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Micrographic characteristics of eleven medicinal plants used for the traditional treatment of schistosomiasis in the health district of Adzopé (Côte d'Ivoire)

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Abstract
The objective of this study is to describe the micrographic characteristics of 11 medicinal plants used in the traditional care of schistosomiasis in the Health District of Adzopé (Côte d'Ivoire). These species were selected on the basis of their heritage value. The methodology is based on a microscopic description of the plant powders after observation under the microscope. Micrography allowed the identification of characteristic elements, such as fragments of parenchyma, calcium oxalate crystal, wood vessels as well as hairs (secretory, tectorial and star-shaped). The observation of these elements makes it possible to distinguish each plant powder and thus contribute to the definition of the quality of the powders in case of adulteration.

Keywords: Medicinal plants, micrography, schistosomiasis, Adzopé, Côte d'Ivoire

Introduction
Caused by worms of the genus *Schistosoma*, schistosomiasis or bilharzia is a neglected tropical disease (NTD). It represents the second parasitic endemic in the world after malaria and is one of the most widespread parasitic diseases in the world [1]. This pathology has major health and socio-economic repercussions in developing countries, where it constitutes an important public health problem [2]. In Côte d'Ivoire, the results of epidemiological and parasitological surveys have shown that urinary and intestinal schistosomiasis remain endemic with high prevalences in unfavourable hygiene and sanitation conditions despite control efforts [3, 4, 5, 6]. So far, the effective control method remains chemoprevention (CP) through the use of Praziquantel (PZQ), advocated by the WHO in the control strategy [7]. However, evidence of emerging drug resistance and low efficacy of PZQ has been reported in Egypt and Senegal [8]. This is compounded by serious adverse effects, prolonged treatment duration and complex drug delivery systems [9] (Pink *et al*., 2005). Faced with these constraints, plants offer a therapeutic alternative to be explored. Indeed, several drugs have been based on plants including Bersama abyssinica used for the development of an antimicrobial ointment by Bene *et al*. [10]. However, for the production of phytomedicines in large quantities, it is important to ensure the choice of plant drug and the quality of the plant powders. It is in this context that the present study was conducted to distinguish the characteristic elements of each plant powder and thus contribute to the definition of the quality of selected plant powders in the treatment of schistosomiasis. Thus, during an ethnomedicinal survey in the Adzopé Health District, 11 plants were selected for their heritage value in the traditional treatment of schistosomiasis [11]. The aim was therefore to describe the micrographic characteristics of these plants in order to prevent adulteration. According to Chanda [12], adulteration or substitution or adulteration is nothing more than the replacement of the original plant with another plant or the intentional addition of any foreign substance to increase the weight or potency or to decrease the cost of the product. For example, belladonna leaves are often adulterated which decreases the alkaloid content of the batch [13]. The therapeutic effectiveness of medicinal plants depends on the quality and quantity of the chemical constituents.

Material
Table I shows the 11 selected plants and the different parts used.

Table I: Selected plants and parts used

Medicinal plants	Botanical families	Parts used
Anthocleista djalonensis	Gentianaceae	Root bark
Blighia unijugata	Sapindaceae	Leaves
Cananga odorata	Annonaceae	Stem bark
Cymbopogon giganteus	Poaceae	Whole plant
Distemonanthus benthamianus	Fabaceae	Stem bark
Eclipta prostrata	Asteraceae	Leafy twig
Eleusine indica	Poaceae	Whole plant
Gouania longipetala	Rhamnaceae	Leaves
Mareya micrantha	Euphorbiaceae	Leaves
Scoparia dulcis	Plantaginaceae	Leafy twig
Vernonia amygdalina	Asteraceae	Leaves

Methodology

The plant organs were harvested, washed and cut up before drying in the shade at room temperature for one week. They were then ground to a fine powder using a Silver Crest Blender 1800W.

