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Comparative morphological and anatomical studies of the barks of three *Albizzia* species

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ABSTRACT

*This study deals with the morphological and the anatomical features of the barks of the three medicinal plants *Albizzia anthelmentica*, *Albizzia lebbek*, *Albizzia zygia*. The barks of these three species show considerable differences in the patterns of the periderm formation in the outer bark. *A. lebbek* and *A. zygia* have a number of parallel layers of periderm and the outer bark is irregularly fissured and ridged. *A. lebbek* bark is gray to brown with rough fissures but *A. zygia* bark is pinkish gray to dark brown and roughly fissured whereas *A. anthelmentica* bark is gray and smooth and it has virtually smooth outer bark forming a single superficial periderm and there are no fissures. Anatomically, the barks of these *Albizzia* species contained crystals, stone cells, starch granules and tannins, their quantities differed among the three species. The powders of the three barks microscopically contain the same elements but they can be distinguished by the large abundant starch granules and the large stone cells in *A. anthelmentica*. Whereas *A. lebbek* can be distinguished by the abundant large calcium oxalate crystals and the isodiametric small stone cells. *A. zygia* can be distinguished by the presence of small few stone cells and the very rare small starch granules. The bark parenchyma cells are found in between the phloem and cortical cells.*

Key words: *Albizzia*, periderm, phloem, xylem, sclerieds.

INTRODUCTION

In this work, a morphological and anatomical study of the complete and powdered forms of the stem barks of three medicinal plants, *Albizzia anthelmentica* Brong, in Bull. Soc. Bot. France 7: 902(1860), *Albizzia lebbek* (L.) Benth, in Hook, lond . journ .Bot . 3:87 (1844) and *Albizzia zygia* (DC.)Macbr, in contib. Gray Herb., n.s. 59:3 (1919) (family *Mimosaceae*) were studied in

details. The study was aimed to provide valuable and reliable illustrated anatomical descriptions of the barks of these three *Albizzia* species. The investigated plants were selected for their great importance in Sudanese folkloric medicine and they are wide spread in Sudan. The literature survey revealed that no anatomical studies were carried on their barks in the Sudan or abroad. On the other hands there are many taxonomical, phytochemical, pharmacological and toxicological studies on these plant barks. Enumeration of diagnostic features followed in this investigation will definitely lead to correctly identified species and adulterants can, therefore, be detected. In addition these anatomical characters will contribute positively to establish a Sudanese Herbal Pharmacopoeia.

Plant anatomy deals with the structure, contents and development of cells and tissues. It is of primary importance for all aspects of research in plant sciences such as morphogenesis, physiology, ecology, taxonomy, evolution, genetics, reproduction etc [1]. The systematic anatomy is mainly aimed towards relating structure particularly of vegetative organs to taxonomic classification of the plants in which the characters are exemplified. Application of systematic anatomy can also be extended to detection of adulterants and substitutes [2].

Taxonomically *Mimosaceae* is composed of about 40 genera divided among five tribes [3]. The genus *Albizzia* comprises about 120 species and occurs throughout the tropics with approximately 35 species found in continental Africa and 40 species in Medegashger [4].

Albizzia anthelmentica Brong, in Bull. Soc. Bot. France 7: 902(1860) is a bush or tree up to 150cm high, bark grey. Pinnate leaves in 1-4 pairs. Leaflets obliquately obovate to sub or bicular, obtuse and macronate at apex, 1.2 - 0.6cm. Long, glabrous, pale beneath. Flowers usually appearing before the leaves; peduncles solitary or clustered usually from leafless nodes on older wood. Calyx and corolla pale green. Stamens white. Pod straw coloured, papery, oblong, 7.5-15 cm. long, 1.2 - 1.8 cm. broad, tapered at both ends, 3-5 seeded.

