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STUDY OF THE PHARMACOLOGICAL PROPERTIES OF THE THREE PLANTS USED IN MEDICINE

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SUMMARY

Paveta crassipes, Terminalia avicennioides and Zanthoxylum zanthoxyloides are medicinal plants well-known to traditional therapists from Burkina Faso. The leaves and roots are used in decoction to treat malaria, fever and jaundice. The present study aims to study them properties pharmacological of these three plants used in the Burkinabe traditional medicine. To do this, the method by diffusion in environment agar and the method of dilution in liquid medium have been used to test antimicrobial activities. The antioxidant activity of these extracts was evaluated by the DPPH (1,1-Diphenyl-2-Picrylhydrazyl) method. Extracts methanolic of *Terminalia avicennioides* and hydromethanolic of *Paveta crassipes* have exhibited very high (2.17) and high (1.97) antioxidant activity indices, respectively. The results of the antifungal activity showed that extracts of the leaves of *Terminalia avicennioides* specifically the methanolic and methanol-water extracts, showed greater zones of inhibition (20 mm and 19 mm respectively) for *Candida albicans*. The hydromethanolic and aqueous extracts of *Paveta crassipes* exhibit weak antibacterial activity with zones of inhibition (10 mm and 11 mm respectively) for *Escherichia coli*, higher than those of others extracts. These interesting results justify the use of these plants in the treatment of the diseases infectious.

KEYSWORDS: Plants medicinal, Anti-fungal, Antimicrobial, Antioxidant, Burkina Faso.

INTRODUCTION

Traditional medicine remains the main recourse of a big majority of the populations to solve their health problems. This because it constitutes on the one part an important cultural heritage, but on the other part for limited financial means of the populations compared to conventional products.[1,2] Due to the high cost of available drug associated with the emergence of multi-resistant germs, doctors and organisms of health are more interested in the values and effectiveness of treatments by them plants.[3] The square importance occupied by medicinal plants as most important substrate of the recipes of medicine and pharmacopoeia traditional is not more at demonstrate. They are an important natural source of biomolecules likely of reveal countless properties pharmacological drugs capable of curing or circumscribing a large number of pathology human.[4] Many scientific studies have been carried out in order to study appearance botanical and therapeutic of these plants. They wanted to integrate their medicinal properties into a modern healthcare system by exploiting their active ingredients.[5.6] About 80% of the population world and more than 90% of the population of the developing countries use it for healthcare first need.[7]

Faced with these various obstacles of a financial nature and microbial resistance to available drugs, it is essential to seek other substances. These new substances must be both effective and have broad spectrum of action.[8] One of the strategies for this research is to explore the plants

used in traditional medicine. It is in this context that our study was conducted to identify the sources of antibacterial, antifungal and antioxidants molecules. The object of this work aims to study the pharmacological properties of *Paveta crassipes, Terminalia avicennioides and Zanthoxylum zanthoxyloides*, three plants used in the traditional Burkinabe medicine.

MATERIAL AND METHOD

Three plant species were used for this study: *Paveta crassipes (leaves), Terminalia avicennioides (leaves) and Zanthoxylum zanthoxyloides (bark)*. The samples were collected from the herbarium of the Centre National de Recherche et de Formation sur le Paludisme (CNRFP) in Ouagadougou (Burkina Faso).

Five bacterial strains including two (2) references and three (3) clinical havebeen used in our study for the study of sensitivity: *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 9027, *Enterococcus faecalis*, *Staphylococcus aureus* and *Micrococcus luteus.* Three strains fungal have summer used in this study for the test of sensitivity. He is of strains of *Candida albicans*, *Aspergillus niger*, and *Botrytis cinerea.*

Preparation of crude extracts

The powders were used for extraction, with solvents of different polarity. For each part of plants, three types of extracts were prepared: crude organic extracts, crude aqueous extracts and alkaloids extracts.

