ETHNOBOTANICAL SURVEY AND PHARMOCOGNISTIC FEATURES OF *SENEGALIA POLYACANTHA* (WILLD.) SEIGLER & EBINGER

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ABSTRACT

Senegalia polyacantha (Willd.) Seigler & Ebinger formally known as (*Acacia polyacantha* syn) is a plant of the Fabaceae family. It is used traditionally for treatment of different ailments. Ethnobotanical survey as well as the pharmocognostic studies of the plant were conducted using standard procedures. They root, stem, and leaf samples, along with their powdered forms, were studied macroscopically and microscopically. A semi-structured questionnaire was applied for interviews with respondents. Among 120 respondents studied for the traditional importance of the plant 76.7% were male, 69.2% married, 61.7% with no Western education, 39.2% herbalist, 65% of low economic level, 49.2% of age range of 35-54. The most mentioned uses are voice refreshing, followed by easy labour, abdominal pain, male aphrodisiac, back pain, cough, leg pain, cleaning teeth, numbness, osteoarthritis, urinary tract infection and least was spirituality. Anatomically, the leaves were found to be isobilateral with a vascular bundle. Powdered samples revealed some important diagnostic features, including thin-walled fibres with clearly visible lumen and pointed ends, parenchyma cells that are thin-walled, and isodiametric with no intercellular spaces. The fragment stem tissue includes sclereids with phloem, fibre and epidermis. The plant has an ethnobotanical importance and the plant can be distinguished from close related because of the unique pharmacognostic features.

Keywords: Ethnobotanical survey; medicinal plant; *Senegalia* Polyacantha; Pharmacognostic study

INTRODUCTION

According to Romulo and Ierecê (2007), "traditional medicine" (TM) is a broad word that encompasses both different types of indigenous medicine and systems like traditional Chinese medicine, Indian Ayurveda, Arabic Unani medicine, and so on. Throughout history, people have utilized plants and animals as a source of medicine [Lev, 2003; Alves and Rosa, 2006]. In the present era, animal- and plant-based healthcare systems remain crucial [Chivian, 2002].

Plants have always been the primary source of medicinal substances used to treat human ailments. Even in developed nations, the usage of herbal treatments is growing.

Nowadays, a lot of naturally occurring substances that have been separated from plants are used as "template" or lead molecules in the creation of entirely new medications (Dzobo, 2022). The rising cost and associated side effects of synthetic drugs prompts a quest for new treatments from a variety of sources, including traditional remedies (Rawayau *et al*., 2022).

A medicinal plant is any plant that, in one or more of its organs contains active ingredients that can be used for therapeutic purposes or contains foundation compounds that can be used for the synthesis of useful drugs (Sourabie *et al*., 2013). The ethnobotanical study is one of the many reliable guides humans have in utilizing the abundance of herbal resources that nature

has to offer to man's benefit (Getasetegn and Tefera, 2016).

Pharmacognosy is a simple and reliable tool by which complete information on the crude drug can be obtained (Karthika and Arts, 2018). The process of standardization can be achieved by stepwise pharmacognostic studies (Karthika and Arts, 2018). Pharmacognostic standardization of plant material includes its morphological (organoleptic), anatomical, and biochemical characteristics (Sreedhar *et al*., 2012). Authentication and standardization are prerequisite steps, especially for herbal drugs and their formulations in traditional systems of medicine (Karthika and Manivannan, 2018). The obstacle behind the acceptance of alternative medicines in developed countries is the lack of documentation and stringent quality control (Sreedhar and Unnikrishnan, 2012). So the documentation and standardization of the raw materials used in herbal medicine is essential for the worldwide acceptance of this system of medicine.

Senegalia polyacantha Seigler & Ebinger formerly known as *Acacia polyacantha* Wild syn. belonging to the family of Fabaceae is a thorny tree ranging from 16 m to 25 m in height. It is a flat and spreading crown to tree bark gray, yellow or blackish, fissured, and scaly (Alain *et al*., 2015), and *Senegalia polyacantha* is an attractive tree growing in Africa (Khalid *et al*., 2012).