Albizzia lebbek (L.) Benth, in Hook, lond. journ .Bot . 3:87 (1844). Synonym: *Mimosa lebbek* L., Sp PI. 516 (1733). Vernacular name: Dign Elbasha (Ar.). Trees 2.5-15 m. high. Bark gray rough, young brachlets puberulous, sometimes pubescent, pinnate (1-2-4-5) pairs, and leaflets 3-11 pairs 15-flowers pedicellate.

Albizzia zygia (DC.)Macbr, in contrib. Gray Herb., n.s. 59:3 (1919). Synonyms: *Inga zygia* D. Mem Fram Legum 440, t. 65 (1825). *Zygia brownei* Walp, Rep. 1: 928 (1842). *Alizzia brownei* (Walp)Oliv., F . T. A. 2:362 (1871); *A.welwistschioides* [schweinf.] ex Balk. F. L.T. A: 867 (1930). Trees 3.0-20m. high. Bark brown rough, young brachlets querulous, pubescent, pinnate, leaflets 5-12 pairs 15-flowers pedicellate.

The family includes economically important species; gum Arabic is derived from *Acacia senegal* Willd. whereas tannin is derived from stem bark of various members such as *Acacia nilotica*. This family produces a considerable variety of timbers for example *Albizzia lebbek* Beth [5]. *Albizzia zygia* is planted as an ornamental shade tree, roadside tree and fire break. It is considered useful for soil improvement. Young leaves are eaten cooked as a vegetable or added to soups and sauces. The foliage is ranked as low-quality fodder, but suitable for use in goat feeds and sometimes also given to sheep and cattle. The gum from the bark is used in the food industry (e.g. as a stabilizer in the preparation of ice cream), cosmetic industry (e.g. as a thickener) and in pharmaceutical industry. In traditional medicine, bark sap is instilled in the eyes to treat ophthalmic. A bark decoction is administered to treat bronchial diseases, fever (including malaria) and female sterility, and as a purgative, stomachic, antidote, vermifuge and aphrodisiac.

Pounded or rasped bark is applied externally to treat yaws, sores, wounds and toothache. Ground roots are added to food to treat cough and as an expectorant. Leaf decoctions are used to treat fever and diarrhea [4]. The aqueous extract of *Albizzia anthelmentica* bark showed no toxicity and high anthelmintic activity against experimental *Hymenolepis diminuta* infection in rats. The water extract of *Albizzia lebbek* was less effective against the cestode *Hymenolepis diminuta* and was toxic to rats at the highest dose tested, the aqueous extract of *Albizzia anthelmentica* bark to rats was safe and successfully eliminate an experimental infection against the cestode *Hymenolepis diminuta*, whereas the butanolic extract is proved to be highly toxic and was inactive against *Hymenolepic diminuta* [5].

The anticestodal and amoebicidal activities beside the phytochemistry of *Albizzia anthelmentica* bark were studied [7] two saponins were isolated, their amoebicidal activity as well as their chemical structure was elucidated. The histamine- like activity of the aqueous fraction of the methanolic extract of the stem bark of *Albizzia anthelmentica* was reported, the presence of histamin in the aqueous extract was confirmed by TLC analysis [8]. Decoction of the leaves and barks of *Albizzia lebbeck* are protective against bronchial asthma and other allergic disorders. Barks and seeds are astringent and are given in piles and diarrhea, stem bark was found to be effective against bronchospasm induced by histaminic acid phosphate and shown to exert disodium chromoglycate like action on mast cells [9]. Bark extract show the antimicrobial activity, the active constitute of the bark extract is anthraquinone glycosides. The main constituent from bark is active against aerobes and mechanism of action is that glycosides cause the leakage of the cytoplasmic constituents [10].

EXPERIMENTAL SECTION

Materials: The barks of *Albizzia anthelmentica*, *Albizzia Lebbeck* and *Abizzia zygia* were collected from National Botanical Garden (Khartoum) in may1998. Deposited at Khartoum University Herbarium (KUH).