Organic crude extracts

These extracts have summer prepared at leave of the solvents organic polarities growing at know the dichloromethane, methanol, hydro-methanol. The extractive protocol presents a process extraction successive using of way increasing these solvents. The extraction is carried out on the same quantity of powder and the leaching is carried with a volume of solvent corresponding to at least 10 times the weight of the powder used. Thus, an intake of 50 g of vegetable powder was used for the extraction with dichloromethane. The powder was loaded into the column of open chromatography for a maceration of at least 16 hours. The exhaustion was made with the same solvent. The leachate was filtered through cotton and concentrated under a Buchi® R254 rotary evaporator. The concentrate is dispensed into the tubes that have been exposed to ambient laboratory temperature to complete solvent evaporation. The residue (marc) was weighed and yield was calculated. The marc obtained after extraction with dichloromethane was dried over paper aluminum laboratory temperature. The dry pomace is then loaded in the column of chromatography opened for a second extraction with methanol by maceration.

After 16 hours, the percolation was made to obtain a solution methanol. The latter was concentrated using a rotary evaporator with the addition of a small amount of water distilled. The fully evaporated methanol leaves the extracts in an aqueous solution, which is distributed in lyophilisation vials. The vials were placed in the -20°C freezer. To ensure only once that the solvent likely to disturb the freeze-drying has completely evaporated and to reduce the freeze-drying time by pre-freezing the solutions otherwise go. The vials containing extracts of frozen solutions were mounted on a lyophilizer in operation for 72 hours. The residues or extracts methanol crudes were recovered, grouped and weighed in order to of calculate the yield. The mark, after extraction to methanol has summer kept in the column of chromatography opened and used for a third methanol extraction 50% (v/v in distilled water). The macerate obtained after 16 hours of time was concentrated using an evaporator rotary until elimination total of methanol. The solution aqueous extracts has summer distributed in of the vials of freeze-drying. After freezing of the solutions, them vialswere mounted in a freeze-dryer for lyophilization of the extracts. The crude methanolic residues or extracts obtained have summer recovered, grouped together and weighed for the calculation of yield.

Aqueous crude extract

It is of a kind extraction that brings us a little closer of the traditional preparation in the environment of the traditional pharmacopoeia. In fact, according to information from the field surveys, decoction is the mode of preparation of traditional medicine for all the selected plants. The preparation of aqueous extracts will allow us to reproduce as closely as possible the traditional products used in their treatment. In the Laboratory, 20 g of vegetable powder was maintained in 100 ml of boiling water for 30 minutes. After cooling, the solution aqueous extract has summer filtered through cotton. The filtrate was then distributed in vials of freeze-drying. These last have summer placed to freezer for 24 hours. After freezing, they were mounted in the freeze-dryer for the freeze-drying of the extracts. Recovered and grouped together in a single bottle, the aqueous crude extract is weighed in order to calculate its yield.

Total alkaloids extracts

Within the frame of our study, the total alkaloids were searched in all selected plants by applying the classical extraction protocol of alkaloids. It is based on the principle of the differential solubility of these molecules which can exist in the form of bases or salts depending on the pH of the medium. The extraction was done on a small quantity vegetable powder. Thus, 50 g of powder was previously moistened with 28% ammonia. This alkalinization will transform the alkaloids present in the form of basic alkaloids in order to make them extractable with the organic solvent, which is dichloromethane. The powder alkalized has summer bet at macerate in a column of chromatography during 16 hours of time about. The phase dichloromethane obtained after leaching has summer submitted at a system extraction liquid-liquid. Thereby it was acidified

with H_2SO_4 3% to pH two to three. The phase aqueous acid has summer recovered and alkalized with ammonia to pH nine to ten. With dichloromethane, an extraction was carried out. The organic phase obtained was subjected to dry concentration on a rotary evaporator. The residues obtained will be crude alkaloids. Therefor 10g of powder were used for this extraction.

Concentration of crude extracts

It is a process for evaporating and condensing extraction solvents in the medium of a rotating vacuum evaporating flask. Thus, depending on the boiling temperatures of the different solvents, each leachate was separate from its extraction solvent. The dichloromethane and alkaloid concentrates were dried at the air free at room laboratory temperature while the methanolics, hydromethanolic were then subsequently freeze-dried.

Lyophilization of crude extracts

The freeze-drying is a procedure extraction of the water frozen raw extracts. This drying is carried out avoiding pass to the liquid state, by sublimation, i.e. the passage directly from the solid state to the gaseous state. This is realized under empty with a temperature of the extracts normally lower at -10°C. It makes it possible to obtain extracts that are easily soluble in water and which, after addition water, have the same characteristics as the extracts of origin.

