

MACROSCOPIC AND MICROSCOPIC STUDY OF
Datura stramonium, Azadirachta indica AND Bidens
pilosa.

BY

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**A Dissertation in partial fulfilment for the award of the degree of Bachelor of
Pharmacy, University Of Nairobi.**

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DECLARATION

I declare that this dissertation is my original work and to the best of my knowledge, has not been presented or produced in any other university or any other institution for the award of degree or examination purposes.

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ABSTRACT

Datura stramonium, *Azadirachta indica* and *Bidens pilosa*, are herbal drugs of global importance used for the treatment of different ailments. At global, regional, national and local levels, the end users of these drugs face the problem of adulteration. Macroscopic and microscopic features of these plants were studied using basic techniques to help in identification of drugs, their constituents and any adulterants. This study contributes towards global recognition and acceptance of these plants as herbal drugs.

TABLE OF CONTENTS

1. Acknowledgement.....	3
2. Abstract.....	4
3. Introduction.....	6
4. Justification.....	8
5. Objectives.....	9
6. Materials and methods.....	10
7. Chapter 1; <i>Datura stramonium</i>	
Literature review.....	11
Description and results.....	12
Discussion.....	13
Conclusion.....	14
8. Chapter 2; <i>Azadirachta indica</i>	
Literature review.....	15
Description and results.....	16
Discussion.....	17
Conclusion.....	18
9. Chapter 3; <i>Bidens pilosa</i>	
Literature review.....	19
Description and results.....	20
Discussion.....	21
Conclusion.....	22
10. References.....	23

INTRODUCTION

Throughout human history, the use of herbal medicines has always been central to all healing systems. Prior to our relatively recent reliance on the isolated, purified, synthetic chemical entities dominant in modern medicine today, plants were the primary source of medicines for the majority of the world's population. This is still true today. WHO estimates that 80% of the global population still relies on plant based medicines for primary health care. Natural products and related drugs are used to treat 87% of all categorized human diseases; hence plants also provide the source material for a large percentage of modern drugs. The future development of the pharmacognostic analysis of herbal drugs is largely dependent upon reliable methodologies for correct identification and standardization of herbal drugs. Describing herbal drugs in a systematic manner is based on multiple approaches of pharmacognostic, taxonomic and chemical analysis, including documentation of their biological and geographical source, cultivation, collection, and processing, morphological, microscopic and chemical characters.

In this study, a detailed description of *Datura stramonium*, *Azadirachta indica* and *Bidens pilosa* based on morphological, organoleptic and microscopic characteristics was done.

Datura stramonium grows wild in many parts of the world and is commonly known as Thorn Apple, Devil's Apple or Jimson weed. The potent pharmacologic effects of the compounds present in stramonium have been known for centuries, with many references to the toxic properties of atropine-containing plants made in early non-scientific literature such as Shakespeare's works. It has been used as an Ayurveda herbal remedy for various diseases. Leaves, seeds and flowering tops have anti-asthmatic, antispasmodic, hypnotic, narcotic and mydriatic properties. Crushed leaves or seeds are mixed with palm oil and applied to severe cases of insect bites and stings, and also on inflammations to soothe the pain. The seeds are sometimes used as an insecticide. *Datura stramonium* is however fatally toxic in only slightly higher amounts than the medicinal dosage, and careless use often results in hospitalizations and deaths.

Azadirachta indica is commonly known as Neem or Indian lilac tree. It is widely cultivated in many parts of Africa although it is native to India. It is drought resistant therefore it grows well in the arid parts of the continent. Neem has been used for over two millennia in the practice of traditional medicine; it has been found to cure over 40 ailments hence the name The Village Pharmacy. Scientists have also studied it extensively for botanical, medicinal, industrial and agricultural uses and its leaves, bark, fruit, flower, seed and root have been proven to be useful.

In traditional medicine the leaves are boiled to give a green concoction which when children bathe in relieves skin diseases; it can also be taken orally to 'clean' blood, preventing high blood pressure. The leaves are also dried and burnt to keep away mosquitoes. The bark, leaves and root are useful in treatment of malaria and is always a substitute for cinchona. The seed produces oil with bitter compounds (azadirachtin) which is a well-known insecticide and pesticide. Extracts of other parts have proven to have antihelminthic, antifungal, antiviral, antibacterial, antidiabetic and antifertility properties.

Bidens pilosa is a tropical weed which originates from tropical and central America. Its hardiness, explosive reproductive potential, and ability to thrive in almost any environment have enabled it to establish itself throughout the world. It is a major crop weed, threat to native fauna and a physical nuisance. It is used as herbal medicine in Asia, Africa, and tropical America. It is commonly found growing along roadsides, shores of rivers and other places where the ground has been disturbed.

It is commonly known as Black Jack in Kenya or Spanish Needle in Europe and the Americas. Its roots, leaves, and seeds are reported to have antibacterial, antidyenteric, anti-inflammatory, antimicrobial, antimalarial, and diuretic, hepatoprotective, and hypotensive properties. In Africa, *Bidens pilosa* is used to treat headaches, ear infections, hangovers, diarrhoea, kidney problems, malaria, jaundice, dysentery, burns, arthritis, ulcers, and abdominal problems. It is also used as an anaesthetic, coagulant, and treatment to ease child birth. The whole plant is antirheumatic, and is also used in enemas to treat intestinal ailments like haemorrhoids. In sub-Saharan Africa, its fresh or dried shoots and young leaves are eaten as a leaf vegetable, especially in times of food scarcity. *Bidens pilosa* is also an ingredient of sauces eaten with many staple foods.

JUSTIFICATION

Macroscopic and microscopic studies of plants are useful in characterizing and ascertaining the origin of herbal drugs. Macroscopic studies play an important role for primary identification of drugs. Microscopic studies help in the secondary identification of drugs. The studies are therefore useful in identifying adulterants present in drugs.

When combined with advanced analytical techniques like High Performance Liquid Chromatography, Nuclear Magnetic Resonance and Mass Spectroscopy these may bring more appropriate results aimed at characterizing and may assist standardization of *Datura stramonium*, *Azadirachta indica* and *Bidens pilosa*.

OBJECTIVES

To characterize and accurately identify *Datura stramonium*, *Azadirachta indica* and *Bidens pilosa*:

1. By observing and identifying characteristic morphologic features of the plants.
2. By determining characteristic organoleptic features of different parts of the plants.
3. By examining transverse and longitudinal sections so as to determine distribution of tissues and characters of diagnostic importance.

MATERIALS AND METHODS

The plant materials used for this investigation were collected from the uncultivated surrounding of the School of Pharmacy, KNH. Morphological characteristics were observed using a hand lens.

Further information from taxonomic sources provided confirmation of morphological characteristics.

Organoleptic analysis was done by studying the physical characteristics of the samples; colour, smell and taste.

For microscopic investigation, materials required were scapel blades, Bunsen burner, phloroglucinol solution, concentrated hydrochloric acid, chlorhydrate solution, dropper, light microscope and microscopic slides.

Botanical sections of the plant material were cut by hand.

For transverse section epidermal preparations, leaf samples were cut from the mid portion of leaves.

For longitudinal sections, the peelings of leaves were washed with distilled water for 2-3 minutes. The leaf blades were placed with the adaxial side upward and then scraped gently with a sharp razor. The same procedure was followed to prepare the abaxial side but the leaf was placed with the abaxial surface upward.

For transverse sections of stem and root, thin cuttings were made across the stem and root of each plant.

Each specimen was then placed in petridish containing distilled water for 4-5 minutes. It was then placed on a clean glass slide and 1-2 drops of chloral hydrate added; this clears chlorophyll so that features could be observed.

The slide was then passed gently over a flame; to evaporate any reagent on the specimen before observation.

To test for lignin, a small amount of phloroglucinol was added, followed by concentrated Hydrochloric acid; a red colour indicated presence of lignin.

The slides were covered with cover slips.

Prepared slides were mounted and the specimen observed under a light microscope

CHAPTER 1: *Datura stramonium*

LITERATURE REVIEW:

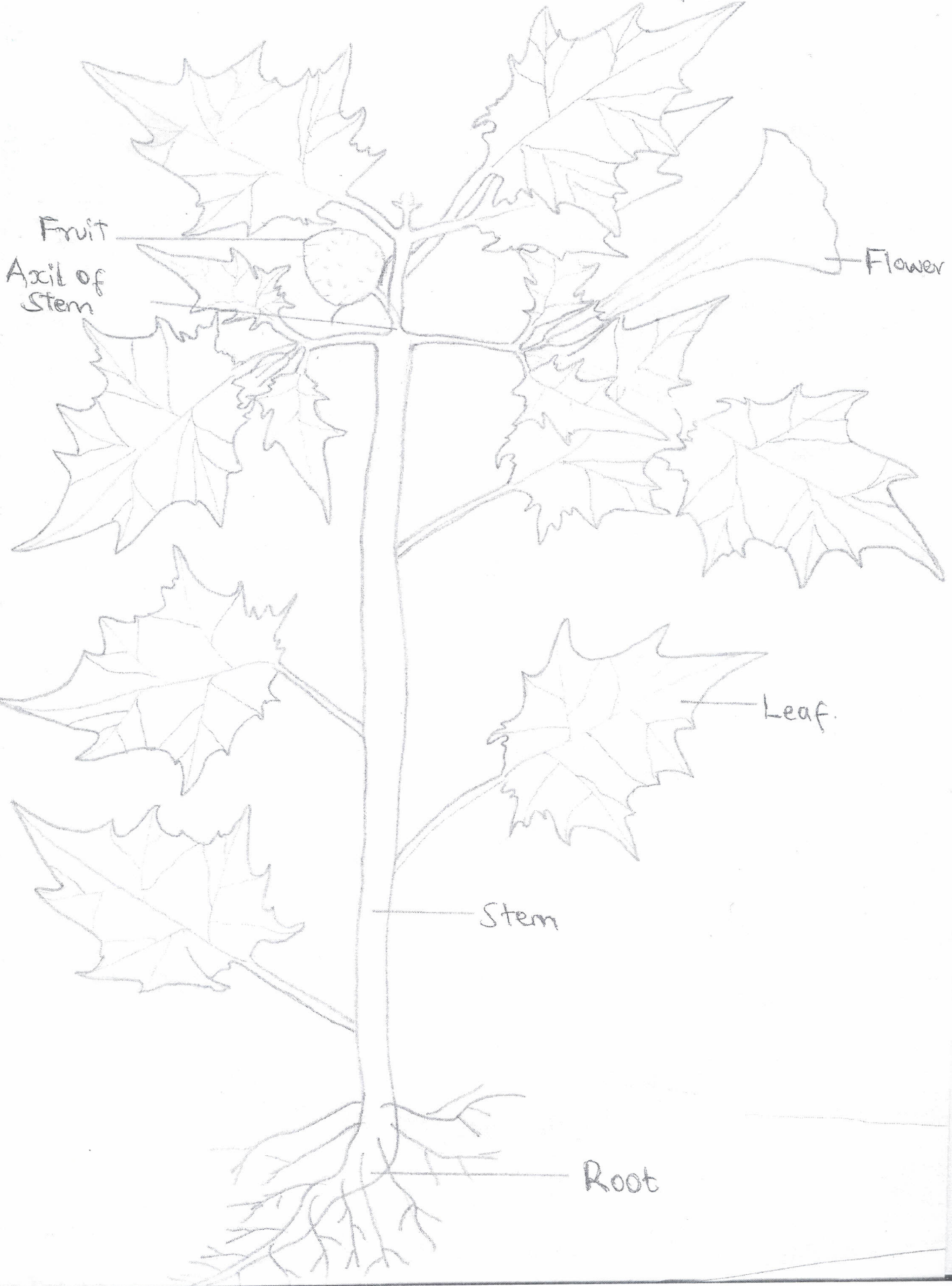
The leaf has epidermal cells with sinuous walls and smooth cuticle, stomata is anisocytic. The mesophyll has single palisade layer, beneath which is found a crystal layer, occasionally rosette or microsphenoidal crystal of calcium oxalate. The midrib contains an arc of several bundles. *Datura* is characterized by the absence of sclerenchyma. Trichomes are present, M. Hess, S. Nyati, -Herbal Pharmacognosy 312.