Methods:

Morphological studies:

The morphological characters of the barks of the studied plant species were examined externally by the naked eye and their characters were outlined.

Preparation of permanent slides:

The hard barks were transversally sectioned using sliding microtome (Reichert. Sustria No. 305999), the sections were put in glass slides using a brush. The sections were stained, using safranin and fast green stains, mounted in a drop of Canada balsam and then covered with a cover slip. The slides were left to dry in an oven adjusted at 60° C for at least three days.

Preparation of temporary slides:

The powders of the dry barks of the studied plants were cleared in chloral hydrate solution, mounted in 10% aqueous glycerin, covered with a cover-slip and examined to outline the diagnostic features of the plants in the powdered conditions.

Examination of the prepared slides:

The prepared temporary and permanent slides were examined using (Leitz Dialux 22 EB) microscope. The eye piece lens was (x10) whereas the objective lenses were (x4, x10 and x25). Measurements were carried out for all materials studied using the eye piece micrometer which was calibrated using the stage micrometer. Ten readings were carried out for each parameter and

then the mean value was calculated. Drawings were made for the temporary slides using the drawing tube fitted in the microscope. The prepared slides were photographed using (Leitz Dialux 20) microscope fitted with (Wild PMPS II) camera, using Kodak colored films 36 Exp. 24 x 36mm ISO 100/21o.

RESULTS AND DISCUSSION

Morphology:

The barks of the three species show considerable differences in the patterns of the periderm formation in the outer bark. *A. lebbek* and *A. zygia* have a number of parallel layers of periderm and the outer bark is irregularly fissured and ridged *A. anthelmentica* has virtually smooth outer bark, forming a single superficial periderm and there are no fissures (plate 1). *A. lebbek* bark is gray to brown with rough fissures, *A. zygia* bark is pinkish gray to dark brown and roughly fissured whereas *A. anthelmentica* bark is gray and smooth.