Many ethnobotanical studies have been conducted and show that acacia species were used in the treatment of different diseases such as infectious diseases and digestive disorders (Tchatchedre *et al*., 2019). The stem bark of *Senegalia polyacantha* is used in several traditional and folkloric medical systems worldwide. The bark's ground dried bark is applied externally to localized sores to promote faster healing, and its decoction is taken orally to treat gonorrhea, pneumonia, leprosy, malaria, diabetes, and is thought to be aphrodisiac [Headbarg *et al* 1983; Gessler *et al*, 1994]. The stem bark is also believed to be an aphrodisiac [Gessler *et al*., 1994]. The stem bark is believed to be effective against malaria [Gessler *et al*., 1994]. The heart wood hydroalcoholic extract of *Senegalia polyacantha* was reported by Drabo *et al.,* (2022) to have the potential to prevent obesity, as supported by the in silico and *in vitro* techniques that have shown strong binding affinity and notable lipase inhibitory action, respectively.

The current study was conducted to investigate several pharmacognostic properties of the plant as a whole, including its intact and powdered form that has not been documented in the literature, in light of the aforementioned information and the significance of this medicinal plant. And also, to conduct research on ethnobotanical surveys in Mashi, Mai'adua, Charanchi, Malumfashi, Funtua, and Katsina LGAs of Katsina State.

METHODOLOGY

Study Area
The survey was conducted in Katsina state, northern Nigeria. Katsina state (Fig 1) which covers an area of 24,192 sq km, with an estimated population of 5,792,578, is located between latitudes 11°08′N and 13°22′N and longitudes 6°52′E and 9°20′E. The state is separated into three senatorial districts—Funtua, Daura, and Katsina—and includes 34 Local Government Areas. Two Local Government Areas (LGAs) were chosen at random from each senatorial district for the purposes of this study.

Fig.1:Map of Katsina State Showing the Study Areas
Source:- National Aeronoutic and Space Administration Spot Image 2022

Legend
- ──── Int. boundary
- ──── State boundary
- ──── L.G.A. boundary
- ▨ Study areas
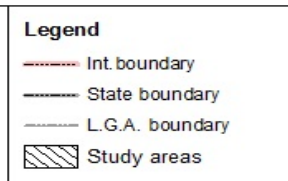
Data Collection

This study was conducted from March 2021 to November 2021. The data were collected from three Senatorial districts of Katsina state and two Local Governments each. Markets and villages of the selected local governments were used as places for collecting data. The data was collected using a semi-structured questionnaire and interviewed 120 informants, 20 from each Local government which comprised the herbalist, farmers, and other populous. A questionnaire was used in determining the demographic data of the informants, as well as the local name of the plant, part of plant used, method of preparation, and mode of administration.

Macroscopic and microscopic studies

Organoleptic characters such as the size, form, color, flavor, and smell of the powdered root and stem bark were

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determined. Simple light microscope was used for microscopic investigations. *Senegalia polyacantha* stems and leaves were thinly sectioned for use in microscopic research. The stems and leaves were cut into small pieces of 1-2 cm^2. The sections were mounted on glass slides in 50% (v/v) glycerine and covered with a cover slip. Toluidine blue and phloroglucinol-hydrochloric acids (1:1) were used to stain the sections after they had been cleaned with chloral hydrate solution (Chumbhale and Upasani, 2012; Nigam *et al.,* 2018).

For the powdered drug analysis, the shade-dried powdered bark was filtered through sieve number 40. Glycerin, N/20 iodine solution (for starch grain detection), Toluidine blue, phloroglucinol-hydrochloric acid (1:1) for lignin detection, and ruthenium red solutions were applied to the specimens individually. The materials were examined using a compound microscope following staining (Chumbhale and Upasani, 2012).

