinc, 248.33 nm for iron, 285.2 nm for magnesium, 766.49 nm for potassium, 279.48 nm for manganese and 589.0 nm for sodium). Then, the different readings of the calibration ranges were used to establish the calibration curve translating absorbance as a function of concentration. Finally, the samples to be analysed were presented to the apparatus in order to determine their absorbances. A blank is necessarily passed between the passage of two different solutions.

2.2.3. Anatomo-histology

It consisted of making thin cross-sections of a portion of *Dichrostachys cinerea* stem using a new razor blade. The stem was inserted into sorghum or polystyrene pith. The whole set of sections was soaked in diluted bleach for 20 min followed by rinsing with plain water. The sections were then soaked in acetic water for 15 minutes to neutralise the excess bleach, which is chemically basic and makes the cell walls receptive to the dye. After this step, the sections obtained were stained with carmino-green (a mixture of carmine alumina and iodine green) and then rinsed one last time with water. Thus, the cell walls were stained according to their chemical nature (cellulosic walls in pink and lignified walls in green). The stained sections were then mounted between slides and coverslips in a drop of glycerine water for observation under a photonic microscope connected to a computer. After observation, the different sections were photographed.

2.2.4. Micrography

On an object slide, a drop of 10% potash was placed. This preparation was sprinkled with a pinch of fine plant drug powder obtained using a 500 µm mesh sieve. This was covered with a slide without leaving any air bubbles. The powder thus treated was observed with an Optika Microscopes Italy photonic microscope, connected to a tablet. Observations were made at x40 and x100 magnification in order to look for characteristic elements or organ fragments. These observed elements were then photographed.

3. Results and discussion

3.1. Systematic position

- Kingdom: Plantae
- Clade: Angiosperme
- Clade: Dicotyledones
- Order: Fabales
- Family: Fabaceae
- Genus: *Dichrostachys*
- *Species: Dichrostachys cinerea* (L.) Wight & Arn.

3.2. Synonyms

- *Dichrostachys nyassana* Taub.,
- *Dichrostachys glomerata* (Forssk.) Chiov.
- *Acacia cinerea* (L.) Spreng.
- *Cailliea cinerea* (L.) J.F.Macbr.
- *Desmanthus cinereus* (L.) Willd.
- *Dichrostachys lugardae* N.E.Br.
- *Dichrostachys platycarpa* Welw.
- *Mimosa cinerea* L.
- *Neptunia cinerea* (L.) F.Muell.

Common name: Mimosa bell

Local names: Teneu (Yacouba); Danhangon (Toura); Sounhouê (Guéré)

Herbarium specimen number

CSRS : N°223-CSRS004532-A4-C82-R3-E1-F2-P1

3.3. Botanical description

Dichrostachys cinerea is a deciduous shrub or small tree up to 6(-12) m tall; bole often irregular and low-branched, up to 25 cm in diameter; bark surface almost smooth to rough or deeply fissured, dark grey to greyish-brown, peeling in strips, inner bark thick, fibrous, yellowish-white; crown open, with spreading branches; lateral twigs with acute spines at the apex, short hairy [7]. This species has alternate, bipinnate compound leaves with 2-5 or 19-21 pairs of pinnae (Figure 1A); stipules small; petiole and rachis together up to 20 cm long, bearing a stipitate gland between the pairs of pinnae; leaflets are 9-41 pairs per pinnae, sessile, oblong to linear, up to 1 cm × 0.5 cm, glabrous to slightly hairy [8]. The inflorescence is a long-stalked axillary spike (Figure 1B), 1-12 cm long, pendant and slightly hairy. Its flowers are sterile and pinkish in the lower part of the inflorescence. The flowers are bisexual and yellow in the upper part of the inflorescence, regular, pentamerous; calyx 0.5-1 mm long, with a slightly hairy tube and short lobes. Corolla lobes 1.5-3 mm long, slightly fused at the base and glabrous. The stamens are 10, 3-5 mm long, with a gland at the top of the anthers, the stamens of sterile flowers much longer but without anthers. The ovary is ellipsoid, about 1 mm long. It is slightly pubescent and locular with a thin style (Burkill, 1995). The fruit is a flattened, narrowly oblong pod (Figure 1C), 2-10 cm × 0.5-2.5 cm, becoming twisted or spiral, leathery, glabrous, dark brown, indehiscent or irregularly opening, containing about 5 seeds. The flattened ellipsoid seeds are 4-6 mm × 3-4.5 mm in size and brown and shiny [7, 8].