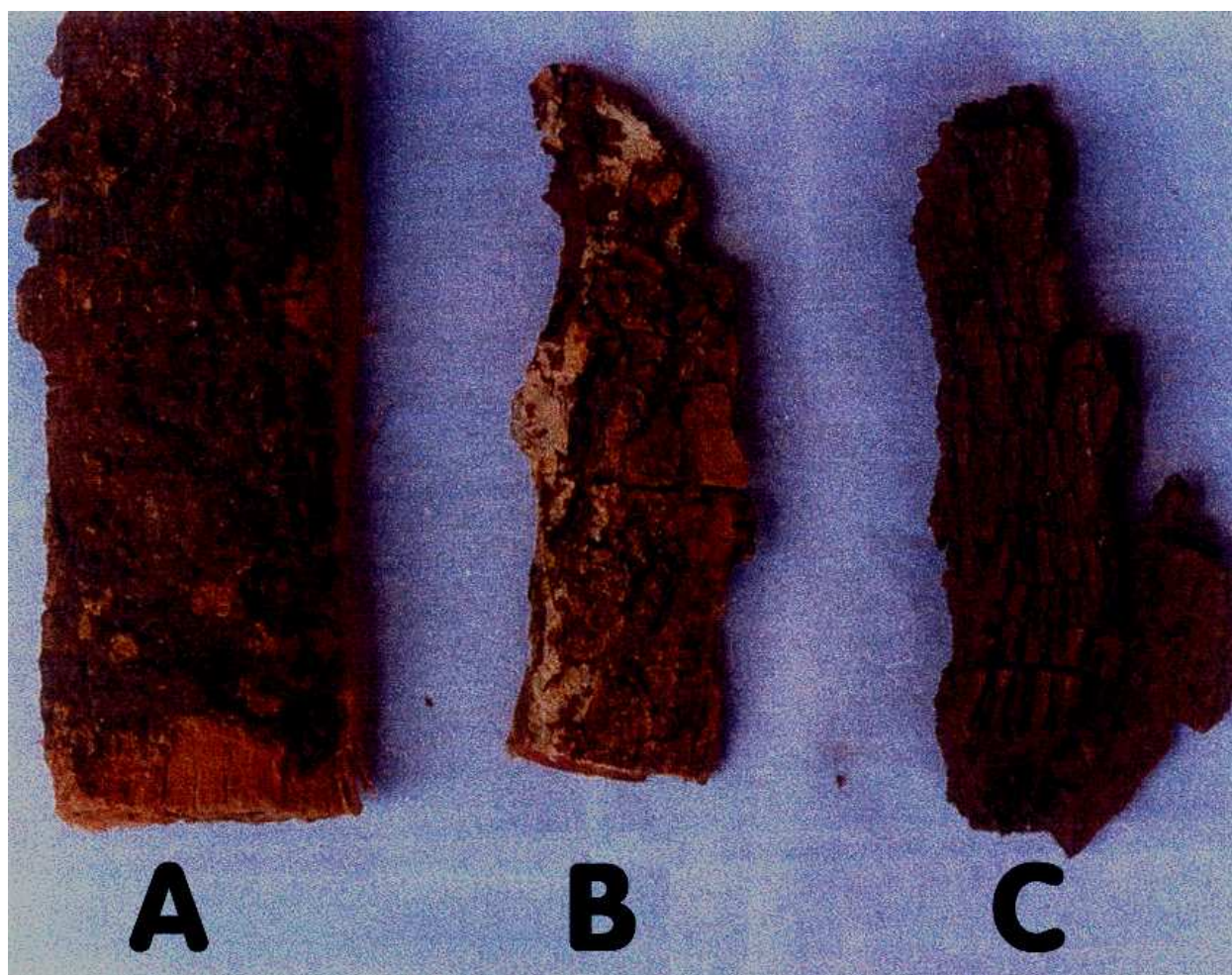