Flower is regular, bisexual and hypogynous. The sepals are 5 and united while petals are 5, united and twisted in the bud. The stamens are 5, epipetalous, and hypogynous along with the style usually forming nectar glands. Carpels syncarpous and are two in number. The fruit is a capsule, Dr. Vidhu Aeri -Principles of Classification of Plants.

DESCRIPTION

The whole plant is a foul-smelling, erect, freely-branching herb about 1 m in height. The root is long, thick, fibrous and whitish with numerous rootlets. The stem is stout, erect, leafy, smooth, and pale yellow-green. It forks off repeatedly into branches and at each fork, forms a leaf and a single erect flower. The leaf arrangement is alternate. The leaves are large, smooth, with a toothed margin, soft, and irregularly undulate. The upper surface of the leaves is darker green and the bottom is light green. They have a bitter and nauseating taste. The fragrant flowers are trumpet-shaped, white to cream with streaks of violet appearing on the ribs and tips of the corolla lobes. They are about 6 cm long. They grow on short stems from either the axils of the leaves or the places where the branches fork. The fruit is a green spiny capsule that encloses black, flat, reticulated, kidney-shaped seeds. It stands erect in the axils of the branches.

Datura stramonium, Whole plant.



Fruit

Axil of
Stem

Flower

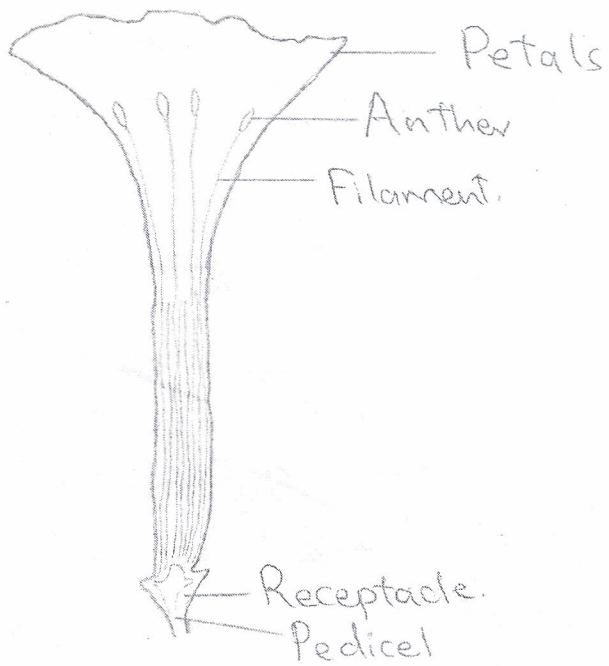
Leaf

Stem

Root

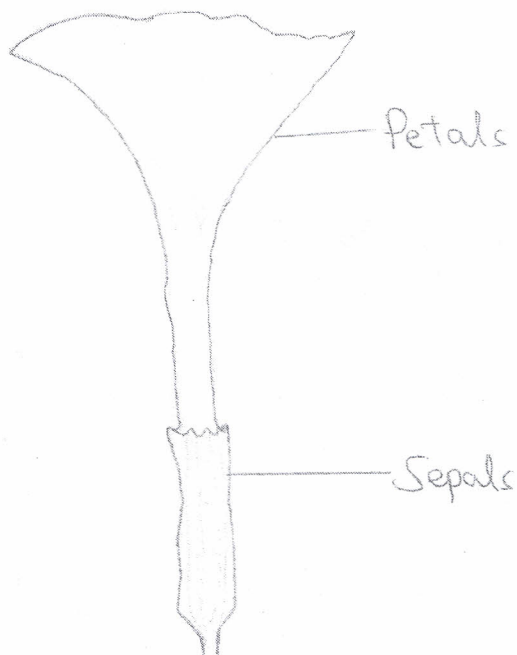
Datura stramonium; Leaf





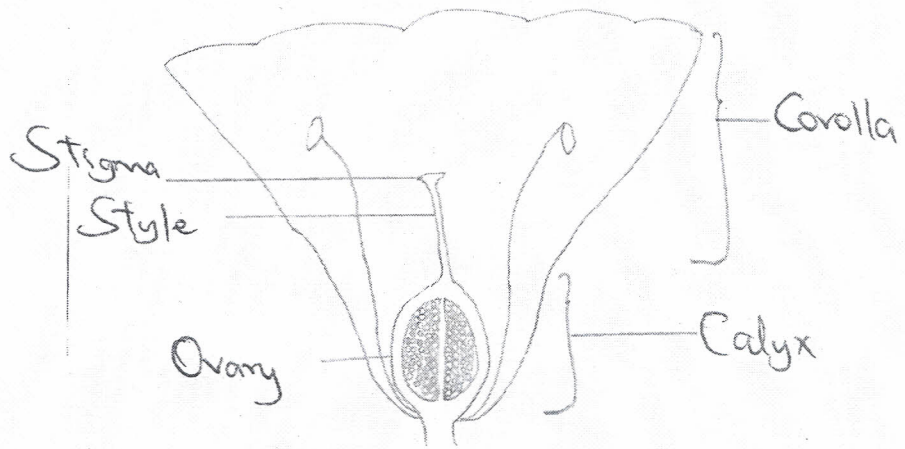
Datura stramonium ; Flower

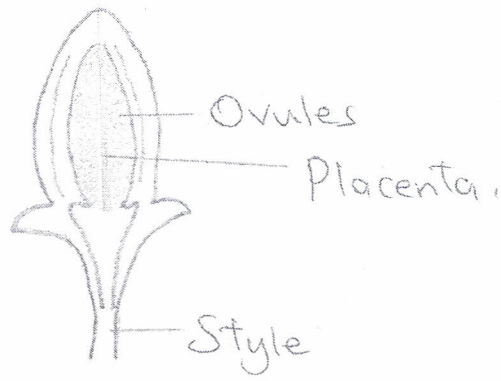
Datura stramonium ; Flower



Datura stramonium

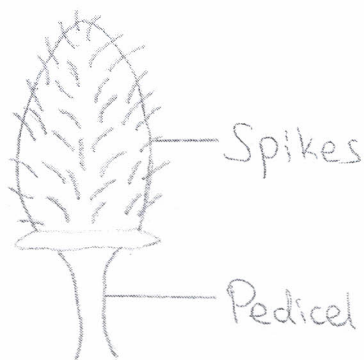
Flower; Perianth ovary relationship - Hypogynous





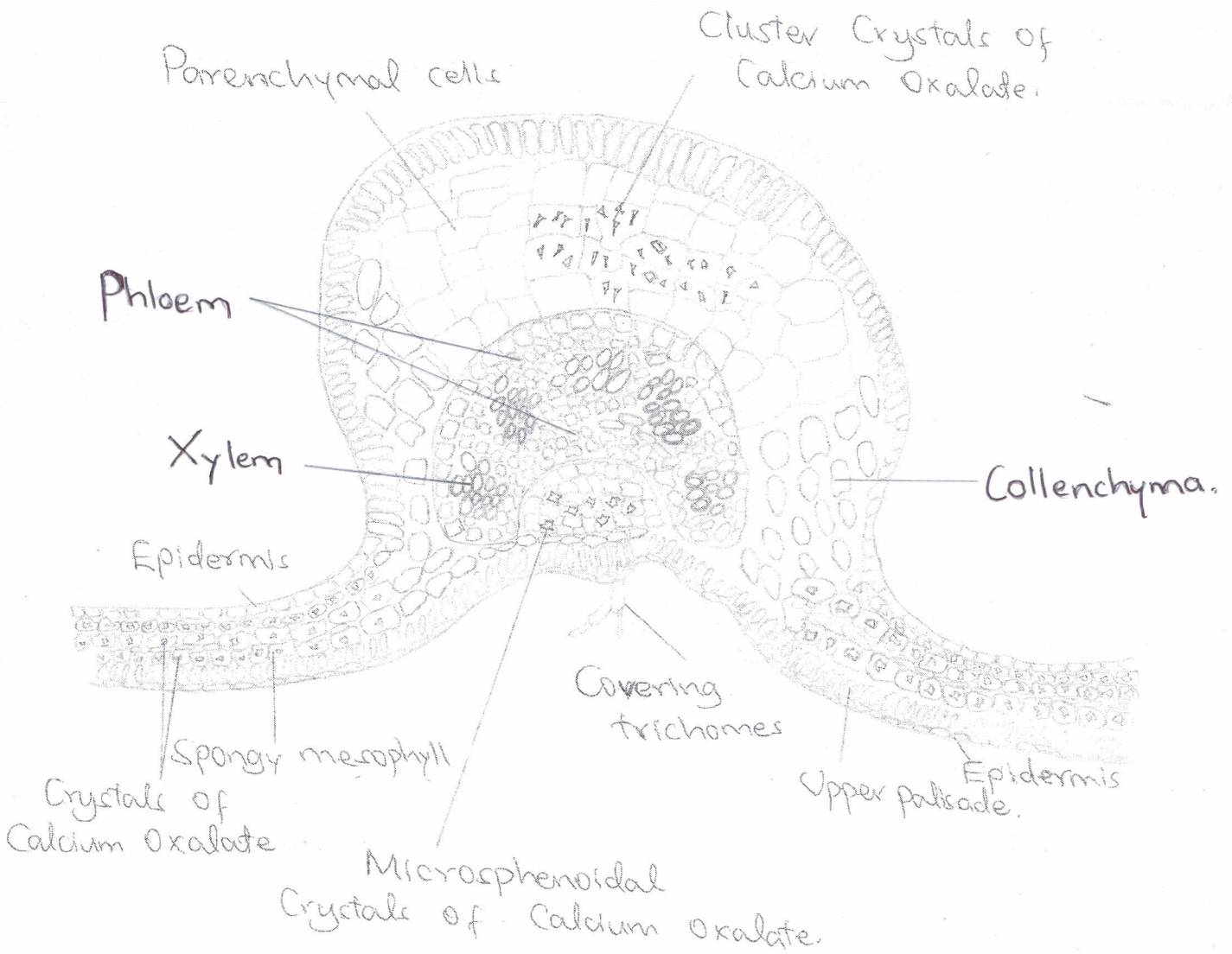
Datura stramonium; longitudinal section of
Fruit.