Extraction yield

the yield extraction has summer calculated for each type extract in applying the formula next:

$$R = \frac{masse\ of\ extract}{masse\ of\ powder} \text{ x } 100$$

Thin layer chromatography (TLC)

Principle

TLC is a fast, easy-to-use analytical technique for the separation and identification of the compounds. She rests principally on the phenomenon adsorption and consists in a separation of the substances chemicals in function of their affinity with respect to two phases: a phase stationary solid (alumina, silica gel, etc.) and a mobile phase liquid (eluent) incorporated by a system of solvents.

Operating mode

A gram (1g) of each extract has summer weighed and share in labeled hemolysis tubes. Then, one ml of adequate solvent (ethanol for organic extracts and water ultra pure for extracts aqueous) in them tubing.

Using a 25 µl micropipette, a quantity of 10 µl of the sample of analysis was taken for each extract and this procedure is repeated three times and deposited on the edge of a plate of CCM. The plaque is afterwards soaked in an eluent contained in a well-closed tank pending migration. The plates were then dried and then observed under UV visible then revealed with 20% sulfuric acid and the colors corresponding to the extracts appeared.

Evaluation of pharmacological properties

Extract sensitivity tests

The standard Kirby-Bauer method or disc method was used to study the sensitivity of bacteria to of the extracts of our plants such that described by the CLSI (*Clinical and laboratory Standards Institute*).[9]

Preparation of the inoculum

The bacteria were cultured in the Muller Hinton broth (Liofilchem, Italy) for 18 to 20 hours so that they are in exponential phase of growth. A colony of each culture was then suspended in saline solution of sodium chloride (NaCl 0.9%) at a turbidity equivalent to that of the standard 0.5 of the McFarland scal. This suspension, whose optical density (OD) at 625 nm must be Between 0.08 and 0.10 corresponds approximately to 1 to 2 $x10^8$ CFU/ml[10] will serve of inoculum for the after.

The study of the antifungal activity of the extracts was carried out using the technique of diffusion in an agar medium. The culture medium for this test is the Muller Hinton (MH) medium. Three strains of *Botrytis cinerea*, *Aspergillus niger* and *Candida albicans* were used and the incubation was carried out at 37°C for 24 to 48 hours. Nystatin discs (100 IU) (Liofilchem ,Italy) were used as a standard in the diffusion method.

Preparation of extracts and discs

The extracts have summer diluted in the dimethylsulphoxide (DMSO) at 100 mg/ml then sterilized at ugly of filtered millipore at syringe (0.22µm). Ten microliters (10 µl) of each prepared extracts were carefully deposited on six mm discs of filter paper (Whattman No.1) previously sterilized. The discs are left for a few minutes at the temperature ambient under the hood.

Preparation of Culture Medium

The dehydrated Muller Hinton agar (MHA) medium (Liofilchem, Italy) was suspended in distilled water at 36 g/l then heated in a water bath until complete dissolution. The pH has summer adjusted at 7.3 ± 0.1 then the medium is sterilized at the autoclave at 121 °C for 15 minutes. It was then cooled to 45-50°C then poured into sterile Petri dishes 90 mm of diameter so that the thickness did not exceed 5mm.

Seeding, disc deposition and incubation

The previously prepared inoculums were seeded by seeding in petri dishes. The discs were placed on the surface by pressing lightly so that they adhere well to the agar. Antibiotics discs (Gentamicin, Ciprofloxacin, Ampicillin or Tetracycline) were also placed in the boxes. The discs were placed at a minimum of 15 mm from the periphery of the dish and so that the zones of inhibition did not overlap. The dishes were then incubated at 37°C for a total period of 24 hours. Antimicrobial activity was estimated by measuring the diameter of inhibition around certain discs. Each trial is said again in less time.

Determinations of MICs and MBCs

The Minimum Inhibitors Concentrations (MIC) and them Minimum Bactericidal Concentrations (MBC) were determined in using the macromethod technique with the broth Muller Hinton.[11] The MIC is defined as the minimum concentration of extract for which no growth visible to the naked eye is observed. As for the MBC, it is defined as being the minimum concentration which eliminates 99.99% of the microorganisms of the starting inoculum. Extracts and inoculum were prepared as previously described to determine MICs and MBCs.