Behaviour of powdered plant with different reagents

The behaviour of the powdered plant's stem, root, and leaf when poured into a different chemical compound was tested as described by Karthika and Manivannan (2018). The chemical compounds used are water, ethanol, iodine solution, 2m dilute HCL, 2M dilute HNO$_3$, dilute H$_2$SO$_4$, and NaOH.

RESULTS

As shown in (Table 1). Among the Respondents 76.7% of them are males which are 92 in number and the rest 23.3% are females. The educational level of the interviewed informants 74 (61.7%) has no formal education followed by 25% of informants that are at primary educational level, 9.2% at secondary level and least number 05 which stand at 4.2% are at tertiary educational level. The occupations

of most of the respondents are herbalists which are 49 (39.2%) followed by farmers with 32 (18.3) the least occupation of the informants are hunters with 15.8% of the respondents, respectively. In term of economic status About 78 which accounts for 65% of the total number of informants are of low economic level, 28.3% are of middle economic level and the least number of informants in term of economic level is of high economic level with 6.7% of informants. The age range of the informants 35-54 range have the highest number of informants 59 (49.2%) followed by >55 with 28 (23.3%), <20 with number of 17 (14.2%) and least number of informants with 16 (13.3%) was under the range of 20-34.

Table 2 shows ethnobotanical use of *Senegalia polyacantha*. The most mentioned importance by the informants was voice refreshing/clarity when the stem chewed raw with the frequency of 64. The water macerated stem of the plant used for labour easiness was mention about 62 by different informants. Out of the 120 informants, 32 mention the use of stem or root of the plant for the issue of abdominal pain when the macerated plant was taken orally. The stem and root of the plant was used as Aphrodisiac when macerated and taken orally and was mentioned by 79 informants. The decoction of stem of the plant was taken orally or poultice for the issue of back pain and leg pain with frequency of 12 and 5 respectively. It was reported by the 18 number of informants that the decoction of the stem of the plants was taken orally for treatment of cough. The raw stem of the plant was used as chewing stick for the cleaning of teeth as mention by 14 informants. The maceration of Stem and or roots was taken orally for the issue of Urinary tract infection (UTI) with a frequency of 17 informants. The macerated stem of the plant was taken orally or poultice for the treatment of numbness and

osteoarthritis with a frequency of 06 and 05 respectively. About 61 informants reported that the root and stem parts of the plant was used for treating spiritual diseases/issues when macerated, decoction or raw by taken orally, bath or smoking.

Table 1. Socio-Demographic Data of the Informants

Factors	Number	Percentage%
Gender		
Male	92	76.7
Female	28	23.3
Marital status		
Single	10	8.3
Married	83	69.2
Divorced	27	22.5
Educational Level		
No	74	61.7
Primary	30	25
Secondary	11	9.2
Tertiary	05	4.2
Occupation		
Farmer	32	18.3
Hunter	19	15.8
Herbalist	49	39.2
Others	22	18.3
Economic Level		
Low	78	65
Middle	34	28.3
High	08	6.7
Age (years)		
<20	17	14.2
20-34	16	13.3
35-54	59	49.2
>55	28	23.3

