

Original Research Article

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Ethnobotany and Pharmacognosic Characterization of *Acanthospermum hispidum* (Asteraceae), A Medicinal Plant widely used in Traditional Medicine in the Central West Region (Burkina Faso)

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ABSTRACT

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Medicinal plants are an important source for the research of active molecules against diseases. The plants used in this setting are rich in therapeutic substances. This study aimed to collect the ethno-medical use of *Acanthospermum hispidum* in the Central West region from resource persons and to determine these pharmacognosic characteristics. A survey collected information on *Acanthospermum hispidum* using a sheet. The whole plant has been used for pharmacognosic characterization through histochemistry and biological activities. There was strong use of the plant in the Central West region. The majority of the people surveyed were men (76.40%). The histochemistry of *Acanthospermum hispidum* allowed the detection of phytochemical groups. Biological activities showed that the ethanolic extract had a good ability to trap free radicals, with a 50% IC of 21.46 ± 1.85 µg/mL for rat liver lipids. These results are probably a scientific source for the use of *Acanthospermum hispidum* as a medicinal plant in the Central West region. The high use of this plant could be explained for its wealth of secondary metabolites.

Introduction

Asteraceae or Compositae constitute one of the largest families of Angiosperms (Cronquist 1981), containing more than 1500 genera (25 000 known species) or nearly 10% of the total flora of the world (Verdi *et al.*, 2005). Although 98% of Asteraceae are herbaceous, shrubs, lianas, trees, there are also

some aquatic species. The main characteristic of this family is the presence of many flowers united in a capsule. The genus *Acanthospermum* includes annual herbaceous plants that are erect or prostrate. The leaves are simple, opposite, with dentate or entire margins, and the inflorescence is axial or terminal, with yellow flowers (Mallmann *et al.*, 2018).

Acanthospermum hispidum is a branched plant that can reach 0.6 m in height. The stems of this plant are covered with tufted hairs and small glandular hairs.

The leaves are elliptical, oval 1.5 cm to 7 cm long. When mature, *Acanthospermum hispidum* bears yellow flowers. Each head has 5-9 flowers; the petals of rays of about 1.5 mm are pale yellow. The flowers of the disc in the center of the head are sterile. Spiny fruits 5 cm to 10 cm long are flattened and triangular in shape. These fruits are covered with stiff hooked hairs and have either a pair of straight or curved spines at the top.

The ruffled and grouped appearance of the fruits on each head is an essential criterion for the identification of this species of plant (Gomathi *et al.*, 2013). These spines, arranged in the form of stars, constitute distinctive points of this species (Goodridge, 2007). *Acanthospermum hispidum* (DC), is a medicinal plant (El-Ghani 2016). It is used in traditional medicine in the Central West region for the treatment of several diseases.

The objective of this study was to determine the ethnomedicine of *Acanthospermum hispidum* in the Central West region and to elucidate these pharmacognosic features. Thus pharmacognosic tests and biology activities have justified this important use of *Acanthospermum hispidum* by the population of the Central West region for their health problems.

Materials and Methods

Laboratory equipment

Appliances

Scale (Radwag Poland), UV-Visible Spectrophotometer (epoch 251465, Biotek Instruments, USA), Steamer (Momment,

Beschickung, Loadig, Model 100-800), Rotary Evaporator (Büchi 461) with Vacuum Pump, Bain Marie (Büchi B-480, Switzerland), magnetic stirrer (Fisher Scientific, Topmix), sonicator (Elma Gemany), refrigerated centrifuge (Eppendorf, 5702 RH).

Glass

Column, Flask, Graduated cylinder, Erlenmeyer flask, Volumetric flask, Test tubes, Separating funnel.

Reagents

Sigma reagents (Steinheim, Germany): methanol, hydrochloric acid, chloroform, ether, lugo, mayer reagent, Physiological Solutions: Phosphate Buffer, Tris Buffer, Dimethylsulfoxide (DMSO), Sodium Hydroxide, Sodium Chloride, Potassium Chloride.

Consumables: Aluminum Foil, Surgery Kit, Porcelain Mortar, Microscope Gloves, Slides and Slides, Bleach, Blotting Paper, 96-Well Microplate, Micropipettes, Eppendorff Tubes, 90 ° Alcohol. They are all analytical grade.