Datura stramonium; Fruit.



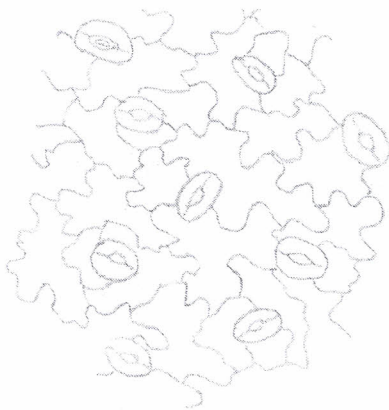
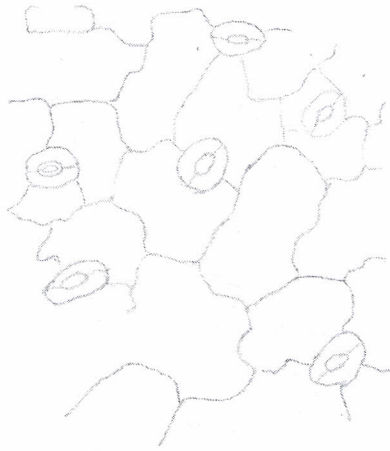
Datura stramonium.

Transverse section of leaf
around the Midrib.



Datura stramonium, Leaf

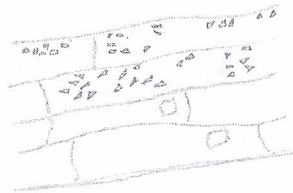
Anisocytic stomata on upper epidermis.



Anisocytic stomata on lower epidermis.

1 Datura stramonium; leaf.

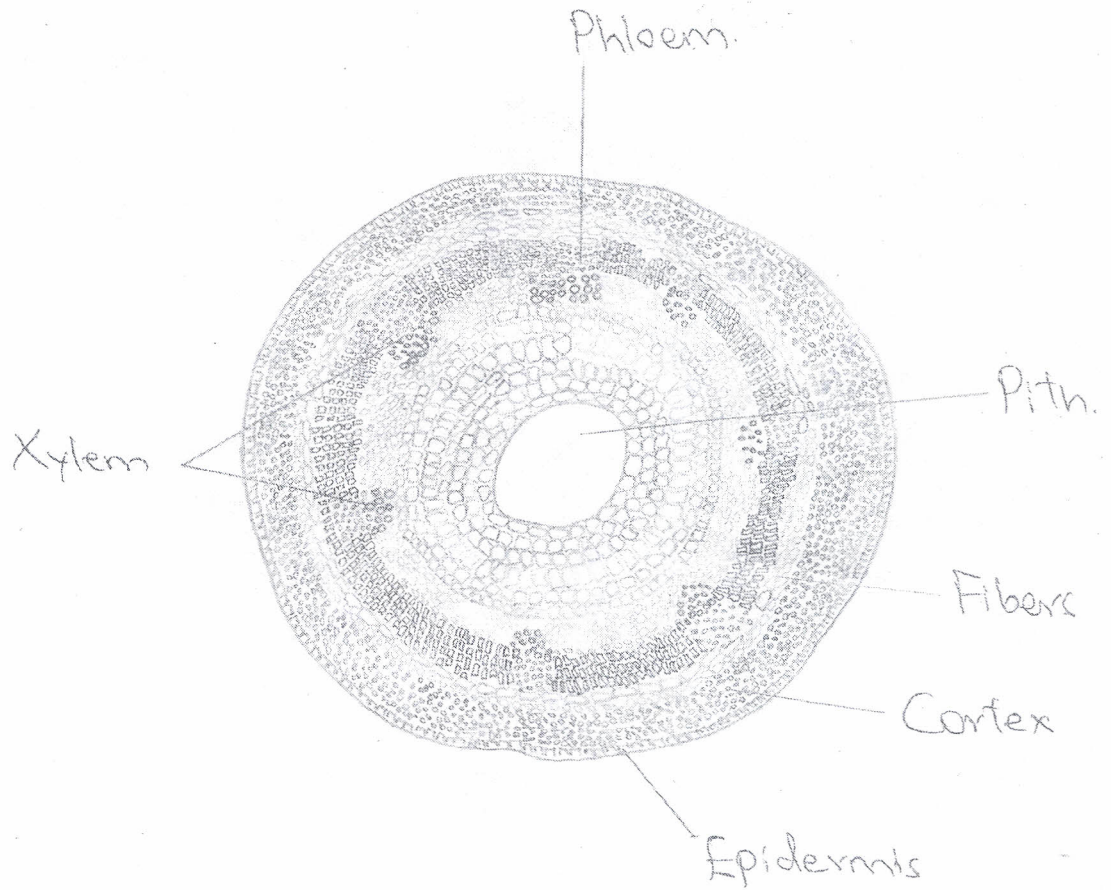
Prisms and Microsphenoidal Crystals of Calcium Oxalate on the midrib.



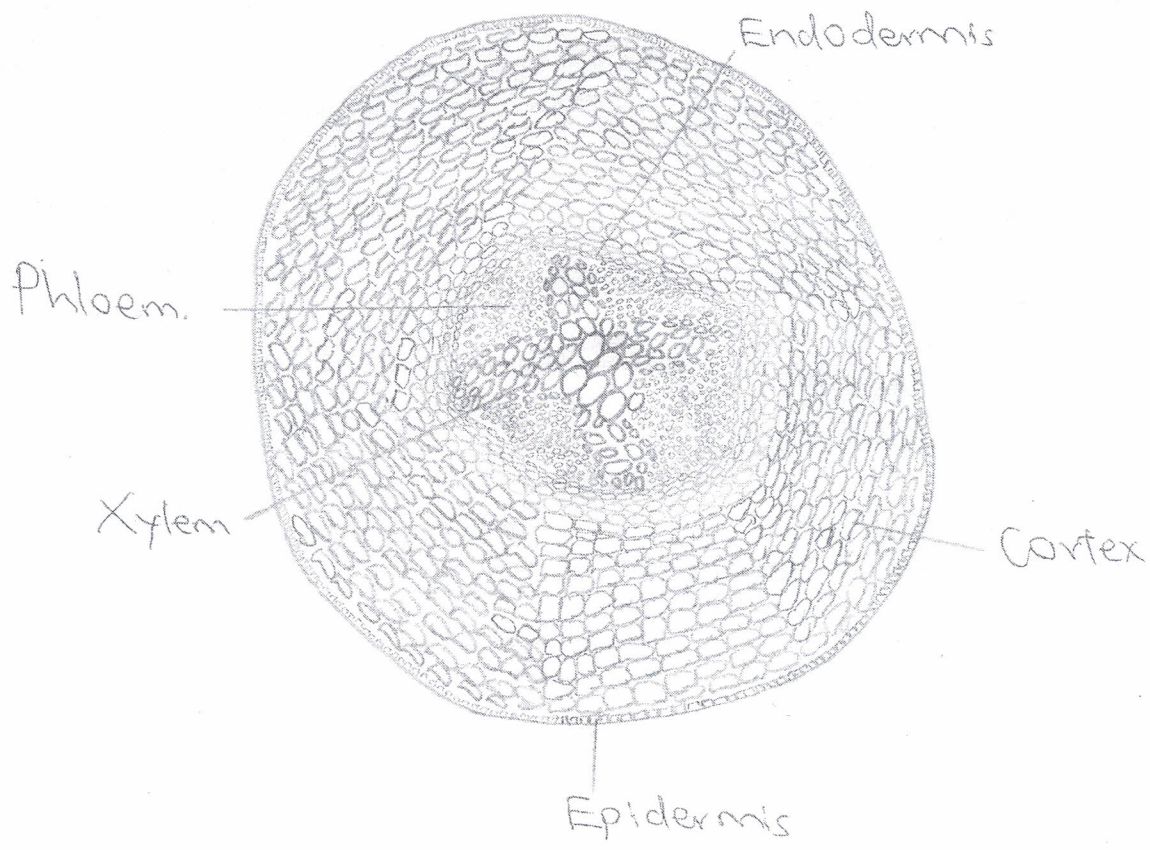
Crystals around the vein on leaf.



Datura stramonium, stem



Datura stramonium; Root.