Table 2. Ethnobotanical Uses of *Senegalia polyacantha* Plant Information

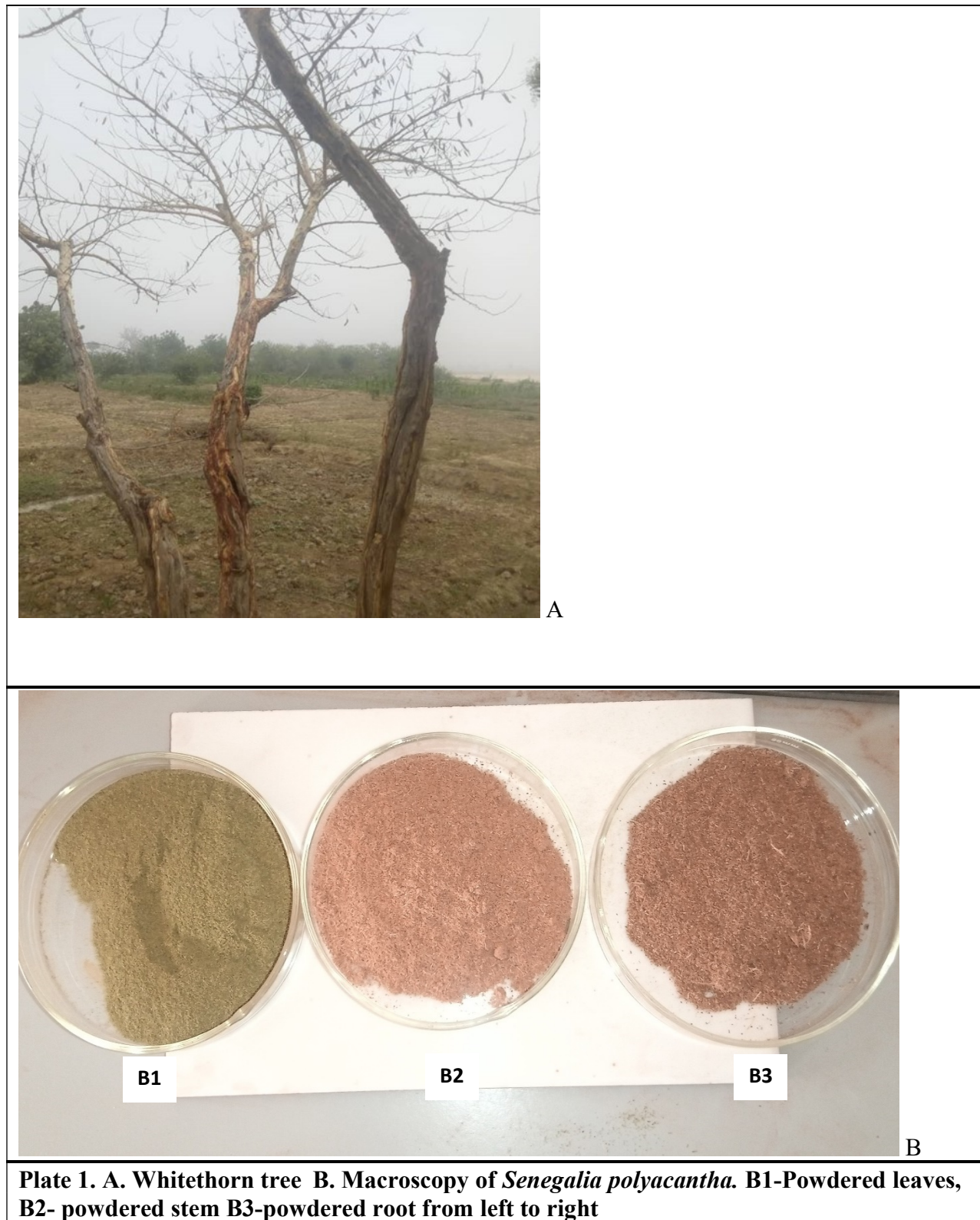| S/N	Uses	PU	MP	RA	VA
1.	Voice Refreshing	Stem	Raw	Chewing	64
2.	Labour Easiness	Stem	Maceration	Oral	62
3.	Abdominal Pain	Stem/Root	Maceration	Oral	32
4.	Male Aphrodisiac	Stem/Root	Maceration	Oral	25
5.	Back Pain	Stem	Maceration/	Oral/Poultice	12
6.	Cough	Stem	Decoction	Oral	18
7.	Leg Pain	Stem	Maceration	Oral/Poultice	05
8.	Cleaning Teeth	Stem	Raw	Chewing	14
9.	Numbness	Stem	Powdered	Poultice	06
10.	Osteoarthritis	Stem	Powdered	Poultice	05
11.	Urinary Tract Infection	Stem/Root	Maceration	Oral	17
12.	spirituality	stem/root	maceration	oral/bath	61