Figure 1 A. *Dichrostachys cinerea*; B. Inflorescence; C. Fruit

3.4. Habitat and geographical distribution

Source: https://africanplantdatabase.ch/en/nomen/146303

Figure 2 Geographical distribution of *Dichrostachys cinerea* in Africa

Dichrostachys cinerea is widely distributed, from tropical Asia and Australia to the Caribbean and Africa. In Africa (Figure 2), it occurs in all regions except the rainforest zone, from Cape Verde to Somalia, and southwards to Namibia and northern South Africa. It has been introduced into the islands of the Indian Ocean and the Caribbean, where it has become naturalized and behaves in places as an aggressive weed, for example in Reunion and Cuba [7].

3.5. Traditional uses against NTDs

For lymphatic filariasis, the Guéré prescribe the decoction of the stem bark of *Dichrostachys cinerea* orally, once or twice a day, until cured. [6] have revealed that the plant is used to treat elephantiasis. Indeed, El-Sharawy et al. [9] showed the anti-parasitic effect of phytochemical constituents of *Dichrostachys cinerea*.

3.6. Other therapeutic uses

Stem bark of this plant is used against intestinal worms, sore throats, coughs, mouth ulcers and bleeding gums by the Guéré. Effectively, *Dichrostachys cinerea* is a medicinal plant with multiple therapeutic uses (Figure 3) [10]. *D. cinerea* is traditionally used in the treatment of rheumatism, diabetes, coughs, asthma, kidney disorders, gonorrhea, syphilis, malaria, tuberculosis, epilepsy, snake bites, pains, wounds, boils, burns, toothache, headache, and scabies. *D. cinerea* displays diverse phytochemistry, with a wide range of isolated compounds that have well-documented biological activities [10, 11, 12].

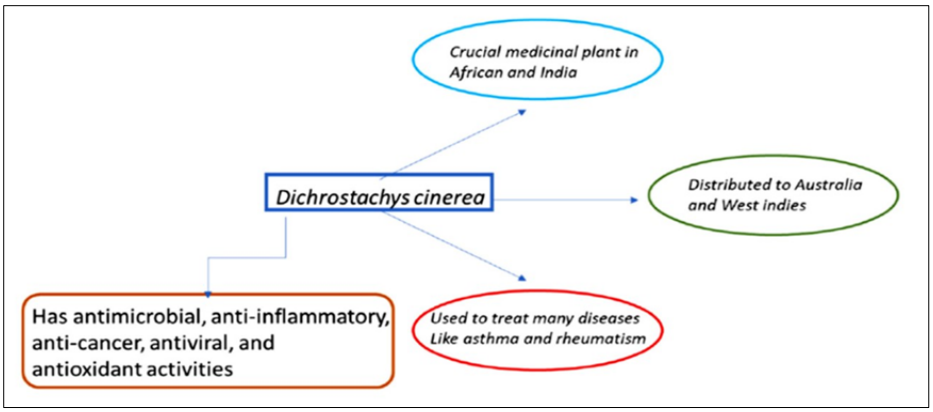
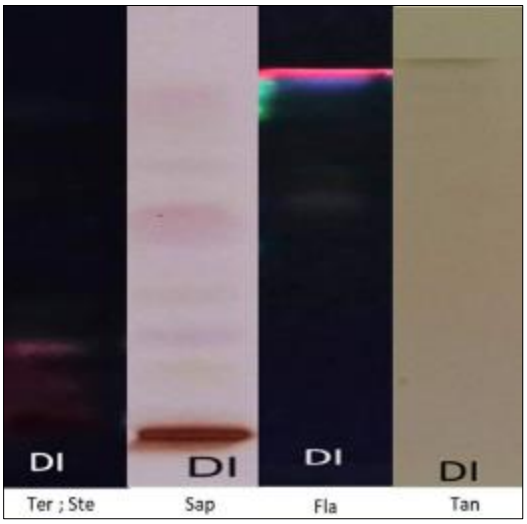


Figure 3 Multiple uses of *Dichrostachys cinerea* [10]

3.7. Phytochemistry

Chromatogram (Figure 4) presents the phytochemical composition of *Dichrostachys cinerea* stem bark. The presence of terpenes and sterols, saponosides, flavonoids and tannins can be distinguished. Apart from terpenes and sterols, Neondo et al. [5] found saponosides, flavonoids and tannins in the stem bark of *D. cinerea*. The work of Vijayalakshmi et al. [11] confirms the presence of terpenoids, saponosides and tannins in the ethanolic extract of *D. cinerea*.