DISCUSSION

Macroscopical characteristics; **Root** is a tap root with numerous rootlets. **Stem** is simple and glabrous. It forks off repeatedly into branches and at each fork it forms a leaf and a single erect flower. Leaf arrangement on the stem is alternate. **Leaf** is simple, ovate, with an acuminate apex. They measure up to 20 cm long and 15 cm wide. The base is hastate, and the margin is sinuate-dentate. Leaf venation is reticulate, and attachment to lamina is petiolate. **Flower** is solitary with a pedicel at the lateral stem or at the fork of two twigs. It is 5-lobed, tubular, gamopetalous and gamosepalous. The calyx is long and tubular about 4 cm long, swollen at the bottom and sharply angled surmounted by 5 sharp teeth. The corolla is funnel shaped with a broad folded 5 point margin. It may reach up to 7 cm long. The flower is a hermaphrodite. It bears 4-5 stamens whose attachment is basifixed. Cohesion of stamens is syngenesious. Perianth –ovary relationship is hypogynous. **Fruit** is an ovary with 2 carpels. It is originally bilocular but as it matures, a false septum arises, except near the apex, so that the mature fruit is almost completely four-celled. The ripe fruit is a thorny capsule about 3-4 cm long. The placentation is axile, and at maturity, it splits into 4 chambers each with dozens of small black seeds. **Seeds;** they are dark brown or blackish in colour, reniform in outline, and about 3 mm long, the testa is reticulated and finely pitted. A longitudinal section shows an embryo embedded in an oily endosperm.

Microscopical characters; **Root;** A transverse section shows that the cells of the xylem are arranged in a stele, surrounded by the phloem. This is characteristic of dicotyledonous plants. The endodermis is composed of closely packed cells so as to screen substances flowing between phloem and cortex. Cells of the cortex surround the endodermis. The cells of the epidermis form the outermost layer. **Leaf;** A transverse section shows it has a bifacial structure. Both surfaces are covered with a smooth cuticle and possess both trichomes and stomata. Cluster crystals of calcium oxalate are abundant in the mesophyll, and microsphenoidal crystals are also found in parenchymal cells of midrib. Anisocytic stomata are present on both surfaces; they are more numerous on the lower epidermis. The epidermal cells have wavy walls, especially at the lower epidermis. Cells of upper epidermis are thin walled with a sinuous outline while the underlying palisade cells are irregular in size and rather loosely packed. Covering and glandular trichomes are fairly abundant; the uniseriate covering trichomes are 3-5 celled, slightly curved with thin, warty walls while glandular trichomes have a short stalk and an ovoid to pyriform head composed of thin walled cells. When portions of the leaf are cleared with chloral hydrate solution the abundance of the cluster crystals of calcium oxalate and their distribution with regard to the veins is seen. The midrib shows a bicollateral structure and characteristic sub-epidermal masses of collenchyma on both surfaces. The xylem takes the form of a strongly curved arc. Sclerenchyma is absent. Vascular bundles are bicollateral. Lignin is present in the vascular bundles and veins. **Stem;** Epidermal trichomes are present, the phloem is perimedullary. The stem parenchyma contains calcium oxalate crystals similar to those found in the leaf. The phloem, parenchymal cells, cortex and epidermis are also observed.

CONCLUSION

Datura stramonium is a foul smelling herb with a forked and branched greenish yellow stem. The leaves are large, smooth, irregularly undulate and toothed. Its root is thick and whitish. It has characteristic trumpet shaped, white fragrant flowers; the fruit is a spiny capsule. It is a dicotyledonous plant as seen in the vascular bundle arrangement in the transverse sections of the root and stem. The leaf has characteristic anisocytic stomata and uniseriate 3-5 celled covering trichomes. The sclerenchyma is absent. The characteristic layer of calcium oxalate crystals just below the palisade cell layer is also of diagnostic importance.

CHAPTER2:*Azadirachta indica*

LITERATURE REVIEW

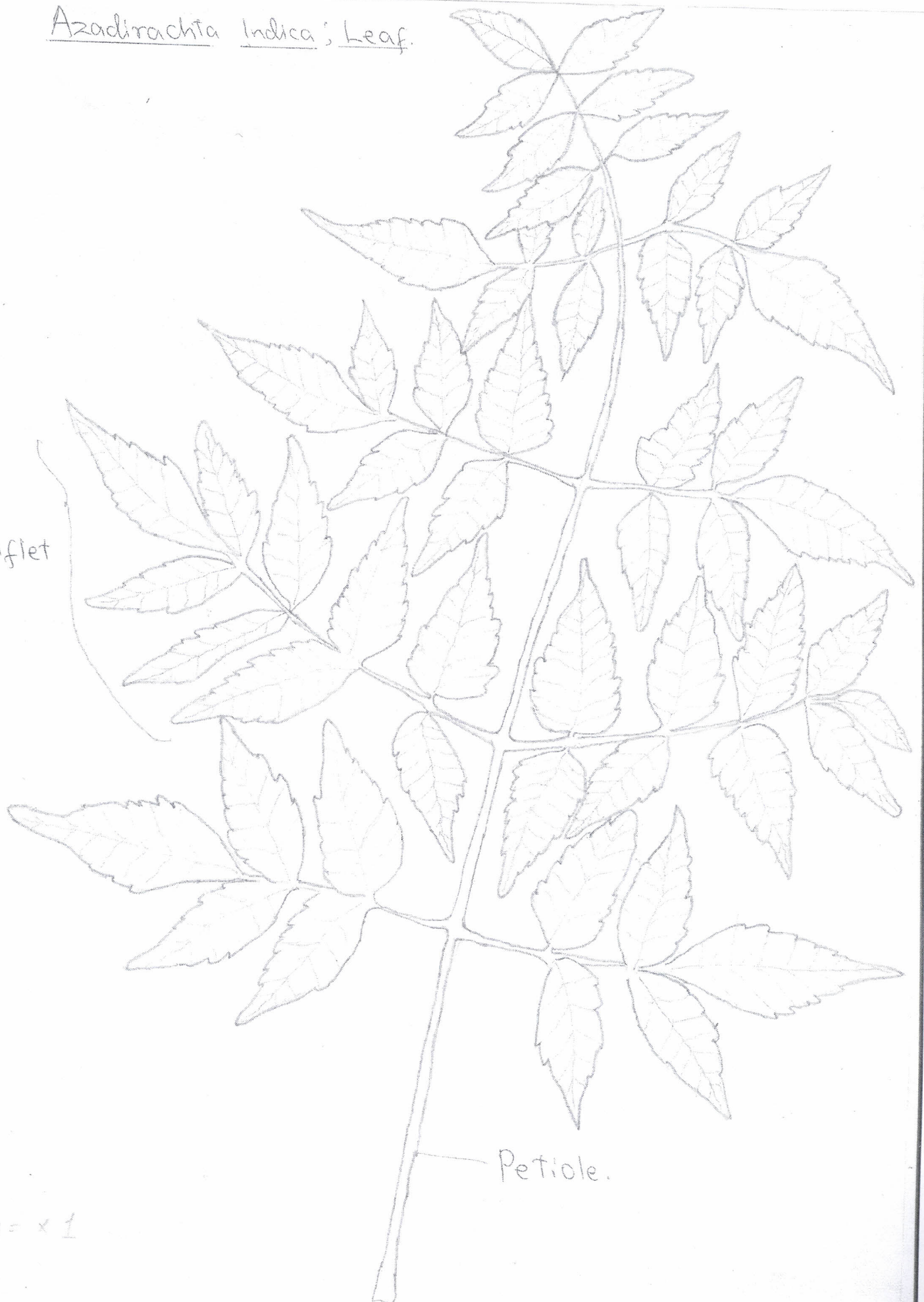
Azadirachta indica is an evergreen tree that grows up to 20 m tall; with dark green alternate and bipinnate leaves. Each leaf has 10-12 serrated leaflets. No trichomes are observed on leaves. Numerous stomata were observed under light microscope, Shazia Sultana, Mir Ajab Khan, Mushtaq Ahmad et al -AUTHENTICATION OF HERBAL MEDICINE (*AZADIRACHTA INDICA*) BY USING TAXONOMIC AND PHARMACOGNOSTIC TECHNIQUES.

Leaf shape is oblique, lanceolate while base is symmetric. The margin is serrate, the apex is acuminate .the venation is pinnate, the texture is thin papery. The taste is bitter while odour is unpleasant. Vein-islet number is 14.9, palisade ratio 3.4, stomata index is 9.4, M. Kundu, R. Mazumder, M.D. Kushwaha et al -PHARMACOGNOSTIC PROFILES OF LEAVES OF *AZADIRACHTA INDICA*.

DESCRIPTION

Azadirachta indica is a fast growing tree in the mahogany family Meliaceae that can grow to a height of 15-20 m. It is evergreen, but in severe drought may shed most of its leaves. It has a rough dark brown bark with wide, shallow longitudinal fissures separated by flat ridges. The trunk is short and stout. The branches are wide spread. The fairly dense crown is roundish and may reach a diameter of 15-20 m in old, free standing specimen. The leaves are pale green when young but dark glossy green when mature. It bears many flowered panicles, mostly in the leaf axils. It produces yellow drupes, which are ellipsoid.

Azadirachta Indica; Leaf.