PU= part used MP= method of preparation RA=route of Administration VA= Value

Macroscopically/ organoleptic features of the powder macroscopy of *Senegalia polyacantha* indicate that the leaf is green in colour with mild odour, tasteless and smooth. The stem is light brown, sandy in odour, slightly bitter and no after taste and globous leaves. The root is dark brown, dry sandy with chocking sensation, slightly bitter with spicy after taste and smooth with scanty hair like stud as shown in Table 3 and Plate 1.

Table 3. Macroscopical Features of *Senegalia polyacantha*

		Leaves	Stem	Root
1	Colour	Green	Light brown	Dark brown
2	Odour	Mild	Sandy	Dry sandy with cocking sensation
3	Taste	tasteless	Slightly bitter and no after Taste	Slightly bitter with spicy after taste
4	Texture	smooth	Smooth	Smooth with scanty hair like stud

Plate 1. A. Whitethorn tree B. Macroscopy of *Senegalia polyacantha.* B1-Powdered leaves, B2- powdered stem B3-powdered root from left to right

The powdered of the Root, Stem and Leaves shows different behaviour when treated with different reagents such as Ethanol, Iodine Solution, 2M dilute HCL, 2M dilute HNO₃,

dilute H$_2$SO$_4$, NaOH, and Water as indicated in (Table 4).

As shown in (Plate 2). The powder microscopy, leaves and stem (*Senegalia polyacantha*) show the presence fragment of tissue including Vessels, fibre, Sclereids, starch grains, calcium oxalate crystals, lignified fibres, epidermal cells and fragment vascular tissues.

Table 4. Behaviour of Powdered Plant with Different Reagents

|	Root	Stem	leaves
Drug powder + ethanol	The powder settles down immediately. Dark brown	It settles down immediately. Light brown	It settles down slowly Light green
Drug powder + iodine solution	The powder floats Dark brown	It settles down slowly slowly Brown	It settles down slowly slowly Dark green
Drug powder + 2M dilute HCL	It settles down slowly Dark brown	The powder floats and then settles down slowly Brown	The powder floats until after shake Army green
Drug powder + 2M dilute HNO$_3$	The powder settles down. Dark brown	It starts settling down slowly Brown	The powder floats until shake Army green
Drug powder + dilute H$_2$SO$_4$	The powder settles down immediately. Dark brown	The powder settles down slowly. Light brown	The powder float even after shake Green
Drug powder + Naoh	The powder settles down slow. Dark brown	The powder settles down slow. Dark brown	The powder float until shake. Green
Drug powder + water	The powder settles down slowly Dark brown	The powder settles down slowly Reddish brown	The powder float Green

The transverse section of the plants' leaf (Plate 3) shows the presence and position lower epidermis, upper epidermis, vascular bundles, chlorenchyma, sclerenchyma and trichomes, the covering trichomes were simple, uniseriate, unbranched and unicellular with blunt apex and smooth walls.