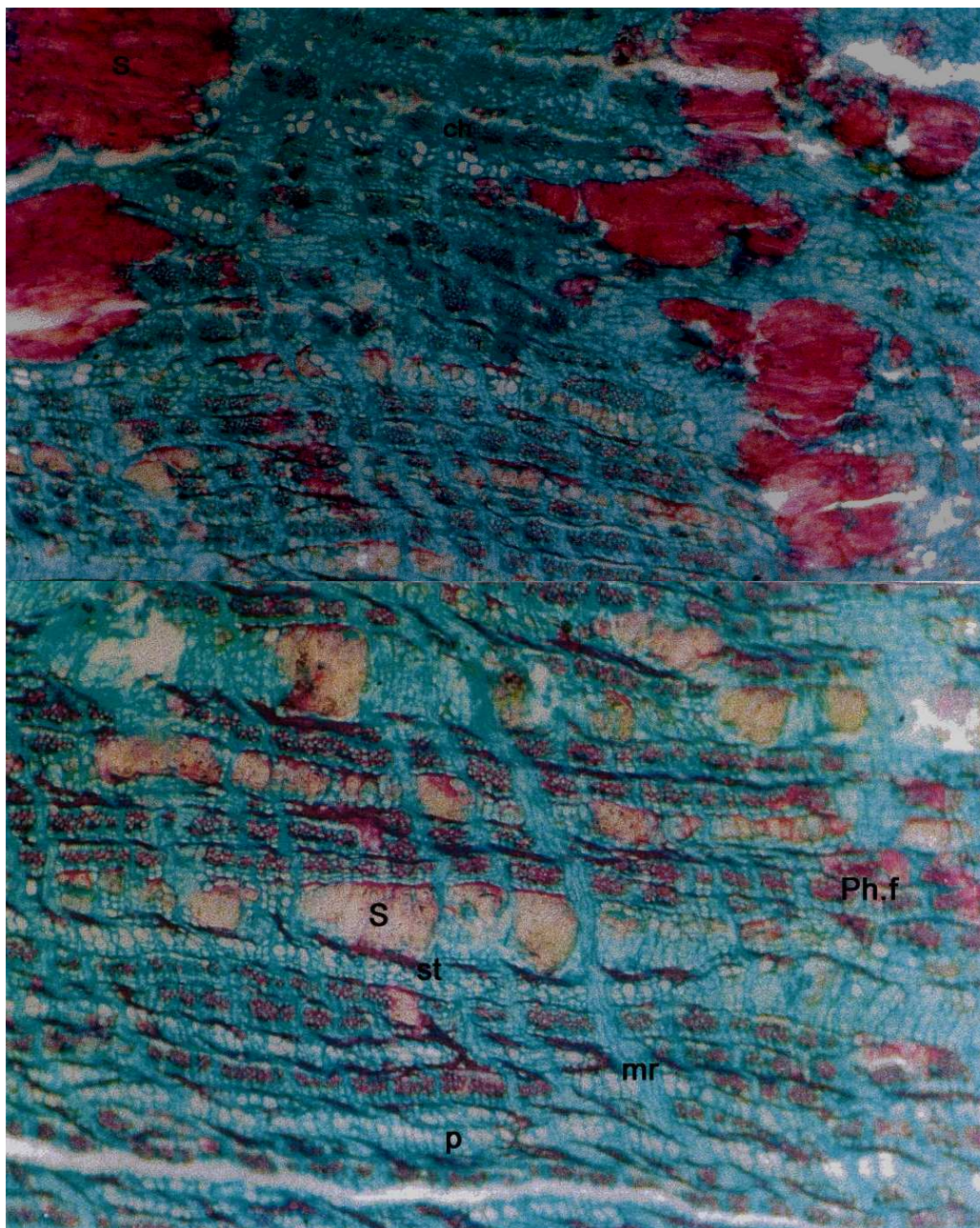