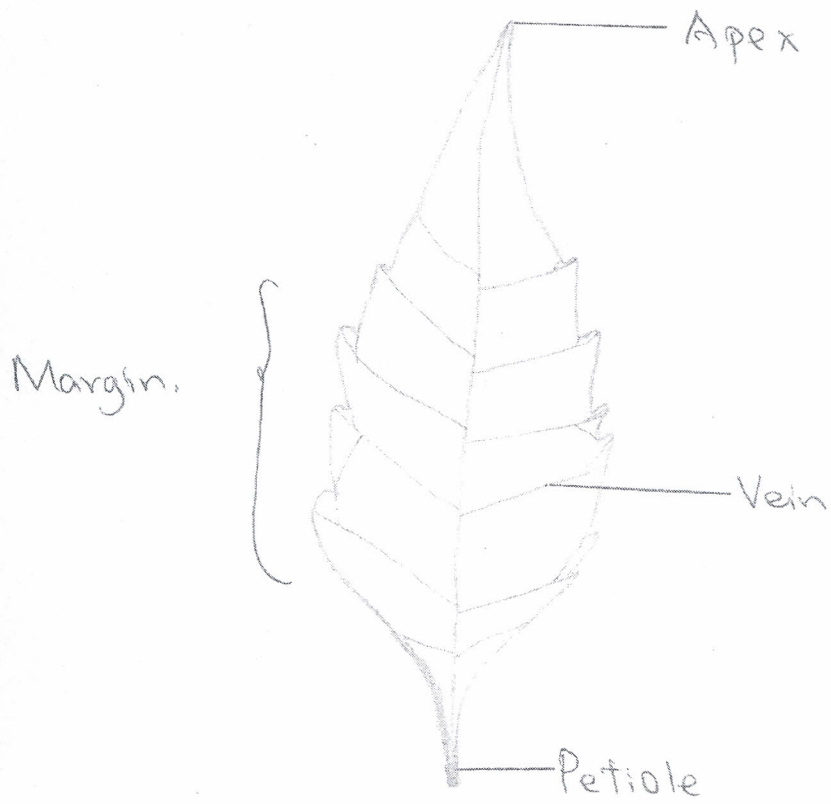


Leaflet

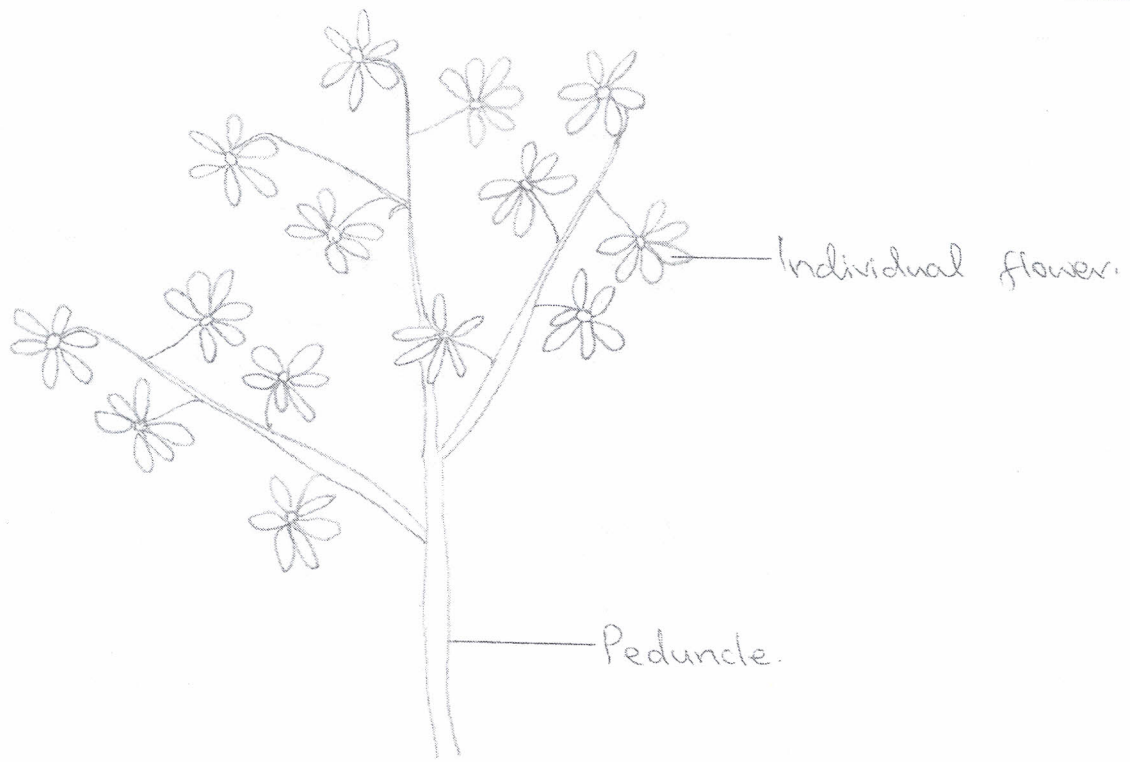
Petiole.

Mg = x 1

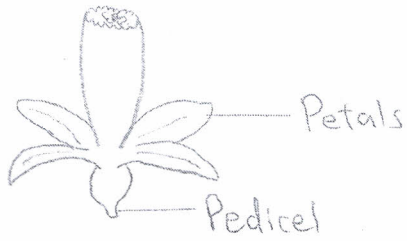
Azadirachta Indica



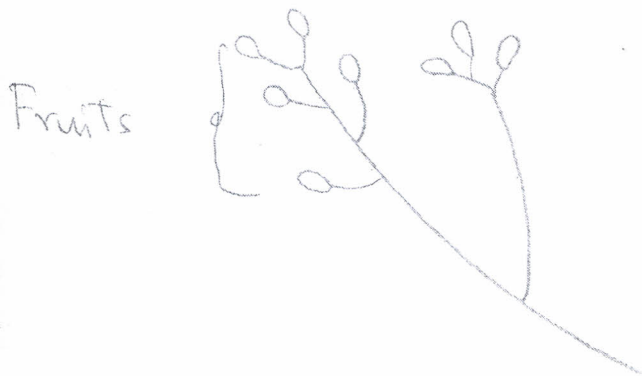
Azadirachta indica ; Flower (Panicle)



Azadirachta indica ; Individual flower

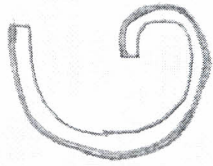


Azadirachta indica ; Fruits

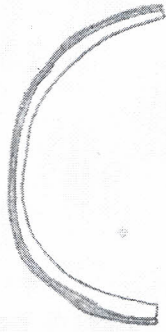




Azadirachta Indica Bark

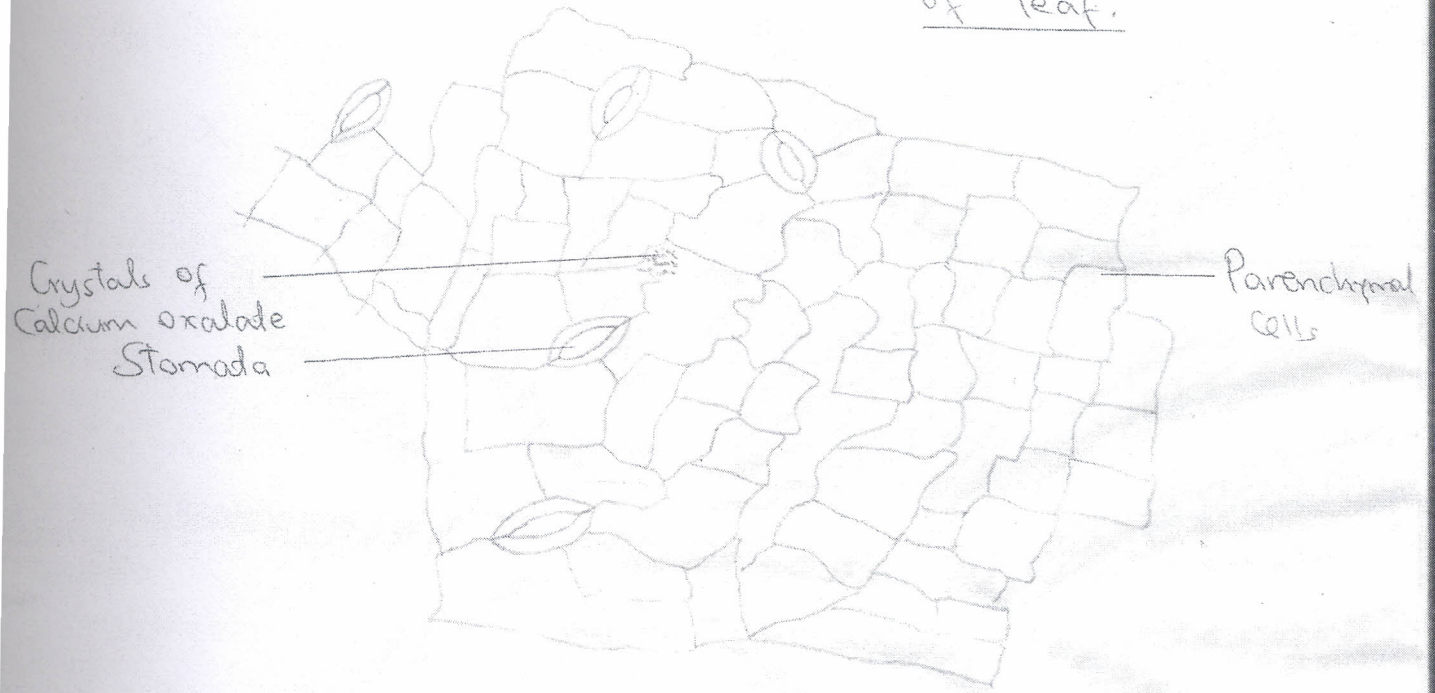


Quill



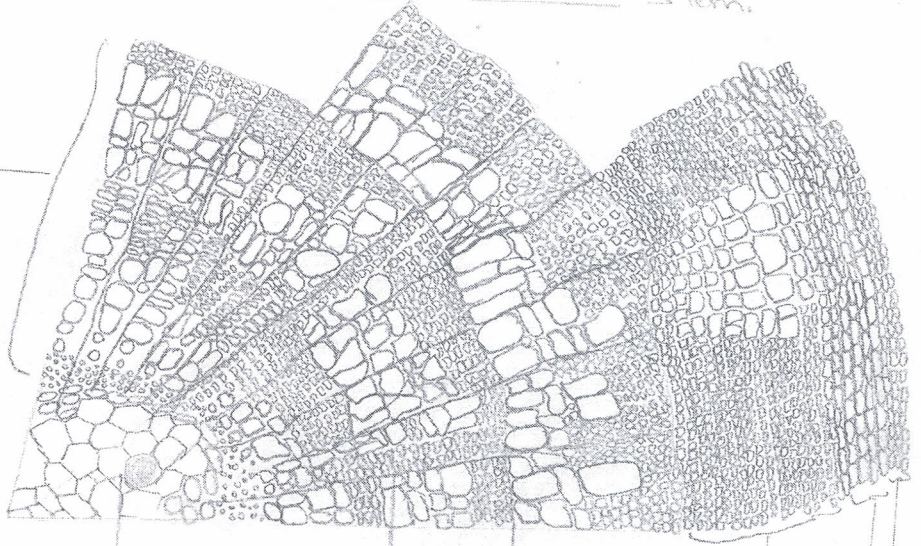
Curved

Azadirachta indica; Longitudinal section
of leaf.



Azadirachta indica Stem.

Xylem.



Pith.