The microscopic of T.S of stem (Plate 4) of the plant showed the position of epidermis, endodermis, cortex, vascular cylinder and trichomes. For stomatal observation the leaves indicate the type of stomata which is paracytic.
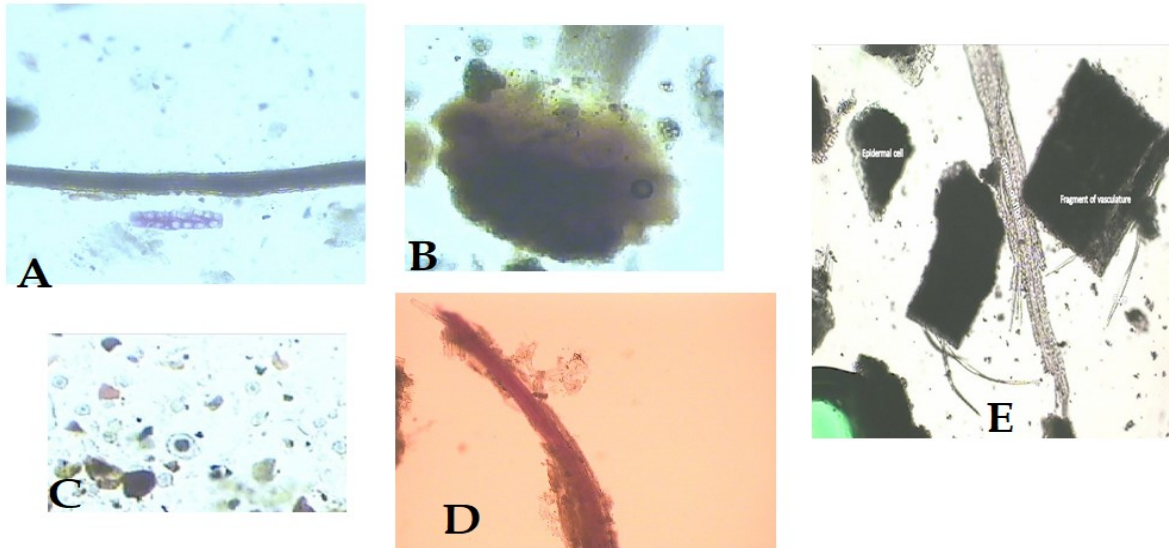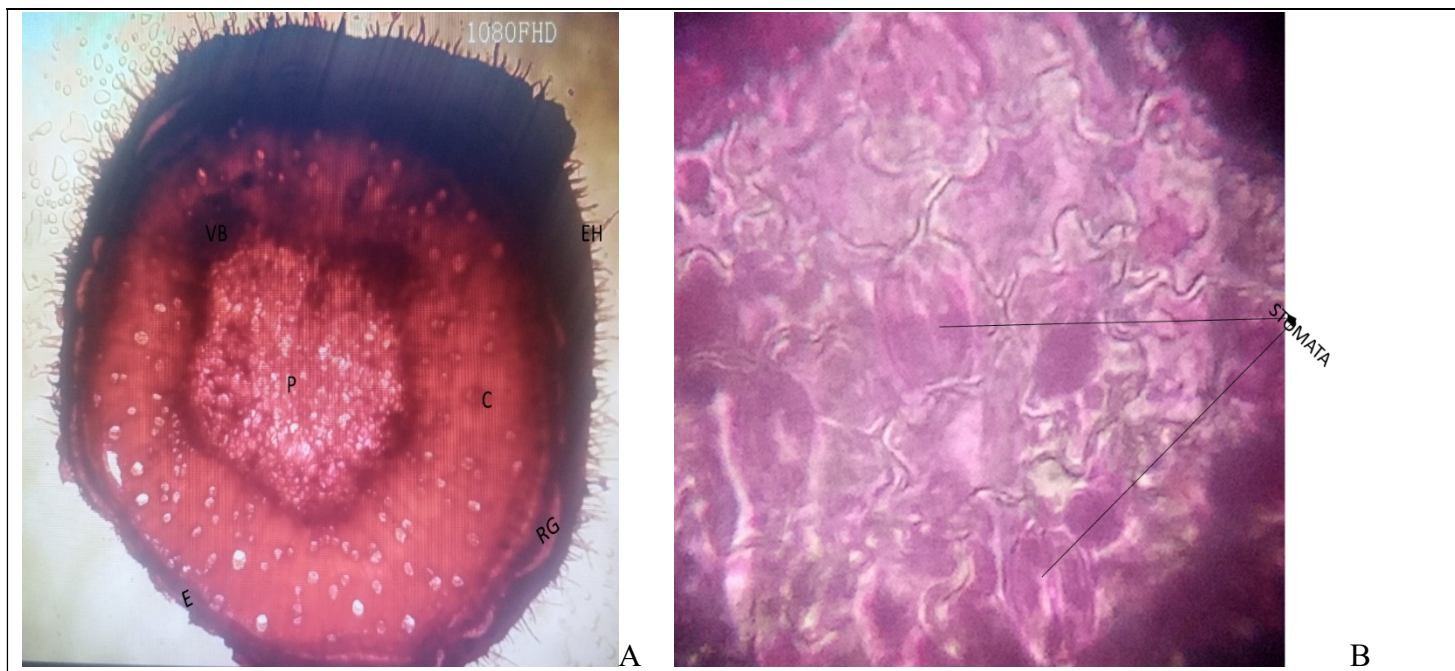