Preparation of the medium

Muller Hinton broth (MHB) was prepared by solvent 13 g of dehydrated medium in one liter of distilled water. The pH is adjusted then the broth is sterilized in an autoclave at 121°C for 15 minutes.

Determination of the Minimum Inhibitory Concentration (MIC)

A dilution by cascade of each extract has summer realized starting from a concentration of 1.25 mg/ml to 10 mg/ml. The initially prepared MHB was left sterile in haemolysis tubes at a rate of one ml per tube, afterwards of each concentration and one ml of bacterial inoculum were added. So for each strain and each extract, the following tubes were used: A control tube (Mueller Hinton broth + extract), a test tube (Mueller Hinton broth + extract + inoculum) and a control tube were prepared for each test. The tubes are gently shaken and then incubated at 37° C for 24 hours, after which the inhibition is assessed by the absence of turbidity in the tube.

Determination of the Minimum Bactericidal Concentration (MBC)

Tubes with concentrations greater than or equal to the MIC were used to determine the MBC. In order to determine the CMB, 100 µL of broth are taken from the tubes showing no growth and inoculated by spreading on a new agar. After 18 to 24 hours of incubation in the oven, the dishes showing no visible growth constitute the MBC.

Study of antioxidant properties (DPPH test)

DPPH (1,1-Diphenyl-2-Picrylhydrazyl) is a free radical purplish stable which absorbs at 517 nm. When it comes in to contact with an antioxidant compound, it reduced and then changes color by turning yellow or pale orange. The measure of a compound's antioxidant effectiveness (ability to look at free radials) to make up the extent of the decrease in purple color. This decrease measured at 517 nm is proportional to the antioxidant power of the compound. To test the antioxidant capacity of our extracts, we adopted the protocol of Mensor et *al.*[12] with of light changes. The lyophilisates were first diluted in the methanol at one mg/ml. A 96 well microplate was prepared by introducing 100 µl of methanol into each well, the first row of well receiving 160µl.

Forty microliters (40 µl) of each stock solution of extract previously prepared are added to the 160 µl of diluent of the first row of well, then cascade dilutions are carried out in the plate by transferring 100 µl each time in the next well and so on. In well now containing 100 µl of different dilutions extracts, we quickly added a methanolic solution of DPPH at 100 µg /ml. A concentration range from 0.781 µg /ml to 100 µg/ml was this prepared for each extract, acid ascorbic (Vitamin C) and BHA (Butylhydroxyanisole) prepared under the same conditions as the extracts were used as control antioxidants. Witnesses made up DPPH alone and controls consisting of methanol were also included in the plate. Each extract or witness has been prepared in triplicate. The plaque is incubated for 15 mn at darkness and at the temperature ambient then the absorbances of the wells are measured at 517 nm using a plate reader (µQuant™, BioTek Instruments, Winooski, USA). The results are recorded and then processed with the KCJunior software1-31-5. The percentage inhibition was obtained by the following formula.

$$Percentage\ inhibition = \frac{Abs\ DPPH - Abs\ sample}{AbsDPPH} \times 100$$

Abs DPPH = absorbance from DPPH + ethanol only
Abs sample = absorbance of the sample (extract or vitamin C or BHA)

The percentages of inhibition for each extract made it possible to determine the concentration of extract reducing 50% of DPPH (CI_{50}) from the curve giving the percentage of inhibition as a function of the concentration of extract. The lower the IC_{50} value, the greater the antioxidant activity big.

To better appreciate this activity, the activity index antioxidant (IAA) according to Scherer and Godoy[13] was calculated at the help of the formula next.

$$IAA = \frac{[DPPH]\ finale}{CI_{50}}$$

IAA = Antioxidant Activity Index
[DPPH] final = Final concentration of DPPH in the reaction medium
CI_{50} = Concentration of extract reducing 50% of DPPH.