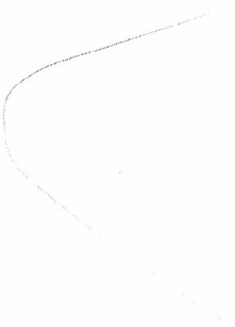
Ray.

Annual ring.

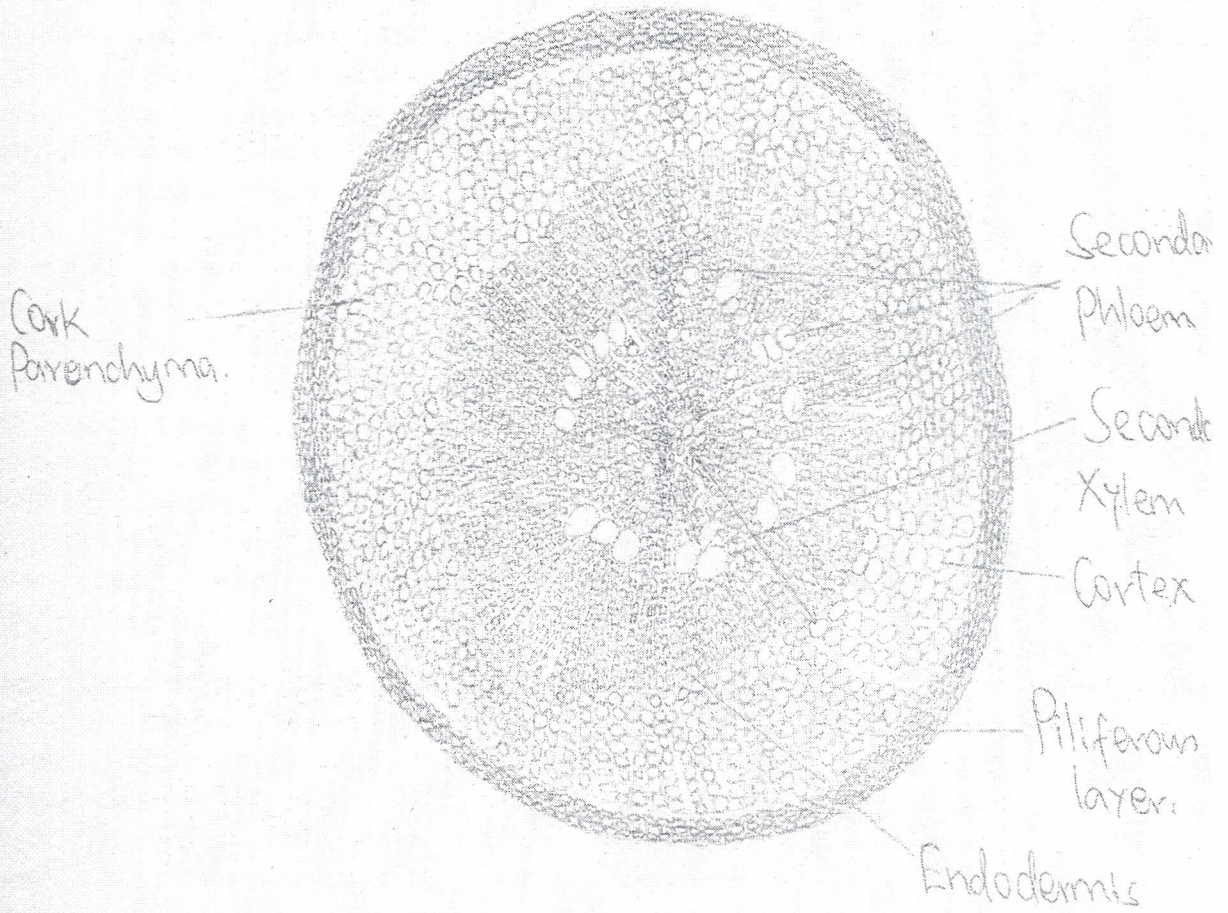
Cork

Cortex.

Phloem.



Azadirachta indica ; Root.



DISCUSSION

Macroscopical characteristics; **Root** is comprised of a strong taproot system and excellently developed lateral roots. The nature of curvature of the root bark is quilled or curved and is about 0.25-0.50 cm. The outer surface is reddish-brown or greyish-brown, irregular, rough, scaly, and fissure. Inner surface is yellowish-brown with parallel striations; fractured planes are splintery and fibrous. Its odour is like that of saw dust and it has a bitter taste. **Trunk** is short, upright and relatively thick. The bark is dark brown, fairly thick with many longitudinal and oblique crevices which are lighter in colour. The inner surface of the bark is reddish brown. The sapwood is greyish white while the heartwood is red, but becomes brownish when exposed. It is a hard, fragrant lasting wood which sometimes is somewhat shiny, especially when radially cut. It is fairly unevenly textured and moderately heavy. **Leaves** are compound, imparipinnate, each comprising 5-15 leaflets arranged in alternate pairs with a terminal leaflet, with the compound leaves themselves alternating with each other. The thin, lanceolate leaflets are very diagnostic and measure about 6 cm long and 2 cm broad. They are glabrous and attenuated at the tip and unequal at the base. The margin is bluntly serrate. Leaf venation is pinnate. Leaf attachment to lamina is petiolate, though the leaflets have short petioles. **Flowers** are panicles; they are small, white, pleasantly fragrant and hermaphrodite. Peduncles are short and panicles axillary. Bractae are small and deciduous. They are hypogenous, regular, and bisexual. The calyx is comprised of 5 ovate sepals that are short and united at the base. They are about 1 cm long. The corolla comprises 5 sweet scented white oblanceolate petals; free, spreading, with oblong petals. They are fixed at the base of a disc forming a long cylindrical pipe. The stamens are 10 and the stamina tube inserted at the base of the corolla. Gynoecium is tricarpeal, syncarpous (3-5 carpels), superior, trilocular with two ovules at each locule. There is one style while stigma three lobed. The taste is mildly bitter. The odour is indistinct. **Fruit** is a small drupe, ellipsoid in shape, yellow-green when ripe sometimes with two seeds. It is glabrous and measures 12-20 cm. **Seed;** Brownish in colour, oval shape, dorsally convex. Seed coat is thin, brown in colour and forms a shell like structure over the seed. The seed coat usually cracks on touch. The inside of the cracked pieces appear as golden yellow and seed kernels are light brown in colour. The seed is oily in odour and has a bitter taste.

Microscopical characteristics; **Root** bark shows cork, cortex and phloem. Cork is composed of 6-7 layers of polygonal and thin walled cells with reddish brown contents. Outer cortex consists of tangentially elongated large rectangular cells, with tangentially elongated sclereids, singly or in groups in isolated patches. Sclereids vary in size and wall thickness; they are distinctly striated, pitted and often associated with cells containing crystals. Inner cortex is composed of polygonal parenchymatous cells with bundles of sclerenchymatous fibers, thick walled with irregular lumen. The secondary phloem is composed of alternating tangential bands of bast fibers and parenchymatous tissues intercepted by uniseriate to biseriate phloem rays. Abundant starch grains are present in parenchymatous cells of the cortex and phloem. Abundant prismatic crystals of calcium oxalate are observed in the cortex. **Seeds;** transversely cut surface shows well separated epidermis and endosperm. The epidermis is single layered and attached to the tegmen. The endosperm is a fleshy oil storage tissue. The embryo is embedded in the endosperm. **Flower;** the calyx shows thin walled polygonal papillose epidermis with elongated thin walled unicellular conical trichomes of varying length. Rosette crystals are observed in cells of epidermis. The corolla has epidermis made up of rectangular cells, with papillose at margins. The non-glandular unicellular trichomes and numerous rosette crystals in epidermal cells are observed.

CONCLUSION

Azadirachta indica is an evergreen tree with widespread branches, whose trunk is short and stout. The crown is fairly dense. The leaves are pale green, and are thin and lanceolate which is diagnostic. The ellipsoid drupes are green when unripe, and yellow when ripe. White fragrant flowers are borne in panicles. The bark is dark brown, fairly thick with many longitudinal and oblique crevices. The outer cortex has characteristic striated, pitted sclereids.