Plate 2. Powder microscopy of *Senegalia polyacantha* leaves and stems bark. A. Vessels and fibre (100x) B. Sclereids (100x) C. starch grains with calcium oxalate crystals (100x) D. lignified fibres (100x) E. epidermal cells & fragment vascular tissues. (100x)
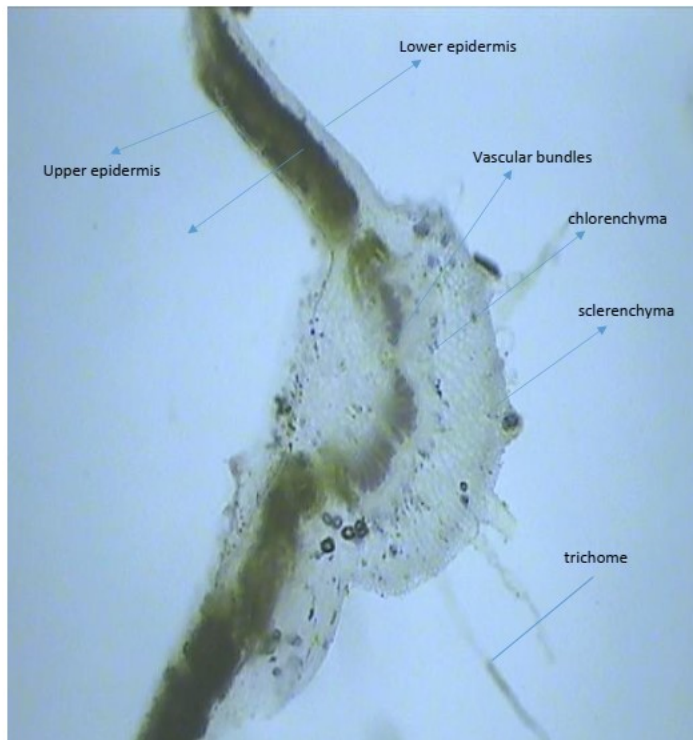
Plate 3. Photomicrograph of the Transverse Section of the Leaf of *Senegalia polyacantha* (Mag. ×400)