Plant material

The entire plant of *Acanthospermum hispidum* was harvested in Reo (province of the sanguie). The plant has been identified at the Laboratory of Plant Ecology and Botany of University Ouaga I Pr Joseph KI-ZERBO. Specimens were deposited in the herbarium of the biodiversity laboratory under the identification code ID 16875.

To obtain extracts, the harvested plants were dried at the Laboratory of Biochemistry and Applied Chemistry (LABIOCA) at room temperature, at room temperature. Shelter from the sun, then the dry plant material was sprayed.

Ethnobotanical survey

Land of inquiry

The Central West region covers an area of 21,891 km², or 8% of the national territory (Ministère *et al.*, 2010). It is limited to the East by the Central Plateau, Central-South and Central regions, to the North by the Northern region, to the west by the Mouhoun region and South-West regions, and to South by the Republic of Ghana.

The Central West region is subdivided into 4 provinces, 4 urban communes, 38 departments, 34 rural communes and 563 villages. The provinces of the region and their capitals in brackets are the following: Boulkiemde (Koudougou), Sanguie (Reo), Sissili (Leo) and Ziro (Sapouy) (Ministère *et al.*, 2011). The chief town of the region is Koudougou and the chief towns of the provinces mentioned above constitute the urban communes (Ministère *et al.*, 2010).

Conduct of the investigation

The investigation consisted of going to the field with a recommendation. The interview process was semi-structured (Yelemou *et al.*, 2007) with traditional healers and herbalists. The interest of this survey was to record knowledge transmitted orally by persons holding knowledge inherited and/or revealed on the ethno-medicinal use of this plant.

The exchanges with the respondents were carried out in french and in local languages (Iyele, Moore, Dioula). The conversations were around the questions contained in the survey card.

The questions asked allowed to have information on the use of *Acanthospermum hispidum*, the method of preparation, the mode of administration, the pathologies treated, the type and the duration of the treatment.

Data processing

The herbaria of *Acanthospermum hispidum* have been realized and authenticated. The completed survey forms were processed using Sphinx V5 software to obtain certain parameters on the plant.

The usual value (UV) of treated disease for each use category was evaluated to show the importance that individuals place on *Acanthospermum hispidum* in the locality to treat a given disease. It is obtained by calculating the following ratio: $UV = \sum U/N$ Where U represents the number of times the species is cited for a use category (disease) and N the total number of informants (Sarr *et al.*, 2013).

We used the Informal Consensus Factor (ICF) that we re-adapted to characterize the species in five (5) categories of use: abdominal pain, eruptive fever, hepatobiliary disorders, microbial infections and other diseases (epilepsy, mental disorders, gonorrhoea, sexual impotence, hernia, joint pain, dental, fractures, pneumonia). It was used to estimate the variability of *Acanthospermum hispidum* uses. Its value varies between 0 and 1. It is obtained by using the following formula (Canales *et al.*, 2005).

$ICF = \frac{Nur - Nt}{(Nur - 1)}$ With Nur is the number of times the species is cited for a particular category of use and Nt is the total number of times that the species is used by all informants for this same category (Cheikhoussef *et al.*, 2011). Loyalty Level (LL) (Cheikhoussef *et al.*, 2011) highlights the importance that populations place on *Acanthospermum hispidum* for its role. It is calculated by the following formula:

$LL (\%) = \frac{Np}{N} \times 100$ Where Np is the number of citations of the species for a use category and N is the total number of uses for all categories.

Pharmacognosic characterization

Structure of the drug

The plant material (whole plant of *Acanthospermum hispidum*) after being dried under the required conditions, was sprayed. This powder has been the subject of macroscopic and microscopic observations.

Histochemical characteristics

Histological sections were performed on the stems and roots of *Acanthospermum hispidum* to identify secondary metabolites in plant tissues.