Ter ; Ste : Terpenes and sterols; Sap : Saponosides ; Fla : Flavonoids; Tan : Tannins

Figure 4 Chromatogram of the ethanolic extract of the stem bark of *Dichrostachys cinerea*

3.8. Mineralogy

Table 1 shows the mineralogical composition of *Dichrostachys cinerea* stem bark. The amount of magnesium is 110.4 mg/100 g dry matter. Minerals were measured in the fruits and seeds of *Dichrostachys cinerea* [13]. The elemental mineral analysis showed that the seeds contain 84.64±0.36 mgKg-1 Na, 540.94± 4.05 $mgKg^{-1}$ Ca, 66.68 ± 0.55 $mgKg^{-1}$ Fe, and 738.43 ± 10.59 $mgKg^{-1}$ Mg, and the fruits contain 0.81 ± 0.01 $mgKg^{-1}$ Na, 1.81 ± 0.04 $mgKg^{-1}$ Ca, 0.39 ± 0.02 mgKg-1 Fe, and 2.89 ± 0.03 mgKg-1 Mg [13, 14].

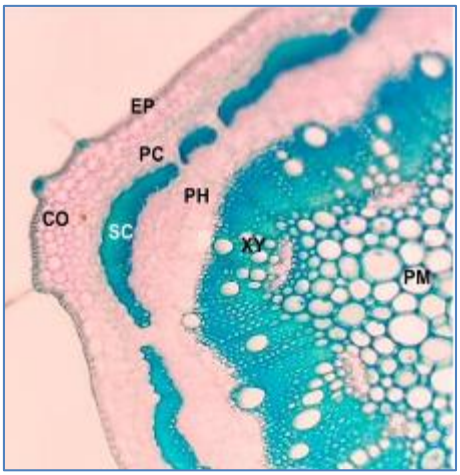
Table 1 Composition and mineral content of *Dichrostachys cinerea* stem bark

Samples	Mg	Cu	Fe	Mn	Zn
mg per 100 g dry matter	110.4	0.86	16,2	1,43	2,7

Mg: Magnesium; Cu: Copper; Fe: Iron; Mn: Manganese; Zn: Zinc

3.9. Anatomy

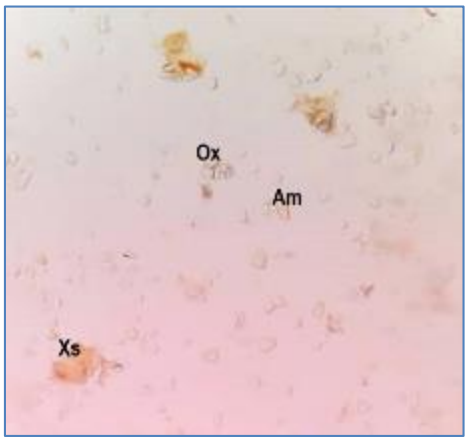
Figure 5 shows a cross-sectional portion of a *Dichrostachys cinerea* stem. From the periphery to the centre of the organ, epidermis, collenchyma, cortical parenchyma, phloem, xylem and medullary parenchyma can be seen. There is also sclerenchyma, which indicates a more or less aged organ, and companion xylem cells coloured pink. Bolleddu et al. [12] observed phloem, xylem and medullary parenchyma in the root transverse section of D. cinerea.



EP: epidermis; CO: collenchyma; CP: cortical parenchyma; SC: sclerenchyma; PH: phloem; XY: xylem; PM: medullary parenchyma

Figure 5 Cross-sectional portion of *Dichrostachys cinerea* stem (G : x100)

3.10. Micrography



Am : starch grains; Ox : calcium oxalate crystals (abundant) ; Xs : spiral xylem

Figure 6 Microscopic elements observed in *Dichrostachys cinerea* stem bark powder (G : x100)

The fine powder of the stem bark of *Dichrostachys cinerea* contains mainly starch grains and oxalate crystals (Figure 6). Starch grains were observed by Bolleddu et al. [12].

4. Conclusion

The study identified the distinctive ethnopharmacological features of *Dichrostachys cinerea* (Fabaceae). Distinctive features such as starch grains and calcium oxalate crystals be observed. In addition, the phytochemical composition justifies the traditional use of *Dichrostachys cinerea* in the traditional treatment of lymphatic filariasis.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

None to declared conflict of interest.

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