Plate 4. A. Transverse section of *Senegalia polyacantha* stem (100x) B. Stomata of *Senegalia polyacantha* (Mag. X400)

KEY :P=Pith, R=ridge, E=Epidermis, C=cortex, EH= Epidermal hair, VB=Vascular bundles

DISCUSSION

The survey result indicates that most of the respondents had no formal education and are of old age which shows the gradual disappearing of the knowledge of the plant to the upcoming generation. This is similar to the findings of Segun *et al.* (2018), who say ''traditional herbal practice is the preserve of the older population, even though it is not exclusive'' and this indicates that those with higher education didn't value the occupation among the respondents, which also matches the findings of (Tchatchedre *et al*., 2019) and (Kankara *et al*., 2015). The survey indicated that males dominated the occupation despite females being the highest patroniser's and this is similar to the findings of Teklehaymanot and Giday (2007) that says most traditional knowledge of medicinal plants in the family or community is passed from male parents to his first-born Son.

It was indicated from the survey that *S. polyacantha* is of medicinal importance among the indigenous people of Katsina State. Traditional singers used to chew the stem bark of the plant before singing for their sound to be very good. Qur'anic reciters especially in "Almajiri school" used to chew the stem and some even made it as their chewing stick for teeth cleaning and most importantly for voice refreshing. Those whose voice is low due to cold or throat-related issues were recommended to chew the plant's stem bark. It has been reported by one of the responders that some people used to chew the stem bark of the plant before appearing in court as they believed that the judge would take whatever came out of his mouth as true. The report by Kankara *et al*., (2015) shows that *Senegalia polyacantha* is used by Katsina state people for maternal issues and this supports our findings. Traditional midwives, parents, and herbalists recommend taking in the

macerated stem of *S. polyacantha* to pregnant mothers in their third trimester which will help with easy delivery and safety and also prevent long labor that may cause mother and infant to suffer. The use of plant for treatment of abdominal pain tallied with the research of Daffala *et al.* (2018) which shows the use of root and stem bark of this plant in treating stomach disorders. The stem bark and root bark of this plant is an important natural aphrodisiac plant that is safer than synthetic aphrodisiac drugs (Ajao *et al.*, 2018). Furthermore, Ajao *et al.* (2018) and Dash *et al.*, (2014) reported that the whole plant of *S. polyacantha* is used as a natural aphrodisiac plant. They research conducted by Mondal *et al.* (2013) reported that *S. polyacantha* is an important analgesic, anti-inflammatory, and antipyretic. Dash *et al.* (2014) also reported that the ground-dried barks are applied externally over local sores for quick healing. Orwa *et al.* (2009) reported the use of this plant for children who are restless at night. Adhikari *et al.* (2021) highlight the importance of this plant in the treatment of gastrointestinal and stomach-related ailments, leprosy, skin diseases, mouth and mucous problems, cough, diarrhea, dysentery, skin ulceration, and lesions, broken horns of cattle, disinfectant in ulcers, skin eruptions, and burns cases, and also in case of toothache and body ache, pains which support these findings.

Pharmacognostic standardization, which includes physicochemical evaluation, is intended for crude drug identification, authentication, adulteration detection, and quality control compilation. Standardizing *Senegalia polyacantha* for drug use is crucial because the plant is helpful in traditional medicine for treating certain conditions. A microscopic assessment of the plant material is crucial for the detection of source materials (Majid *et al.*, 2021). Powder microscopy is one of the simplest and cheapest methods to start with for establishing the correct identity of the source materials (Joshi *et al.*, 2018). A detailed study of macroscopical, microscopical, powder microscopy, organoleptic, and stomatal study of the plant and its powdered drug was done of stem bark, leaf, and root. This will help in the evaluation and identification of the plant from its closely related appearance. This study acts as a reliable aid for detecting adulteration.

CONCLUSION

This study has contributed knowledge and good awareness of the usage of *Senegalia polyacantha* in Katsina State, Northern Nigeria. The continued use of *Senegalia polyacantha* as a treatment for many ailments in the local populations appears to be the reason for the retention of this knowledge. A pharmacognostic evaluation and differentiation study was accomplished by systematic microscopic and macroscopic observations to establish the parameters for *Senegalia polyacantha*. The microscopic data showed discriminative inner morphological characteristics such as thin-walled fibres with clearly visible lumen and pointed ends, parenchyma cells that are thin-walled, and isodiametric with no intercellular spaces, with uniseriate trichome. The World Health Organization has emphasized the necessity of ensuring quality control of the raw materials used to make herbal medicines by applying appropriate guidelines and standards. This study will help in the authentication of the *Senegalia polyacantha* and ensure the reproducible quality of herbal products which will lead to the safety and efficacy of natural products

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