CHAPTER 3:*Bidens pilosa*

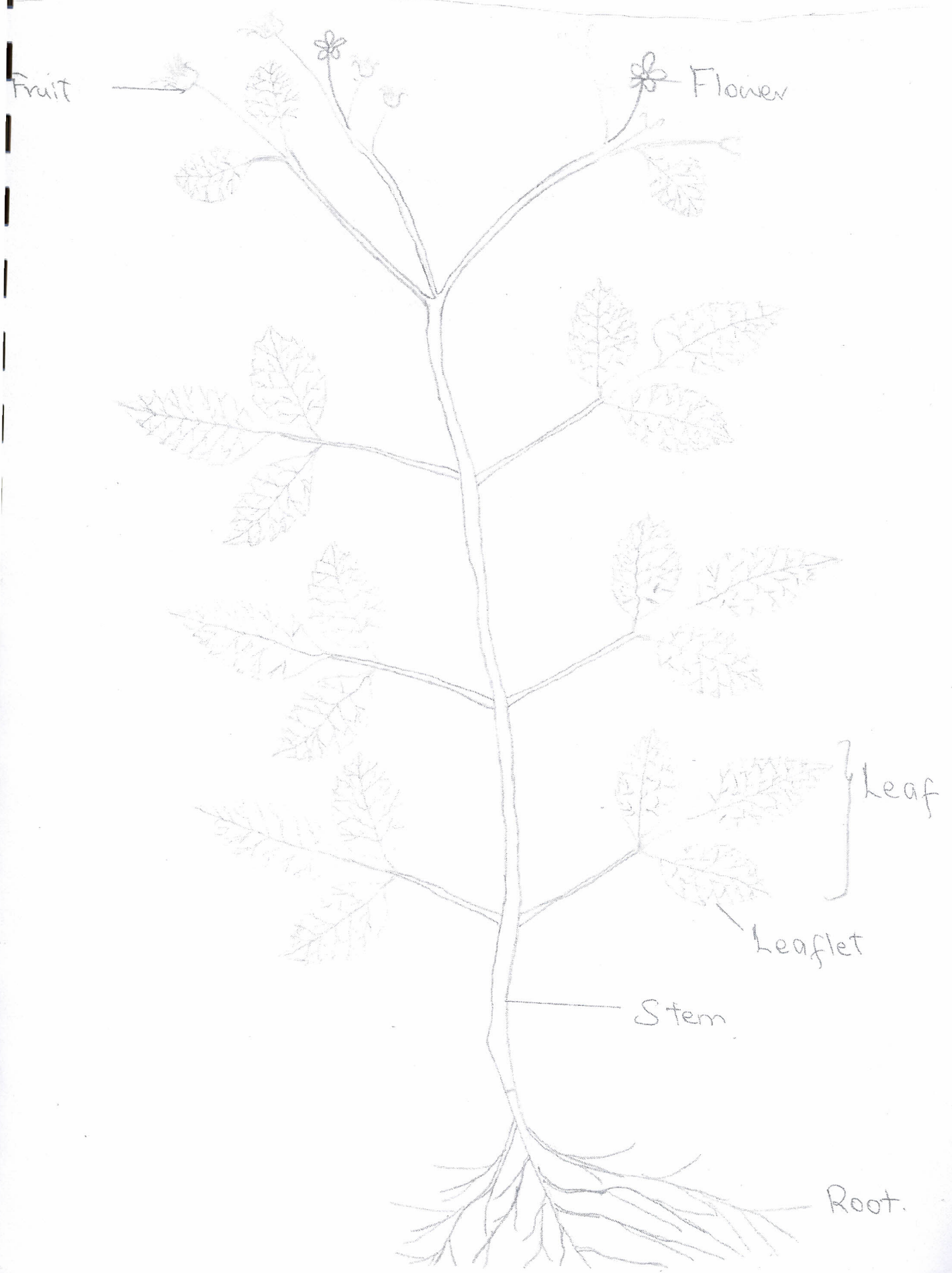
LITERATURE REVIEW

Bidens pilosa is an erect, annual herb which stands from 0.3-2 m high and bears opposite, pinnately compound, broadly ovate, (3-)5-9-lobed leaves 3-20 cm long and 2.5-12 cm wide. Leaf segment is ovate to lanceolate, lobed or bilobed at the base with margins crenate-serrate and apices acute. Stems are reddish tinged; 4-angled, simple, or branched. Heads solitary or in lax paniculate cymes at the ends of the main stem and lateral branches, usually radiate, 5 – 12 mm broad. Heads with 2 rows of involucre bracts, outer ones 7-10, spatulate, reflexed at anthesis, 3-4 mm long, inner ones ovate lanceolate; ray flowers absent or 4-8, sterile, corolla 7-15 mm long, white to yellow or pinkish, disk flowers with 3.5 – 5 mm long, yellow corolla. Achenes are black, 4-8 ribbed, linear, 6-16mm long, with 2-3(-5) retrorsely barbed bristles of 2-4 mm long (Aluka, undated; PIER 2007). *Bidens pilosa* is an annual herb with an erect habit to 1.5 m in height (Stanley and ross 1983-1989) *Bidens pilosa* is bitter in taste, as recorded by Subhuti Dharmananda, Ph. D. in an article 'A Popular Remedy Escapes Notice of Western Practitioners'. Root of *Bidens pilosa* has a distinctive aroma similar to that of a carrot- 'Significance of macroscopic and microscopic studies in homeopathic pharmacy', Dr, K. S. Gopi, et al. The flowers are absent but if present, are 4-8 in number. They are ligulate, sterile with corolla being 7-15 mm long. There are white to yellow disc flowers, which are bisexual with 3.5-5 mm long yellow corolla. Stamens are composed of fused anthers. Ovary is inferior and is 1-celled. The style is bifid. The fruit is a linear achene 4-13mm long, 4-6 ribbed with 2-3 retrorsely barbed bristles of 2-4mm long, Mvere B. 2004. Each flower cluster has 4 or 5 short, broad, white petals but these do not persist for very long. To distinguish *Bidens pilosa* from other species in the genus, there may be absence of ray florets, or if present are 4-7 per head. Rays are 2-8mm long, PIER. *Bidens pilosa* is an erect annual herb 0.3-1.8 m tall. Leaves pinnately compound, usually 2.5-13.5 cm long including petiole, leaflets (1-) 3-5 (-7). Heads 21-42 in compound cymes terminating main stem and lateral branches, discoid and 0.7-1 cm in diameter including ray florets, peduncles 1-9 cm long; outer involucre bracts spatulate-tipped, 2.5-5 mm long; ray florets absent or 4-7 per head, rays white or yellowish, 2-8 mm long; disk florets 35-75 per head, perfect, corollas yellow; pappus of 2-3 (-5) barbed awns 1-2 mm long. Achenes are dark brown or black, straight, wingless, 8-16 mm long, setose. Wagner et al, 1999; pp. 279-281. *Bidens pilosa* is an erect annual or perennial herb with branching habit to about 1m high. Leaves are deeply divided into three toothed lobes, with the terminal lobe larger than the other two. Individual flowers are yellow but are tiny and held in dense terminal clusters in a widely branching flowering head. Each flower cluster has four or five short, broad, white 'petals' but these do not persist for very long. The seeds are black, about 1 cm long, with 2 or 3 barbed awns at the tip. (Waterhouse and Norris, 1987; pp. 274-276) *Bidens pilosa* has characteristic ray florets that are 5-8 per head; rays are 10-16 mm long. Wagner et al., 1999; pp. 279-281).

DESCRIPTION

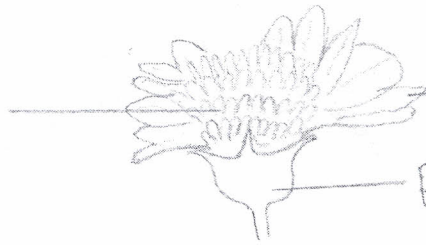
The whole plant is an erect, slender, branching, annual herb growing up to 40 cm. The leaves are opposite; pinnately compound about 2.5 cm long including the petiole, with three, dentate ovate-lanceolate leaflets. The petioles are slightly winged. It may flower at any time of year; flowers are borne in small heads on relatively long peduncles. The heads bear about four or five broad white petals of ray florets, surrounding a disk of tubular yellow florets; this is a morphology that occurs commonly in the **Asteraceae**. The fruits are slightly curved, stiff, rough black rods, tetragonal in cross section about 1 cm long, with typically two to three stiff, heavily barbed hair-like appendage at their distal ends. The fruits form star-shaped spherical seeds that bear hooks. They present the barbed awns to catch onto animals or clothing.

Bidens pilosa ; Whole plant.



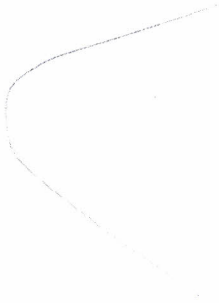
Bidens pilosa; Flowering head

Disc
florets

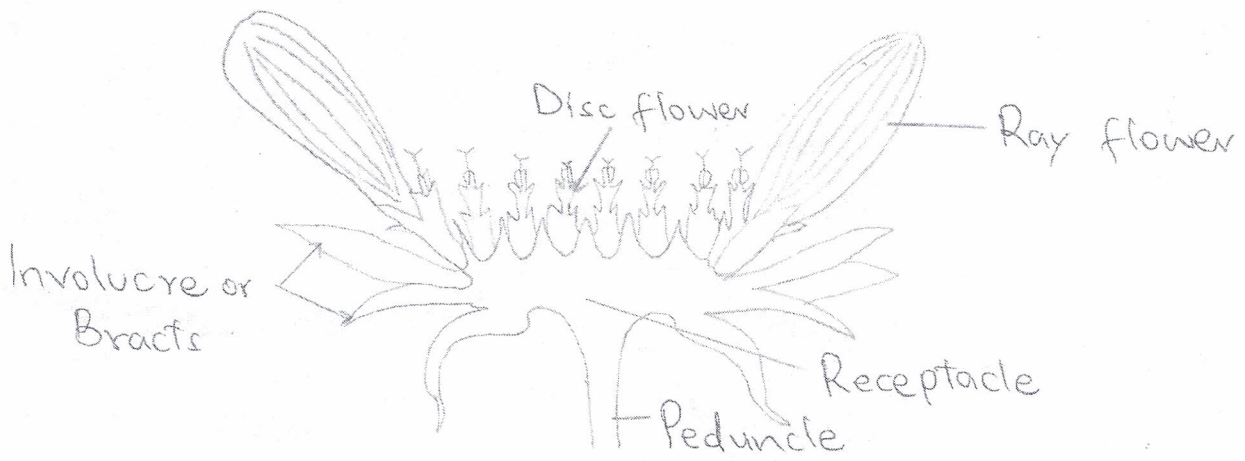


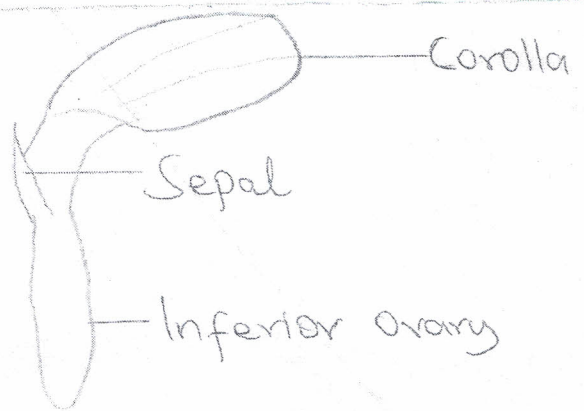
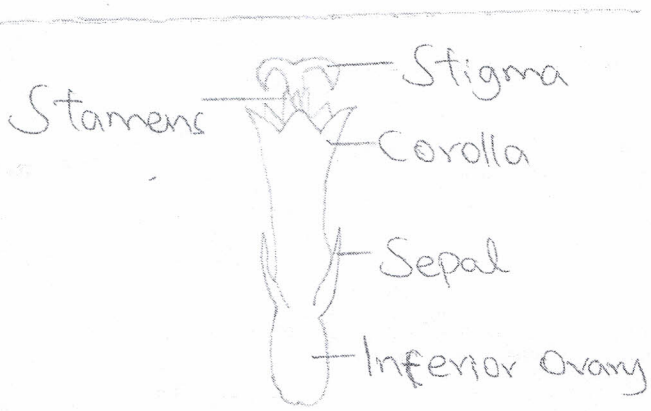
Ray florets

Receptacle



Bidens pilosa; Head Inflorescence:





Bidens pilosa. Disc flower

Ray flower



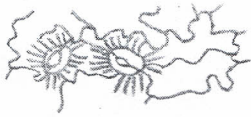
Bidens pilosa; Fruit.