Plate (I): Morphological features of the barks of
(A) *Albizzia anthelmentica* (B) *Albizzia lebbek* (C) *Albizzia zygia*.

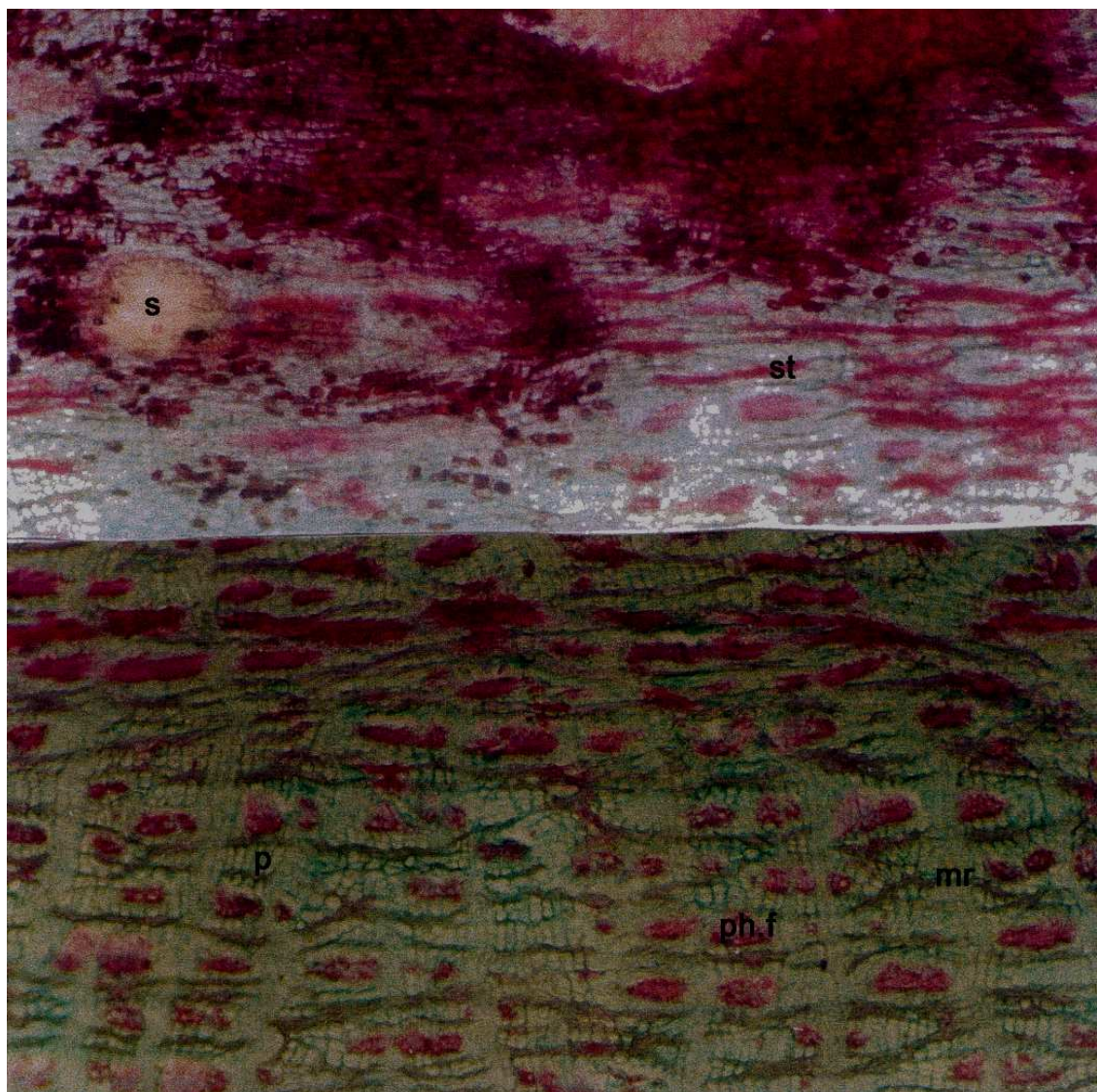
Anatomy

The transverse sections of the barks showed that the cortical parts are formed of cells deposited with tannins and calcium oxalate crystals (plates 2, 3 and 4). In *A. zygia*, 1-3 layers of periderm cells are found (plate 4). *A. anthelmentica* parenchyma cells are interrupted by large patches of red sclerenchymatous stone cells which are found in groups and they are of different shapes and sizes, the chlorenchyma cells are abundant (plate 2). Phloem fibers are found in groups between

the phloem parenchyma and the crushed old phloem sieve tube cells. The phloem is transversed by uni and multiseriate medullary rays in *A. anthelmentica*, whereas the medullary rays in *A. lebbek* are multiseriate (plate 3). The stone cells and the chlorenchyma cells are found in *A. anthelmentica* in large quantities and their amounts decreased to the inner side of the bark until they disappear in the inner phloem which is formed of phloem fibers and parenchyma cells only. Calcium oxalate crystals are found in the parenchyma cells, their quantities are larger in *A. lebbek* followed by *A. anthelmentica* and they are very rare in *A. zygia* bark.