The micrographic study was carried out according to the classical method described by the European Pharmacopoeia 10th edition (European Pharmacopoeia, 2021). A drop of lactic acid was placed on a slide with a spatula. A fine pinch of plant organ powder was poured onto the drop of lactic acid. The preparation was covered with a slide by pressing lightly with the finger and placed on the stage for observation. The microscope was focused at 40x magnification and observed at 100x magnification. The microscopic elements were identified and photographed with a high-resolution 108-megapixel Huawei Nova 9 SE mobile phone.

Results and Discussion

The micrographic study determined the micrographic characteristics of the 11 species of heritage value. The micrographs of the 11 species selected for the treatment of schistosomiasis are presented in Plate 1. These are calcium oxalate crystal, fiber, parenchyma, secretory hair, spiral xylem, starch granule, tector hair. Tector hair is observed in the powder of seven plant species. Calcium oxalate crystal is observed in five powders, while parenchyma, spiral xylem and starch granule are present in four plant powders. Secretory hair and starred hair were only observed in *Cymbopogon giganteus* and *Mareya micrantha* powders respectively. Osuala *et al*. [14] and Haïdara *et al*. [15] observed such microscopic elements in their study conducted on *Picralima nitida* (Apocynaceae) and *Prosopis africana* (Fabaceae) – *Tamarindus indica* (Fabaceae) respectively.

Star-shaped

A distinction is made for each plant

***Anthocleista djalonensis* (Gentianaceae)**

Characteristic elements are: parenchyma; spiral xylem and tector hair (Plate 1A). The parenchyma was found in the Gentianaceae family [16].

***Blighia unijugata* (Sapindaceae)**

Plate 1B shows the characteristic elements of this species. These are the fiber, starch granule and tector hair.

***Cananga odorata* (Annonaceae)**

Fiber, calcium oxalate crystal, parenchyma, starch granule and spiral xylem are the characteristic elements distinguished from the stem bark of *Cananga odorata* (Plate 1C).

***Cymbopogon giganteus* (Poaceae)**

The characteristic elements are calcium oxalate crystal, starch granule, secretory hair, tector hair (Plate 1D). Jackson and Snowdon [16] have demonstrated the presence of calcium oxalate crystal and starch granule in Poaceae powders.

***Distemonanthus benthamianus* (Fabaceae)**

In this species, the following characteristic elements are present: fiber, tector hair and spiral xylem (Plate 1E).

***Eclipta prostrata* (Asteraceae)**

Calcium oxalate crystal and parenchyma are the distinguishing features of the leafy branch of (Plate 1F).

***Eleusine indica* (Poaceae)**

Plate 1G shows the characteristic elements of *Eleusine indica*. These are the starch granule and tector hair. Starch granule was revealed by Jackson and Snowdon [16] in the family Poaceae.

***Gouania longipetala* (Rhamnaceae)**

Calcium oxalate crystal and tector hair are characteristic elements of *Gouania longipetala* leaf powder (Plate 1H). The Rhamnaceae have the particularity of containing calcium oxalate crystals [16].

***Mareya micrantha* (Euphorbiaceae)**

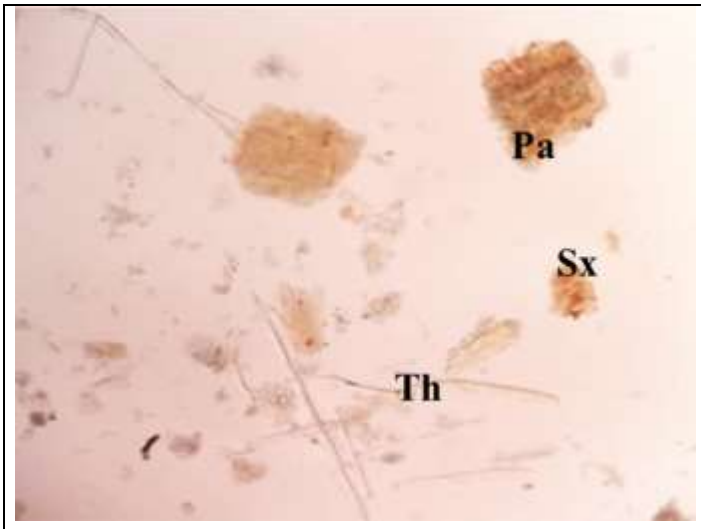
The only distinguishing feature of this species is the starred hair (Plate 1I). Mamadou *et al*. [17] (2020), have demonstrated the presence of starred hair in a Euphorbiaceae they studied. This micrographic feature could be characteristic of this botanical family.