RESULTS AND DISCUSSIONS

Extraction yields

The extraction yields vary from 0.15% to 18.33% in the leaves of *Pavetta crassipes*, from 0.11% to 19.6% in the leaves of *Terminalia avicennioides* and from 0.07% to 8.23 % in the barks of *Zanthoxylum zanthoxyloides* (Table I). The highest extraction yields are obtained in the water, hydromethanolic and the methanol. Respectively for the leaves of *Terminalia avicennioides*, the leaves of *Pavetta crassipes* and them barks of *Zanthoxylum zanthoxyloides*. However, these lower extraction yields are all achieved with the totals alkaloids. These low yields could be explained by the fact that this extraction is more specific that what relatively low total alkaloids contents could contain.

Indeed, this extraction is based on the selective depletion system which eliminates some chemical groups as the extraction continues.

Phytochemical characteristics

Table 1 shows the presence of alkaloids, flavonoids and saponasids in them extracts dichloromethane, methanols, methanols-water, water and total alkaloids from *Paveta crassipes, Terminalia avicennioides and Zanthoxylum zanthoxyloides*.

Saponosides are absents in all extracts of *Paveta crassipes extracts*. However, there is a strong presence of alkaloids in the methanolic extracts of *Paveta crassipes* and *Terminalia avicennioides* and in hydromethanolic extracts of *Terminalia avicennioides*. An absence total of the alkaloids, flavonoids and saponins is observed with the dichloromethane extracts. However, these are all three present in the methanolic extracts of *Zanthoxylum zanthoxyloides.* A lot studies have shown the presence of alkaloids, flavonoids and saponins in the extracts of these plants. The study of Mann et *al.*[14] and those of Koudouvo et *al.*[15] have show the presence of alkaloids, flavonoids and saponins in the leaves and barks extracts of *Paveta crassipes* and *Zanthoxylum zanthoxyloides*. Moussa Baba et *al.*[16] showed the antifungal properties of *Terminalia avicennioides* leaves extracts rich in alkaloids, flavonoids and saponins. In India, recent work on the barks of *Zanthoxylum zanthoxyloides*, has given different varieties of flavonoids which are said to have antitumor activity.[17] Most alkaloids are considered complex molecules that can be highly toxic even at low doses.[18]

Table 1: Index of the activity antioxidant

Plants	DCM	MeOH	MeOH-Water	Water	Alc
PC	1.5	0.59	1.97	1.03	0.36
TA	0.5	2.17	1.33	0.59	0.3
ZZ	1.76	0.5	0.43	0.32	0.4

PC= Paveta crassipes TA= Terminalia avicennioides ZZ= Zanthoxylum zanthoxyloides
DCM= Dichloromethane MeOH = methanol MeOH-Water = methanol-water Alc = alkaloid.

Biological tests

Antibacterial activity

The results show that the extracts of *Terminalia avicennioides* leaves draw zones of inhibition with more or less wide diameters depending on the extracts used. Table 2 shows that the zones of inhibition around the reference antibiotics are clearly greater than those of the extracts.

The results of the sensitivity tests of the plant extracts of *Terminalia avicennioides* show that the zones of inhibitions produced by the methanolic-water and aqueous extracts are greater than those obtained with the extracts of dichloromethane, methanol and total alkaloid plant of *Paveta crassipes* and *Zanthoxylum zanthoxyloides***.** However, the methanol-water extract is the most active extract.

Furthermore, studies carried out on the hydromethanolic extracts of *Terminalia avicennioides* and *Paveta crassipes* have shown good antiplasmodial and antioxidant activity.[19]

However, the different activities of extract are related to the concentration of these compounds. In this study**,** them hydromethanolic and aqueous extracts contain more than compounds (alkaloids). These extracts remain more concentrated in active matter and therefore more active than dichloromethane, methanol and total alkaloids extracts. Alkaloids exhibit many properties namely bacterial, parasitic, fungal and anticancer inhibition.[17,19] Despite this, most alkaloids are considered complexes molecules that can have high toxicity, even at low doses.[20]

Table 2: Diameters of areas inhibition.