Transverse sections through the bark of *Albizzia anthelmentica* X40

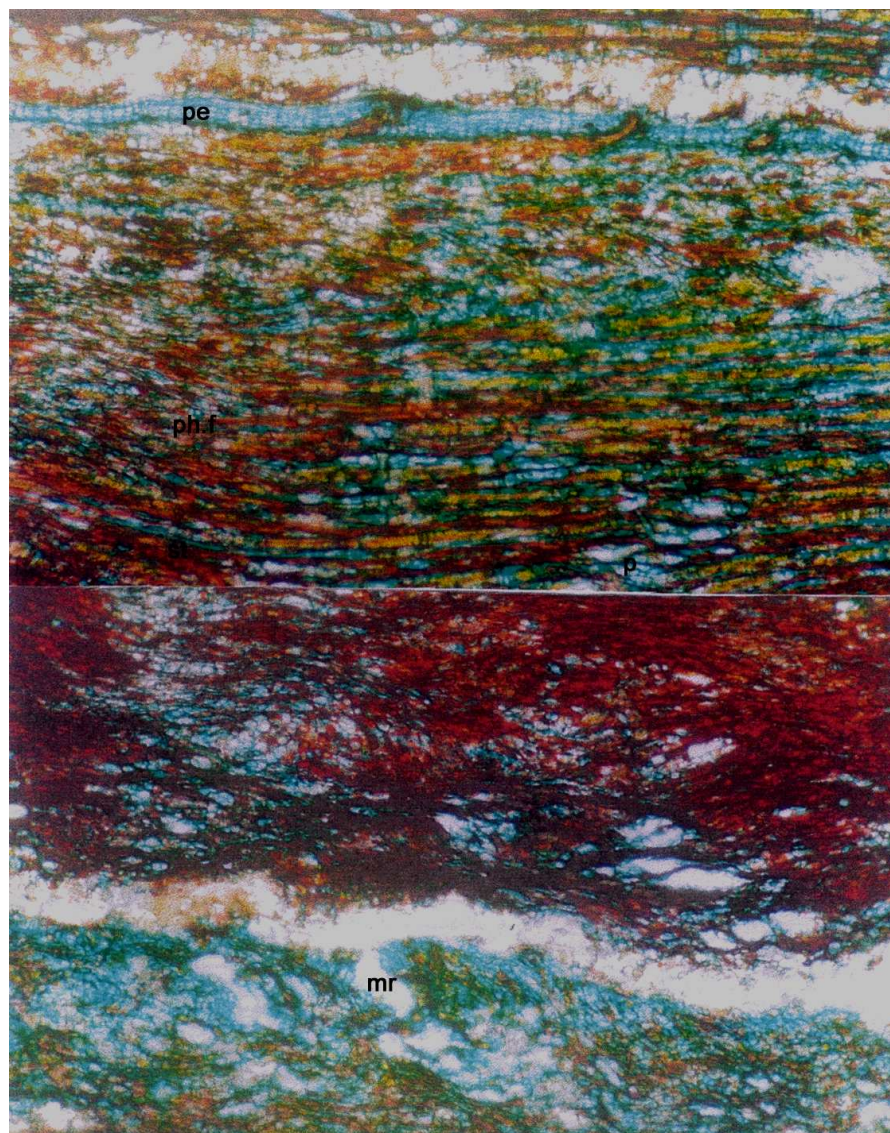


Transverse section through the bark of *Albizzia lebbek*X40

Diagnostic features of the powdered dry bark:

Microscopically, the powders of the barks of the three species (Fig. 1) are containing small spherical granules of starch which are found scattered in the powder or contained in the chlorenchyma cells. They are abundant in *A. anthelmentica* followed by *A. lebbek* and rare in *A. zygia*. Calcium oxalate crystals are found in different shapes and sizes. Sclerieds are abundant in *A. anthelmentica* but they are considerably variable in size and shape, they are rounded to oval and heavily thickened they are found in groups of large numbers. The sclerieds of *A. lebbek* are more or less isodiametric, they occur singly or in small groups. The fairly abundant fibers which occur singly are thick-walled and lignified. The cork cells in surface view are polygonal with thickened walls, while in sectional views they are elongated cells and some of which are filled with reddish brown tannin contents. Thin-walled parenchyma cells and medullary rays of the phloem are found, they contain crystals of calcium oxalates. The powders of the three barks contain the same elements but they can be distinguished by the large and abundant starch granules and also by the large stone cells in *A. anthelmentica*. Where as *A. lebbek* can be distinguished by the abundant large calcium oxalate crystals and the isodiametric small stone cells. *A. zygia* can be distinguished by the presence of small and few stone cells and the very rare

and small starch granules. The bark parenchyma cells are found in between the phloem and cortical cells.