***Scoparia dulcis* (Plantaginaceae)**

In this species, calcium oxalate crystal, parenchyma and spiral xylem are the characteristic elements (Plate 1J).

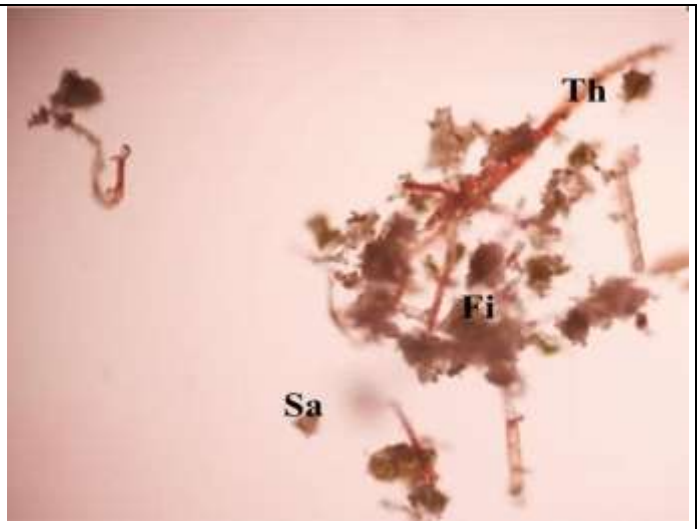
***Vernonia amygdalina* (Asteraceae)**

Tector hair is the main feature observed in the leafpowder of the species (Plate 1K). Ragusa *et al*. [18], Diarra *et al*. [19] and Bagayogo [20] had observed tector hair in the powder of *Vernonia kotschyana*. These hairs could be a constant microscopic character of the genus *Vernonia*, or even of the family Asteraceae for their botanical quality control.



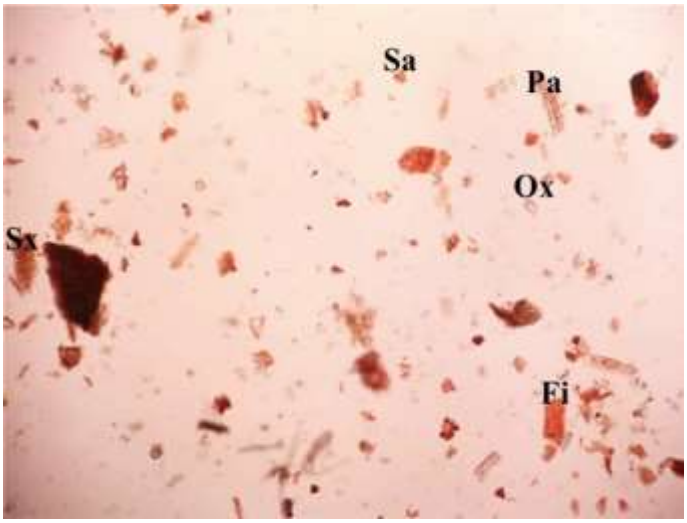
Pa : Parenchyma; Sx : Spiral xylem; Th : Tector hair