Strains	Plants	DCM mm	MeOH mm	MeOH-Water mm	Water mm	Alc mm	AR mm
Enterococcus faecalis	PC	8	7	8	8	8	25
	TA	9	8	8	7	8	
	ZZ	7	8	6	6	9	
Escherichia coli ATCC 25922	PC	8	7	11	10	8	23
	TA	8	7	8	6	8	
	ZZ	7	6	6	8	8	
Pseudomonas aeruginosa ATCC 9027	PC	7	8	8	8	8	22
	TA	6	8	7	6	8	
	ZZ	8	10	8	8	9	
Staphylococcus aureus	PC	7	9	7	6	9	19
	TA	7	7	9	6	9	
	ZZ	7	7	9	8	7	

Micrococcus luteus	PC	8	7	8	8	7	18
	TA	9	9	7	9	8	
	ZZ	7	8	8	8	8	

PC= Paveta crassipes , TA= Terminalia avicennioides, ZZ= Zanthoxylum zanthoxyloides
DCM= Dichloromethane, MeOH = methanol, MeOH-Water = methanol-water
Alc = total alkaloids, AR= reference antibiotic (Tetracycline and chloranphenicol)

Antifungal activity

Table 3 show that the extracts present in the *Terminalia avicennioides* plant exhibit zones of inhibition with more or less wide diameters depending to the extracts used. The extracts of *Terminalia avicennioides* leaves precisely the methanolic and methanol-water extracts show larger zones of inhibition (20 mm and 19 mm) than the other extracts of dichloromethane, water and total alkaloids of the leaves and barks respectively of *Paveta crassipes* and *Zanthoxylum zanthoxyloides*.

Table 3: Diameters of area inhibition.

Strains	plants	DCM mm	MeOH mm	MeOH-Water mm	Water mmm	Alc mm	AR mm
Aspergillus Niger	PC	10	11	11	6	8	
	TA	8	8	8	8	6	20
	ZZ	9	8	8	6	8	
Candida albicans	PC	8	6	8	8	6	
	TA	10	20	19	8	8	24
	ZZ	8	6	8	6	9	
Botrytis cinerea	PC	8	8	6	6	8	
	TA	6	6	8	6	6	20
	ZZ	6	6	8	6	6	

PC= Paveta crassipes; TA=Terminalia avicennioides; ZZ= Zanthoxylum zanthoxyloides
DCM=Dichloromethane; MeOH =methanol; MeOH-Water = methanol-water
Alc = alkaloid; AR= reference antibiotic (Nystatin).

Determination of MICs and CMBs

The methanolic and hydromethanolic extracts of *Terminalia avicennioides* revealed a greater fungal inhibition (Table 3) than bacterial inhibition of strains of Gram-negative bacteria compared to strains of Gram-positive bacteria (Table 2). However, the previous studies have show that the Gram-positive bacteria are more sensitive to medicinal plants extracts than Gram-negative bacteria.[21] Gram negative bacteria have lipopolysaccharides sheets that constitute a barrier to the penetration of antibacterial molecules.[22]

The MBC/MIC concentration ratio: Table 3 shows that there is more fungal activity with an MBC/MIC ratio=2mg/ml than bacterial activity. According to Saffidine[23], when the MBC/MIC ratio=1 or 2, there is a bactericidal effect.

Antioxidant activity of extracts

The anti-radical activity of our extracts is expressed in IC_{50}. For each extract the IC_{50} is deduced from the corresponding calibration line.

Among the five extracts of the three plants, the methanol-water extract of *Paveta crassipes*, the methanolic extract of *Terminalia avicennioides* and the dichloromethane extract of *Zanthoxylum zanthoxyloides* represent the more active extracts with an IC_{50} of the order of 12.69 µg/ml, 11.49 µg/ml and 14.2 µg/ml respectively. However, the other four extracts from each plant show much lower anti-radical activity (Table 4).

Table 4: Activity anti radical in µg/ml.

plants	DCM	MeOH	MeOH-Water	Water	Alc
PC	50	42.7	12.69	24.27	69.44
TA	50	11.49	18.67	42	83.33
ZZ	14.2	50	51.3	60	57.5

PC= Paveta crassipes; TA=Terminalia avicennioides; ZZ= Zanthoxylum zanthoxyloides
DCM=Dichloromethane; MeOH =methanol; MeOH-Water = methanol-water
Alc = alkaloid; AR= reference antibiotic (Nystatin).