Double carmino-green coloration

Carmino-green double staining was performed on sections of *Acanthospermum hispidum*. For this purpose, the sections were soaked in a solution of sodium hypochlorite and then rinsed three times. They were then dipped in a coloring solution of carmino-green Mirande for 5 minutes. The stained sections were rinsed with distilled water and then mounted between slide and coverslip in a drop of glycerin for observation under a microscope (Nacoulma 1996).

Detection of secondary metabolites

Detection of flavonoids

Detection of flavonoids in plant tissues was achieved by mounting the sections in a 5% NaOH solution. The presence of flavonoids (flavones) in the tissues is indicated by a yellow or orange-yellow coloring.

Detection of tannins

The detection of tannins in the tissues of *Acanthospermum hispidum* was performed by mounting the sections in a solution of FeCl_3

(1%). The appearance of blackish blue or blackish green in the tissues, indicates the presence of tannins.

Detection of alkaloids

A brown precipitate in the cell vacuoles using lugol as a reagent on the sections indicates the presence of alkaloids.

Extraction

Extraction by ethanol maceration

The whole plant powder of *Acanthospermum hispidum* was mixed with ethanol (in the proportions 5%) and stirred for 24 hours. After filtration under reduced pressure, the filtrate obtained was frozen and then lyophilized.

Extraction by aqueous decoction

In a flat-bottomed flask was mixed *Acanthospermum hispidum* powder with distilled water in the proportions 1:5. The mixture was homogenized and boiled under reflux for 30 minutes. The contents of the flask, after being allowed to warm, were spilled in centrifuge tubes. The supernatant obtained was concentrated, frozen and freeze-dried.

Inhibition of lipid peroxidation of rat tissue liposomes

The potential of both forms of extracts to protect biomembranes from four rat organs (liver, kidney, pancreas and lungs) against ferrous Fe^{2+} ion and sodium nitroprusside was evaluated respectively according to the methods described by Su *et al.*, (Su *et al.*, 2009) with some modifications. The percentages of inhibition were determined at different concentrations and then reported on a curve to derive the inhibitory concentration 50% (IC 50%). These tests were performed in

triplicate independently. The results were expressed as mean \pm standard deviation.

Trapping hydrogen peroxide

Hydrogen peroxide has a relatively long life and is capable of causing damage far from its place of production. It diffuses easily through the cell membrane. Under oxidative stress conditions, it can give rise to the hydroxyl radical in the presence of metal ions. The ability of ethanolic and aqueous extracts of *Acanthospermum hispidum* to trap hydrogen peroxide was evaluated according to the method described (Ogbunugafor *et al.*, 2012). The reaction mixture consisting of 100 μ L of extract and 100 μ L of hydrogen peroxide (100 mM) was incubated for 10 minutes at room temperature. Residual hydrogen peroxide was measured at 230 nm against a blank containing only the phosphate buffer. The activity of the hydrogen peroxide trapping extract was expressed as a percentage of trapping hydrogen peroxide relative to the control without extract. The experiment was carried out in triplicate (independent tests) and ascorbic acid was used as a reference substance.

Statistical analysis tools

The results were expressed as the mean value of several independent experiments \pm standard deviation. The MS Excel software was used to obtain the graphs of the survey results. For statistical analysis, Graph Pad Prism software (version 5.0) was used to obtain standard curves and graphs, percentages of inhibition, averages and standard deviations.

Results and Discussion

Results of the survey

The survey allowed to exchange with 89 herbalists and traditional healers. These people

consisted mainly of men, including 68 men. It was found that *Acanthospermum hispidum* is an herb that is widely used in traditional medicine in the Central West region against several diseases including mainly abdominal pain, eruptive fever, hepatobiliary disorders, microbial infections and other diseases.

Analysis of the table revealed that for the usual value (UV), the greatest value was recorded in the treatment of bacterial infections with calcination as a method of preparation (0.68). The decoction of *Acanthospermum hispidum* administered orally against abdominal pain presented the highest informant consensus factor (Table 1). As for the level of fidelity, a low value was observed at the level of the treatment of other diseases (2.21%) whereas the strongest one was noted at the level of the treatment of the microbial diseases with *Acanthospermum hispidum* (Table 1).

Results of pharmacological characterization

Image of the drug

Photo (1a and b) shows the macroscopic appearance and the microscopic aspect of the plant drug. The appearance of the vegetable powder makes it possible to optimize the yield of the extractions.