A) Micrograph of *Anthocleista djalonensis* root bark powder



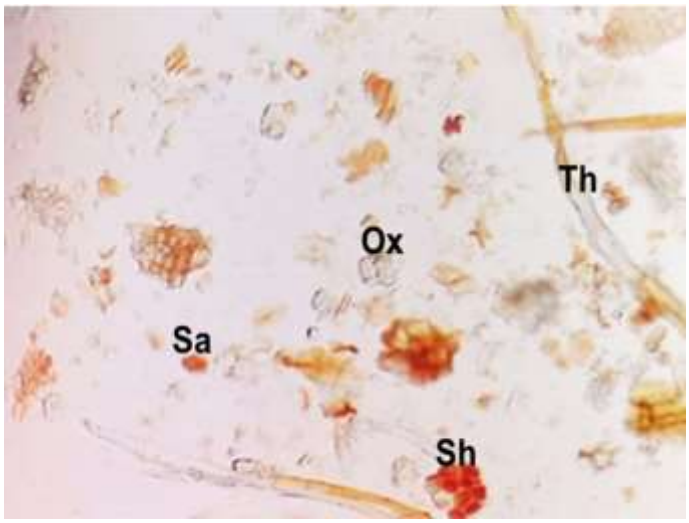
Fi : Fiber; Sa : Starch granule; Th : Tector hair

B) Micrograph of *Blighia unijugata* leaf powder



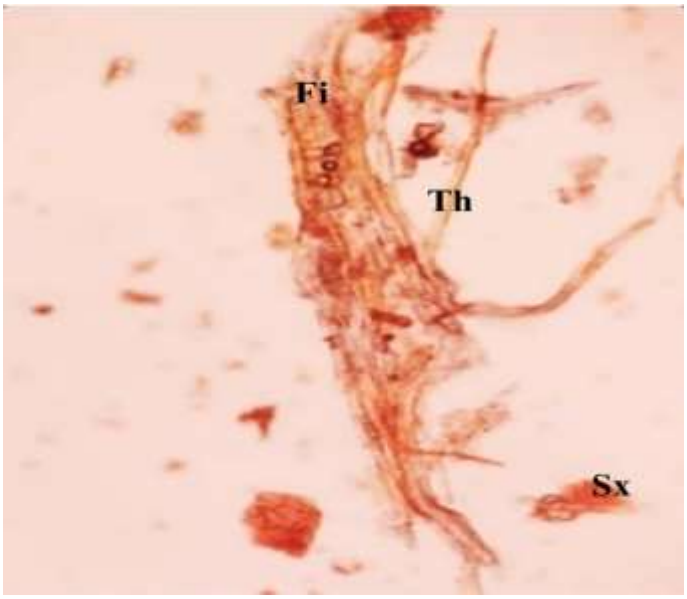
Fi: Fiber; Ox: Calcium oxalate crystal; Pa: Parenchyma; Sa: Starch granule; Sx: Spiral xylem

C) Micrograph of *Cananga odorata* stem bark powder



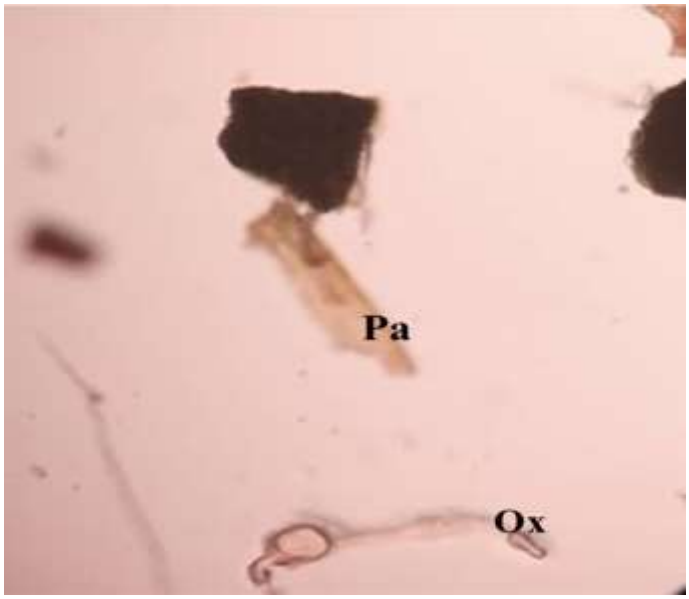
Ox: Calcium oxalate crystal; Sa: Starch granule; Sh: Secretory hair; Th: Tector hair