The indices of antioxidant activities vary of 0.36 to 1.97 with *Paveta crassipes extracts*, from 0.30 to 2.17 with the extracts of *Terminalia avicennioides* and from 0.32 to 1.76 with the extracts of *Zanthoxylum zanthoxyloides*. The methanolic extracts of *Terminalia avicennioides* and the hydromethanolic of *Paveta crassipes* present respectively very high antioxidants activities (2.17) with the IC_{50} which was 11.5 µg/ml and

high (1.97) including an inhibitory concentration of 12.69 µg/ml. On the contrary, the alkaloid extracts of these two plants confer low antioxidant activities. Indeed, antioxidant activity is considered low when IAA<0.5, moderate when it is between 0.5 and 1, high between 1 and 2, and very high when IAA>2.[13] These results are close to those reported by Omonkhua et *al*.[24] with CI_{50} is equal 13 µg/ml.

CONCLUSION AND PERSPECTIVES

The study evaluated the antibacterial and antifungal properties of extracts of *Paveta crassipes, Terminalia avicennioides and Zanthoxylum zanthoxyloides.* These plants are commonly used to Burkina Faso in case of malaria and of diarrhea. The methanolic extract of *Terminalia avicennioides* and methanolic-water extract from *Paveta crassipes* show very high antioxidant activity indices (2.17) and (1.97) respectively. In all the extracts of *Paveta crassipes* it is the methanolic-water and water extracts which are active on *Escherichia coli and its* methanolic extract is active on *Pseudomonas aeruginosa*. For *Terminalia avicennioides, its* methanolic and methanolic-water extracts are more active on *Candida albicans* and *Aspergillus niger*. *Zanthoxylum zanthoxyloides,* methanolic extract is active against *Pseudomonas aeruginosa*. All of the phytochemical and pharmacological results of the study constitute a scientific basis for traditional use. Continuing the study on the confirmation of other strains means identifying and characterizing the fractions or molecules in the active extracts. The study should be extended to other pathogens responsible for infectious diseases of parasitic, bacterial and viral origin.

REFERENCES

1. Koné D. Enquête ethnobotanique de six plantes médicinales maliennes: extraction, identification d'alcaloïdes, caractérisation, quantification de polyphénols : étude de leur activité antioxydante [Doctorate dissertation]. Metz: Université Paul Verlaine, 2009.
2. Ladoh YCF, Dibong SD, Nyegue MA, Djembissi TRP, Lenta NB, Mpondo ME et al. Activité antioxydante des extraits méthanoliques de *Phragmanthera capitata* (Loranthaceae) récoltée sur *Citrus sinensis*. Journal of Applied Biosciences. 2014 ; *84*:7636-43.
3. Akoua-Koffi C, Guessend N, Gbonon V, Fayekette AYH, Dosso M. La méticillino-résistance de *Staphylococcus aureus* isolés à Abidjan (1998–2001): un nouveau problème en milieu hospitalier. Médecine et Maladies Infectieuses, 2004; 34(3): 132-36.
4. Sourabié TS, Nikiema JB, Lega I, Nacoulma OG, Guissou IP. Etude *in vitro* de l'activité antibactérienne d'extraits d'une plante de la pharmacopée burkinabé: cas d'*Argemone mexicana* L. (Papaveraceae). International Journal of Biological and Chemical Sciences, 2010; 4(6): 2009-2016.
5. Biyiti LF, Meko'o DJL, Tamzc V, Amvam-Zollo PH. Recherche de l'activité antibactérienne de quatre plantes médicinales camerounaises. Pharm. Med. Trad. Afr, 2004; 13: 11-20.
6. Mpondo EM, Yinyang J, Dibong SD. Valorisation desplantes médicinales à coumarines des marchés de Douala Est (Cameroun). Journal of Applied Biosciences, 2015; 85: 7804-23.
7. Dibong SD, Mpondo EM, Ngoye A, Kwin NF. Plantes médicinales utilisées par les populations bassa de la région de Douala au Cameroun. International Journal of Biological and Chemical Sciences, 2011; 5(3): 1105-1117.
8. Sanon S, Azas N, Gasquet M, Olivier E, Mahiou V, Barro N et al. Antiplasmodial activity of alkaloid excerpts from *Pavetta crassipes* (K. Schum) and *Acanthospermum hispidium* (DC), two seedlings used in traditional medicine in Burkina Faso. Parasitol Res, 2003; 90: 314-17. Doi:10.1007/s00436-003-0859-9.
9. CLSI. Performance Standards for Antifungal Disk Diffusion Susceptibility Testing of Filamentous Fungi, Informational Supplement. 1st ed. CLSI guidelines M51-S1. Wayne, PA: Clinical and Laboratory Standards Institute, 2009.
10. McFarland J. The nephelometer: an instrument for estimating the number of bacteria suspensions. Journal of the American Medical Association, 1907; 49(14): 1176-78.
11. NCCLS. Methods for antimicrobial dilution susceptibility tests for bacteria that grow aerobically. 5th ed, vol 20. Approved standard M7A5. NCCLS, Wayne PA, 2000.
12. Mensor LL, Menezes FS, Leitão GG, Reis AS, Santos TCD, Coube CS et al. Criblage d'extraits de plantes brésiliennes pour l'activité antioxydante par l'utilisation de la méthode des radicaux libres DPPH. Recherche en phytothérapie, 2001; 15(2): 127-30.
13. Scherer R, Godoy HT. Antioxidant activity index (AAI) by the 2,2-diphenyl-1-picrylhydrazyl method. Food Chemistry, 2009; 112: 654-58.
14. Mann A, Ifarajimi OR, Adewoye AT, Ukam VS, Udeme EE, Okorie II et al. In long live antitrypanosomal effects of some ethnomedicinal plants from Nupeland of north central Nigeria. Afr J Tradit Complement alternate Med, 2011; 8(1): 15-21.
15. Koudouvo K, Karu SD, Iboudo DP, Kokou K, Essien K, Aklikokou K et al. In vitro antiplasmodial activity of crude excerpts from Togolese medicinal plants. Asian Pacific Journal of Tropical Medicine, 2011 Feb; 4(2):129-32. Doi:10.1016/S1995-7645(11)60052-7.
16. Moussa-Baba, F. (1999). Antifungal activities of seven western african combretaceae-used in traditional medical.
17. Karmakar I, Haldar S, Chakraborty M, Chaudhury K, Dewanjee S, Haldar PK. Regulation of apoptosis through bcl-2/ bax proteins expression and DNA