Histochemical characteristic

The histochemistry of *Acanthospermum hispidum* is shown in Photo 2. The numbers 1, 2, 3, 4, 5, 6, of the photos respectively indicate the epidermis, the collenchyme, the medullary parenchyma, the sclerenchyma, the phloem, and the xylem of the stem of *Acanthospermum hispidum*.

The plant has a secondary tissue structure with a remarkable presence of hair on the aerial

part. Flavonoids have been observed in the conductive vessels; tannins, they have been located in the epidermis and conducting vessels (photo 2). As for the alkaloids, they were found in trace at the level of the medullary parenchyma of the stem and the root (photo 2).

Results of biological activities

Inhibition of lipid peroxidation of rat tissue liposomes

The ethanolic extract of *Acanthospermum hispidum* gave a good ability to inhibit the peroxidation of the membrane lipids of the various organs compared with the aqueous extract with $31.33 \pm 1.2 \mu\text{g/mL}$ as the inhibitory concentration of the peroxidation of 50% of rat liver lipids. The ascorbic acid used as the reference compound had a better activity compared to the extracts with respectively $5.5 \pm 1 \mu\text{g/mL}$, $5.03 \pm 1.2 \mu\text{g/mL}$, $0.8 \pm 0.0 \mu\text{g/mL}$ and $10.5 \pm 0.9 \mu\text{g/mL}$, for inhibition of peroxidation of membrane lipids of the liver, lungs, kidneys, pancreas (Figure 1).

Result of trapping hydrogen peroxide

The ethanolic extract of *Acanthospermum hispidum* showed better ability to trap hydrogen peroxide compared to the aqueous extract.

Ancestral knowledge is an important basis in the search for solutions against the evils that undermine our societies. For years, African people have been resorting to herbalists and traditional healers when they have health problems (Makhanya 2012). These people, who are knowledgeable, tend to take care of medicinal plants. *Acanthospermum hispidum* is an herb widely used in the Central West region. Out of a total of 126 people surveyed (herbalists and traditional health practitioners),

89 recognized *Acanthospermum hispidum* for treatment. This high rate of use of *Acanthospermum hispidum* (70.63%) could be justified by the large number of diseases that the plant treats, which in turn can be explained by the quality and diversity of the active molecules contained in this plant (Yuan *et al.*, 2016).

Phenolic compounds such as tannins and flavonoids have been demonstrated in the tissues of *Acanthospermum hispidum*. Flavonoids have been found in the collenchyme of the stem and root. The presence of flavonoids in the tissues of this herb is in agreement with the work of Ouattara (Ouattara *et al.*, 2011) which indicates that the aerial parts of *Acanthospermum hispidum* are rich in flavones. The presence of flavonoids in plant tissues is an indicator of the plant's defense mechanism against multiple aggressions (Ally *et al.*, 2017). Phenolic compounds in general, and flavonoids in particular, are involved in plant defense mechanisms in the face of environmental threats such as temperature fluctuations, and UV radiation (Kulbat 2016). Flavonoids and terpenes are synthesized in plant tissues in response to infections (Guenne 2014). On the other hand, alkaloids and tannins, thanks to their toxic and astringent effect, defend the plant against insects and repel ruminants. The presence of these secondary metabolites such as flavonoids highlighted in histochemical sections may confirm the results of biological activities.

The antioxidant capacity of the ethanolic extract of the whole plant of *Acanthospermum hispidum* could highlight a capacity of this form of extract to act within the membrane lipid bilayer or on the lipophilic surfaces of lipoproteins and prevent the initiation of lipid peroxidation caused by biological radicals (Mothana *et al.*, 2009b).