Transverse section through the bark of *Albizzia zygia* X40

mr: medulary rays *p*: parenchyma cells *ph.f.*: Phloem fiber *s*: stone cell *st*: sieve tube cells

The barks of *Albizzia* according to [5] are characterized by cortical tissues bounded internally by a more or less complete ring of irregularly-shaped, thicker-walled stone cells and this is found true for the three species. The phloem includes tangential bands of sieve tubes which soon become disorganized situated between rows of parenchyma cells and thick-walled fibers; this is found true for the three species studies. The medullary rays are uniseriate or multiseriate broadening considerably in the outer parts of the bark and this character is also found in the three *Albizzia* species studied. The wood of *Albizzia gummifera* is very similar to that of *Albizzia zygia* and is used for similar purposes [4].

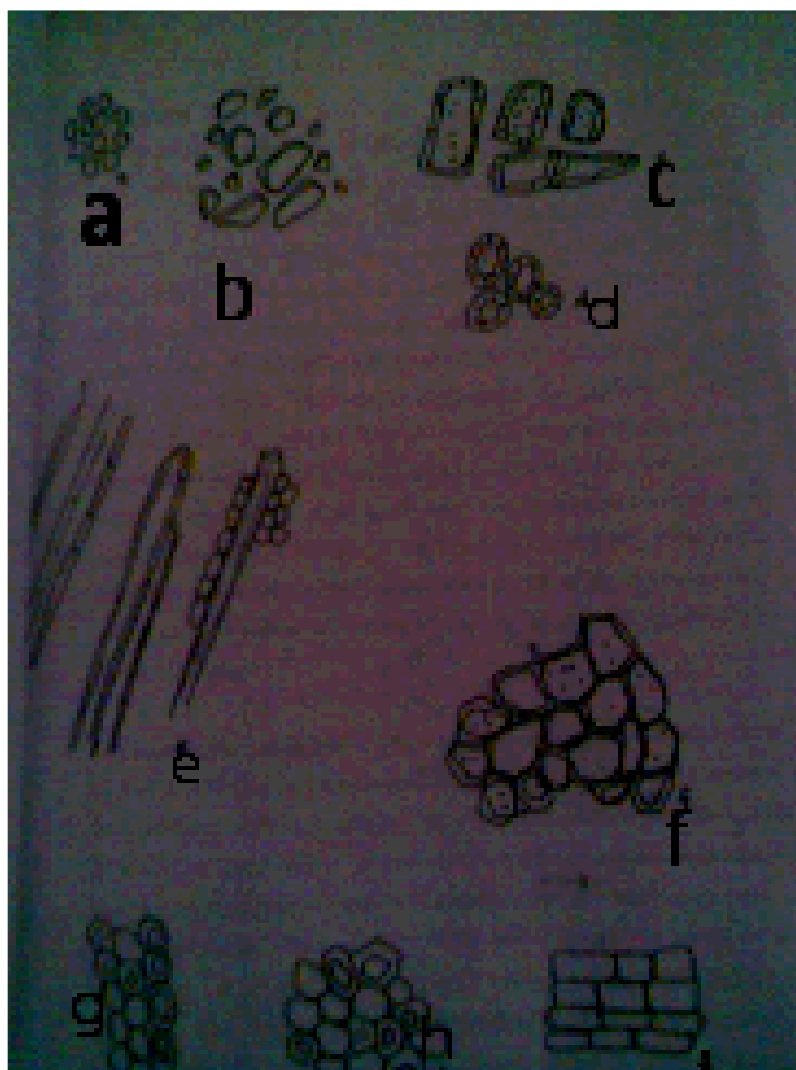


Fig (1): Diagnostic features of the powders of the barks of the three *Albizzia* species
a: starch granules b: calcium oxalate crystals c: stone cells of A. anthelmantica d: stone cells of A. lebbek and A. zygia e: fibers f: cork cells in surface view i: cork cells in sectional view

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