damage by *Zanthoxylum alatum*. Pham Biol, 2015 June; 1: 1-6.
18. Zongo C. Etudes phytochimique et pharmacologique de quelques plantes communement utilisées en Afrique de l'Ouest pour lutter contre les infections parasitaires et microbiennes [Thèse de doctorat]. Ouagadougou : Université de Ouagadougou, 2012.
19. Ouattara LP, Sanon S, Mahiou-Leddet V, Gansane HAS, Baghdikian B, Traoré A et al. In vitro antiplasmodial activity of some medicinal plants of Burkina Faso. Parasitol Res, 2014 jan; 113(1): 405-16. doi:10.1007/s00436-013-3669-8.
20. Ogwal-Okeng JW, Obua C, Anokbonggo WW. Acute toxicity effects of the methanolic extract of *Fagara zanthoxyloides* (Lam) root-bark . African health Sciences, 2003 Dec; 3(3): 124-26.
21. Zongo C, Akomo EFO, Savadogo A, Obama LC, Koudou J, Traore AS. In vitro antibacterial properties of total alkaloids extract from *Mitragyna inermis* (Willd) O. Kuntze, a west African traditional medicinal plant. Asian Journal of Plant Sciences, 2009; 8(2): 172-177.
22. Franche A. Amphiphiles azobenzéniques: potentiel et relations structure-activité pour la lyse cellulaire [Doctorate dissertation]. Liège : Université de Liège, 2019.
23. Saffidine, K. Etude analytique et biologique des flavonoïdes extraits de *Carthamus caeruleus* L. et de *Plantago major* L [Doctorate dissertation]. Sétif : Ferhat Abbass University, 2018.
24. Omonkhua AA, Cyril-Olutayo MC, Akanbi OM, Adebayo OA. Antimalarial, hematologic, and antioxidant effects of methaolic extract of *Terminalia avicennioides* in Plasmodium berghei-infected mice. Parasitology research, 2013; 112(10): 3497-503.