D) Micrograph of the whole plant powder of *Cymbopogon giganteus*



Fi: Fiber; Th: Tector hair; Sx: Spiral xylem

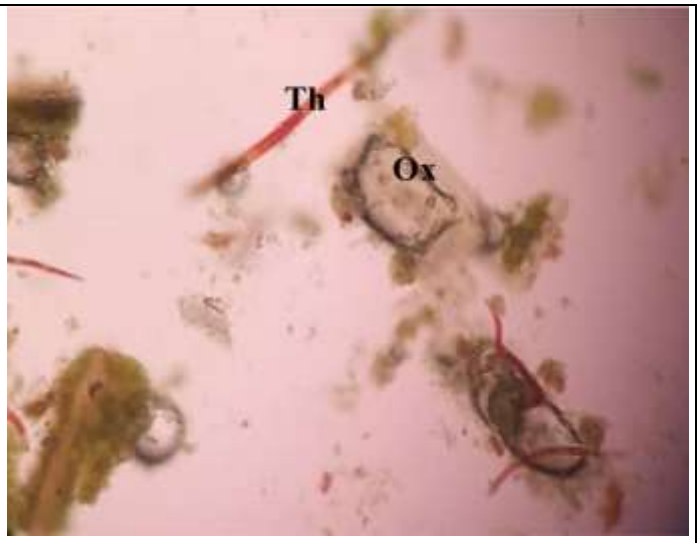
E) Micrograph of *Distemonanthus benthamianus* stem bark powder



Ox: Calcium oxalate crystal; Pa: Parenchyma

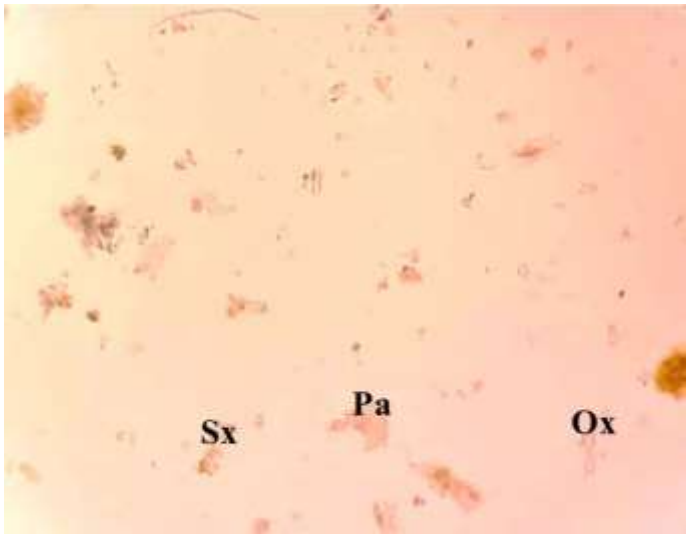
F) Micrograph of the leafy branch powder of *Eclipta prostrata*

Sa : Starch granule; Th : Tector hair
G) Micrograph of the whole plant powder of *Eleusine indica*



Ox: Calcium oxalate crystal; Th : Tector hair
H) Micrograph of *Gouania longipetala* leaf powder

Sh: Starred hair
I) Micrograph of *Mareya micrantha* leaf powder



Ox: Calcium oxalate crystal; Pa: Parenchyma; Sx: Spiral xylem
J) Micrograph of the leafy branch powder of *Scoparia dulcis*

Th : Tector hair
K) Micrograph of *Vernonia amygdalina* leaf powder

Plate 1: Micrographic observation of the eleven plant powders

The isolated or star-shaped tector hairs, the rounded starch grains and the calcium oxalate crystals may have several roles: protection against herbivores, calcium storage, maintenance of the ionic balance in the cells [21] but also detoxification [22]. Indeed, this plant causes vomiting and diarrhoea in some animals [23].

Conclusion

Microscopic analysis of different plant powders used in the traditional treatment of schistosomiasis showed the presence of characteristic and distinctive elements for each plant. These determined elements could serve as a starting point to define quality standards to verify the authenticity of samples collected for the formulation of a phytomedicine. However, studies are needed on samples from other sources to establish the consistency of these micrographic features.

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