Table.1 Results of the survey

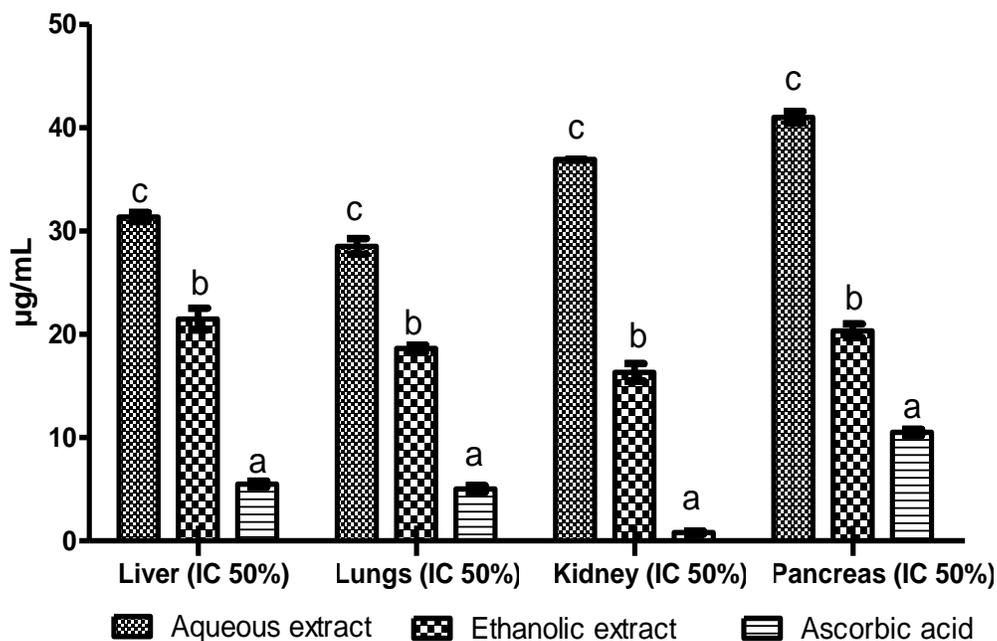
Mode of preparation	Mode of application	Usual value	Factor Consensus Informant	Loyalty Level (%)
Treatment of hepatobiliary disorders (Mallmann <i>et al.</i>, 2018), (Mothana <i>et al.</i>, 2009a)				
Decoction	Oral	0.35	0.58	20
Infusion	Oral	0.25	0.42	
Treatment of abdominal pain (Lemonica and Alvarenga 1994), (Mihigo <i>et al.</i>, 2015), (Mallmann <i>et al.</i>, 2018)				
Infusion	Oral	0.21	0.25	28,35
Decoction	Oral	0.64	0.75	
Treatment of eruptive fever (Edewor and Olajire 2011), (Chinedu, Arome, and Amed 2014; Herekrishna <i>et al.</i>, 2010)				
Infusion	Oral	0.25	0.26	26,11
Decoction	Oral	0.62	0.74	
Treatment of microbial infections (El-Ghani 2016), (Onguéné <i>et al.</i>, 2014)				
Calcination	Application on the skin	0.68	0.67	33.34
Infusion	Oral	0.15	0.15	
Decoction	Oral	0.19	0.18	
Treatment of other diseases (El-Ghani 2016),				
Infusion, Decoction, Inhalation and Calcination	Oral, bath, application to the skin, inhalation	0.09	0.05	2.21

Fig.1 Central West Region, Sannguie Province (survey area)

[https://fr.wikipedia.org/wiki/Centre-Ouest_\(Burkina_Faso\)#/media/Fichier:Burkina_Faso_-_Centre-Ouest.svg](https://fr.wikipedia.org/wiki/Centre-Ouest_(Burkina_Faso)#/media/Fichier:Burkina_Faso_-_Centre-Ouest.svg)(accessed August 03, 2019)