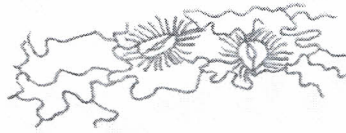
Achenes with sepals of barbed awns.

Bidens pilosa

Abaxial epidermal surface of Leaf.



Adaxial epidermal surface of Leaf.



Spine-like unicellular trichome



Unicellular trichome



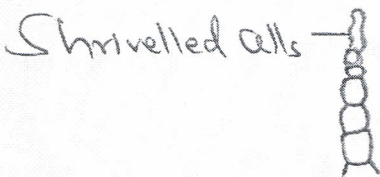
Bicellular trichomes



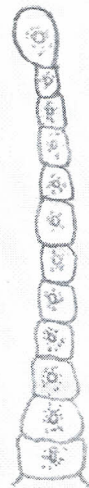
Multicellular trichomes



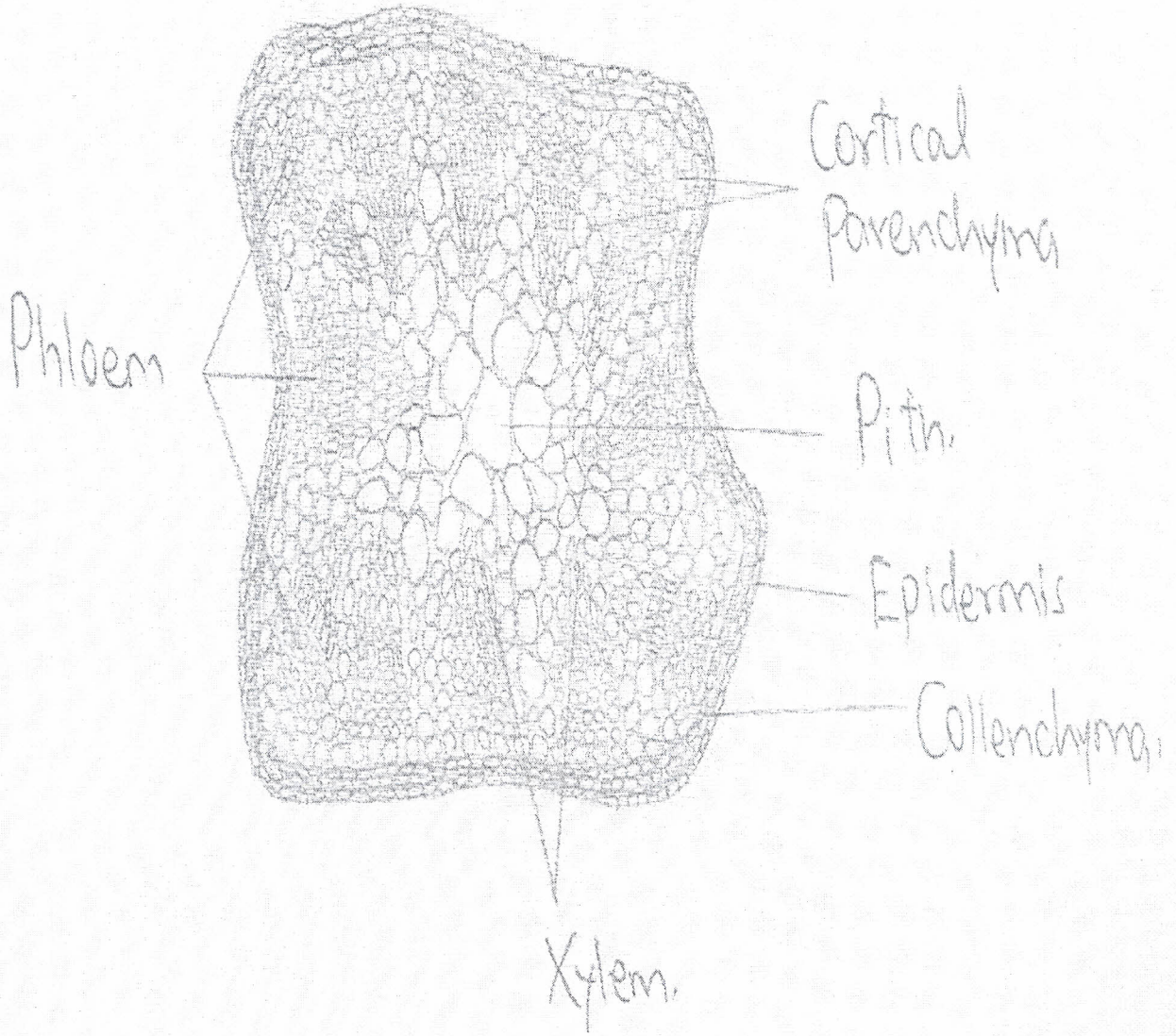
Multicellular Non-glandular trichomes



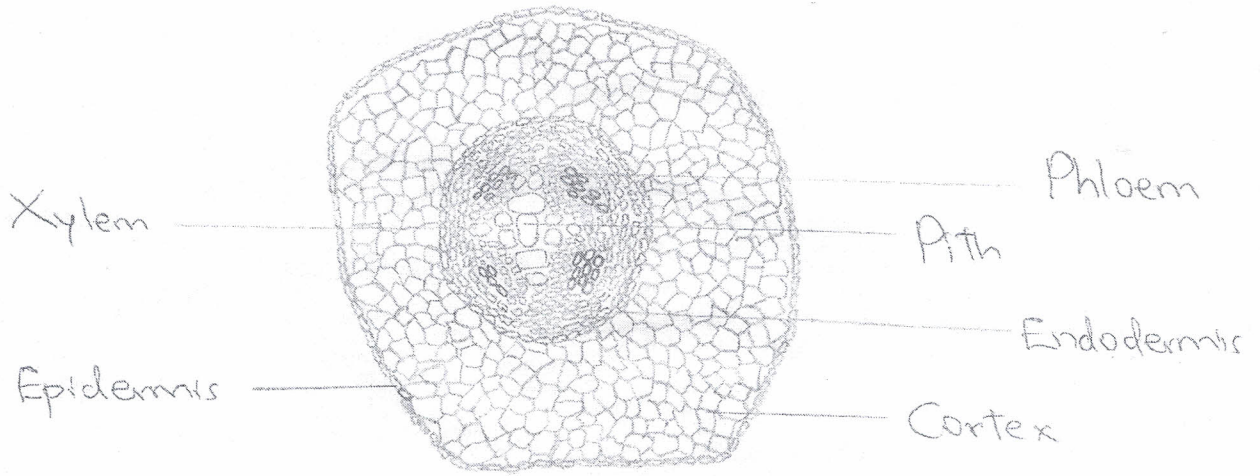
Glandular trichomes
Multicellular stalk and uncellular head.
Capacitated with uncellular head.



Bidens pilosa Stem.



Bidens pilosa ; root.



DISCUSSION

Macroscopical characteristics; **Root** is fibrous. **Stem** is green, slender, erect and stiff with hairs. Leaf arrangement on the stem is opposite. **Leaves** are pinnate, with 3-5 leaflets with elliptic shape. The apex of each leaflet is acute, base is also acute. The leaf margin is serrate, and leaf venation is reticulate. The petioles of the leaflets are slightly winged. Leaf attachment to the stem is petiolate. **Flowers** are ovoid inflorescence borne in small heads on relatively long peduncles. The heads which are discoid to radiate bear about 4 or 5 broad white petals of ray flowers, surrounding disc or tubular yellow flowers; this is characteristic of Asteraceae. The outer involucre has finely hairy margins that are shorter than the inner bracts. Both ray flowers and disc flowers have an inferior ovary. **Fruit** is a linear achene, dark, straight 0.5 inches long, 4-6 ribbed, 4-6 awns at the tip may be present or absent. They radiate out of flower heads up to 6000 from a single plant. Barbs allow the seed to attach itself onto clothing and fur of animals. *Bidens*, means two teeth which refers to the twin barbs at the tip of the achene; while *pilosa* refers to soft hairs.

Microscopical characteristics; **Leaf** has epidermal cells that are rectangular to irregular in shape with sinuous anticlinal cell walls on the adaxial surface and irregular to polygonal with sinuous anticlinal walls on the abaxial surface. Leaf surface is amphistomatic; stomatal apparatus in Asteraceae consists of two guard cells bound to a lenticular pore, the orientation of which is largely parallel to the guard cells. This apparatus is surrounded either by typical epidermal cells or by one or more subsidiary cells. The guard cells are elliptic. Stomata is largely anisocytic occasionally anomocytic or brachyparacytic. Cutin folds occur as striations in the epidermis on both surfaces. They radiate from the guard cells of the stomata and from trichome bases. Cuticular striations present on both adaxial and abaxial epidermal surfaces. Glandular and non-glandular trichome types present. Spine-like, unicellular, bicellular, multicellular non-glandular types are present, one or two cells occasionally shrivelled. Glandular types are largely capitated with multicellular stalk, and unicellular head. Occasional shrivelled cells in the non-glandular multicellular cell trichome types were observed. **Fruit;** Thick pappus bristles found on the achenes are twin celled. Sclerotic parenchyma makes up the achenial wings.

CONCLUSION

Bidens pilosa is an erect, slender, branching herb. The leaves are pinnately compound, ovate-lanceolate in shape with a serrate margin. Flowers are borne in small heads on long peduncles; heads bear white ray florets surrounding a disk of tubular yellow florets- this is a common morphology in Asteraceae. Fruits are black rods with barbed awns. Leaf stomata are anisocytic and the glandular and nonglandular trichomes are characteristic.

REFERENCES

1. Pharmacognosy textbook by Trease and Evans.
2. *Handbook* of AFRICAN MEDICINAL PLANTS.
3. Textbook of PHARMACOGNOSY, T.E. WALLIS.
4. American Herbal Pharmacopoeia: Botanical Pharmacognosy- Microscopic Characterization of Botanical Medicines.
5. Tropical Plant Database.
6. Thorn apple for homeopathic preparations.
7. Journal of Forensic sciences.
8. Ayurveda Pharmacopoeia of India, volume 1 page 137,140.
9. Internet.