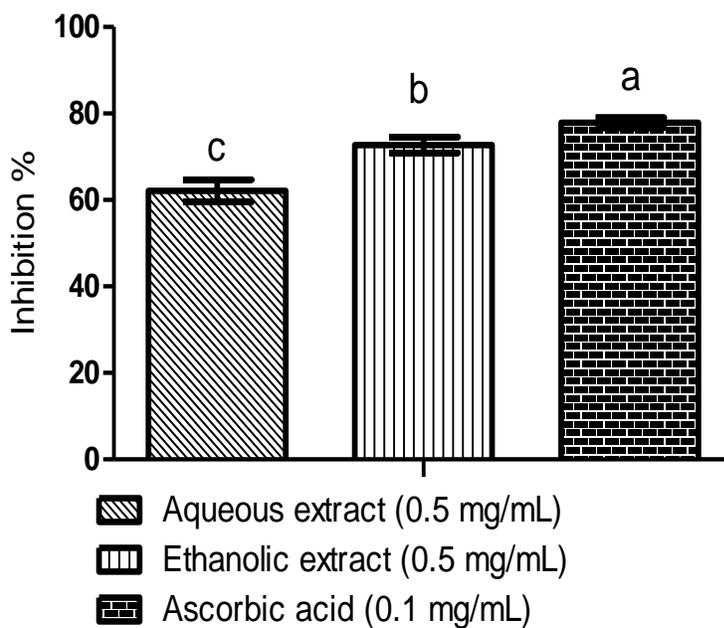


Fig.2 Inhibition of lipid peroxidation of liposomes from rat tissues



A significant difference is considered for $p = 0.05$

Fig.3 Result of trapping hydrogen peroxide



A significant difference is considered for $p = 0.05$

Photo.1 Macroscopic (a) and microscopic (b) aspects of the plant drug

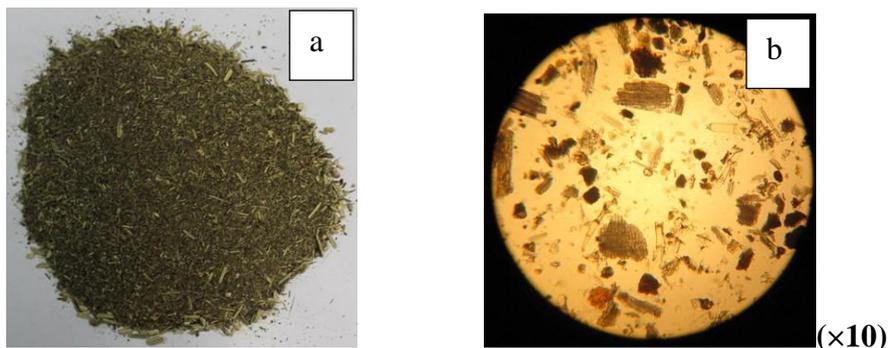
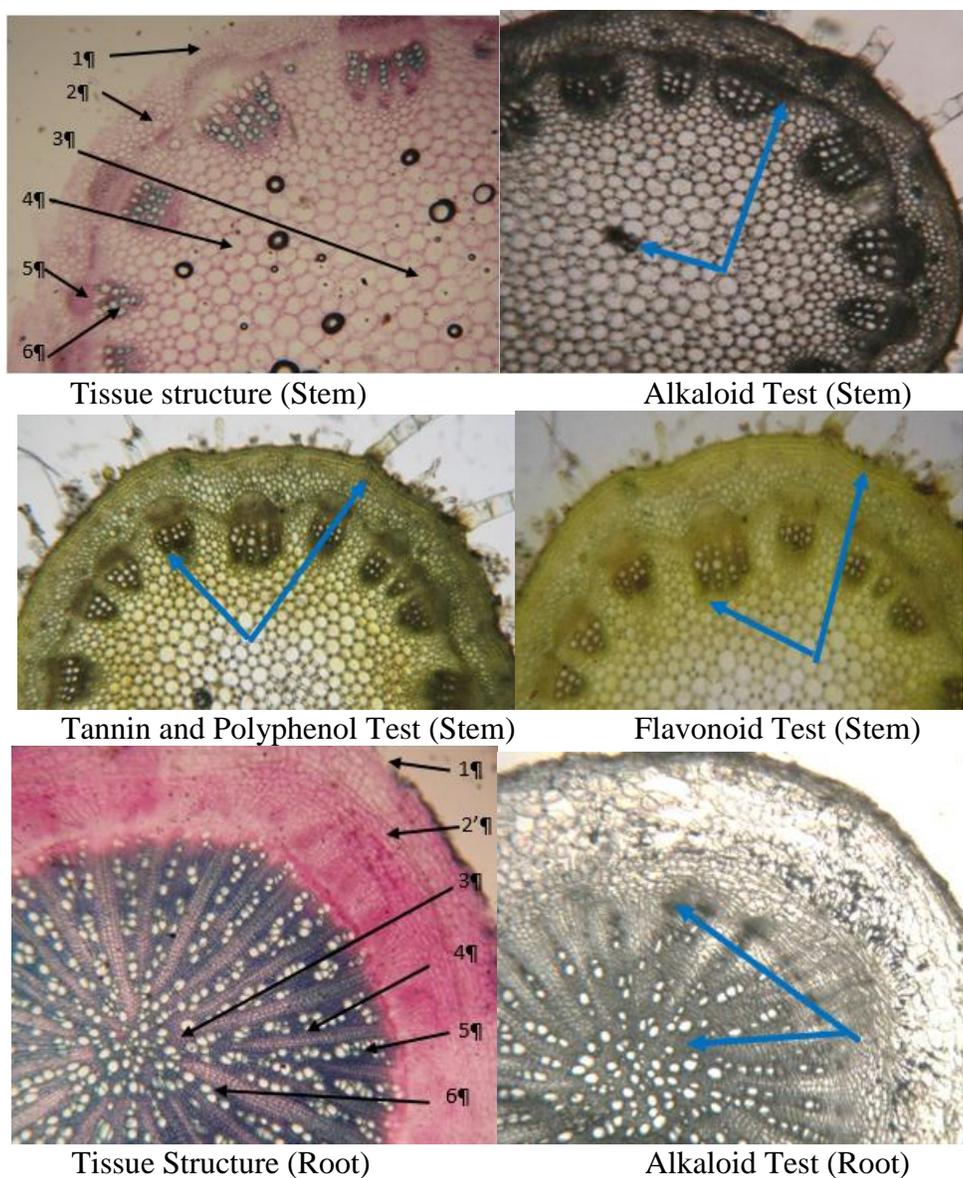
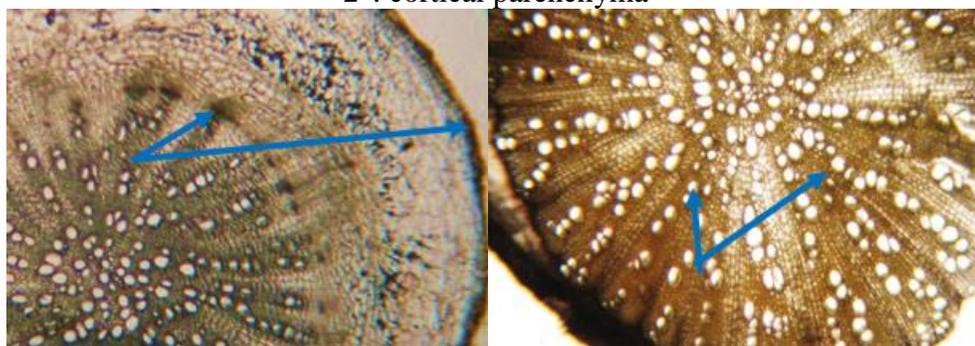


Photo.2 Histochemical sections of *Acanthospermum hispidum* DC



2': cortical parenchyma



Tannin and polyphenol test (Racine) Flavonoid test (Racine)

The ethanolic extract also trapped in this study the hydrophilic radicals (hydroxyl radical), explaining at the same time that this extract would trap the primary radicals present in the aqueous phase (cytosol), or in the polar sites of membrane phospholipids (Fardet 2017). All these arguments would argue in favor of this strong use of this herb in traditional medicine against various.

In conclusion, the macroscopic and microscopic aspects of the vegetable powder have made it possible to obtain satisfactory extraction yields. Phytochemical screening confirmed the tissue structure and localization of secondary metabolites in the tissues of *Acanthospermum hispidum*. Extracts of *Acanthospermum hispidum* play a chemoprotective role against oxidative stress. By their reducing power against the reactive species, the extracts have an antioxidant activity. The alkaloids detected in plant tissues in addition to phenolic compounds highlight the richness of natural substances of *Acanthospermum hispidum*. Each group of compounds highlighted is a therapeutic potential. This probably justifies the use of this plant in traditional medicine against diseases.

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