Antimicrobial Activity of Seed and Leaf Extracts of *Mucuna Pruriens* on Some Common Bacterial and Fungal Pathogens

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Abstract: ***Mucuna pruriens*** **(Fabaceae) is widely known as velvet bean. Phytochemical screening and antimicrobial activities of seed and leaf of the plant were extracted using methanol, ethanol, acetone, chloroform and aqueous as solvents and tested against six clinical pathogens;** ***Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, Proteus vulgaris, Candida albicans*** **and** ***Aspergillus niger*****. The susceptibility test and MIC were determined using agar well dilution method. The qualitative phytochemical screening of the plant parts indicated a high content of flavonoids, tannins, alkaloids, saponins and carbohydrates in the seed while it indicated high content of terpenoids, glycosides and protein in the leaf. Quantitative phytochemical constituents revealed 0.702± 0.005mg and 0.964± 0.052 mg of total Phenols compound and total flavonoid content of 34.95± 4.18 and 43.52± 1.10mg of the leafs and seeds respectively. All plant extracts showed significant activity (p< 0.05) against all the test organisms except** ***Candida albicans*****. The results revealed the extracts of the plant with methanol, ethanol, acetone and chloroform solvents showed more antimicrobial activities against test organisms with zone of inhibition ranging from 28mm-8mm compared to the aqueous extract at varied concentrations. The minimum inhibitory concentration (MIC) assay showed that acetone had the lowest MIC values ≤ 31mg/ml for the test organisms followed by methanol, aqueous, chloroform and ethanol while the minimum bactericidal/fungicidal concentration assay showed that only the methanol seed extract of the plant at a concentration of 500mg/ml was able to exhibit bacterial activity against** ***Escherichia coli*** **while all other concentrations of the plant extract did not exert a bactericidal effect against the test organisms. The phytochemicals seen in** ***Mucuna pruriens*** **revealed it possess antimicrobial properties. Thus, the plant is a potential potent antimicrobial agent which should be greatly encouraged and used in treatment of infections caused by the organisms that showed activity to its extracts.**

Keywords**: Agar well dilution, Antimicrobial activity,** ***Mucuna pruriens*****, phytochemical analysis.**

I. INTRODUCTION

Medicinal plants have been used for ages as remedies for human diseases, and have served a new source of biologically active chemical compounds as antimicrobial agents (Mbajiuka *et al*., 2014). In developed countries, regardless of recent formulations of effective conventional drugs, the treatment of diseases and other ailments with herbal remedies are still very popular (Ojo *et al*., 2014).

Several synthetic antibiotics are used in the treatment of infectious and communicable diseases (Murugan and Mohan, 2011) but synthetic chemicals which are used as therapeutic agents has some questionable side effects such as disrupting the natural intestinal micro flora (Hidayathulla *et al*., 2011), thus, depriving the benefits of these microbes to human body. This has led to a developing interest in considering the alternatives for their replacement (Yerra *et al*., 2005). On this basis, the essential oils and extracts of many plants have been prepared and tested for their antimicrobial activities, resulting in the accumulation of large number of reports in literatures concerning these properties (Salau and Odeleye, 2007).

Despite the several thousands of medicinal plant species around the globe, only a small portion has been investigated both phytochemically and pharmacologically (Mbajiuka *et al.*, 2014). Although antibacterial activity of medicinal plants has also been reported (Viji and Murugesan, 2010), since they contain numerous biologically active chemical constituents. It has been estimated that 14-28% of therapeutic compounds gotten from higher plants were discovered after investigating the ethno-medical use of the plants (Ncube *et al*., 2008).

Mucuna pruriens is a tropical legume known as velvet bean, belonging to the family Fabaceae (Ojo *et al*., 2014). It is among the well-known medicinal plants in Africa and Asia, and contains more than 200 indigenous drug formulations (Eze *et al*., 2017). Traditionally *M. pruriens* is used as herbal drugs for managing male infertility, cure of ailment and commonly used as carminative, hypotensive and hypoglycemic agent. It has also been shown to have anti-parkinson and neuroprotective effects, which may be related to its anti-oxidant activity (Lampariello *et al*., 2012). Report shows the seed are of potential medicinal importance and could be used to treat Parkinson's disease (Lampariello *et al*., 2012).

Medicinal plants are consistently explored in order to provide an alternative to conventional antibiotics, which will reduce cost and side effects. However, due to the increasing rate of the commonly used antibiotic resistance, the search for newer, more effective, affordable, easily available and accessible antimicrobials are continuously investigated. Thus, this research is aimed at evaluating the phytochemical constituents

and antimicrobial activities of seed and leaf extract of *M. pruriens* on some clinically important microorganisms.

II. MATERIALS AND METHODS

Collection and Identification of test organisms

The test organisms used include bacteria; *Staphylococcus aureus, Pseudomonas aeruginosa, Proteus vulgaris* and *Escherichia coli* and the fungi; *Candida albicans* and *Aspergillus* species. The isolates were obtained from the Federal Medical Center, Yenagoa. Bacterial test organisms were subcultured onto nutrient agar and incubated at 37^{O}C for 24 hours. After which the individual organisms were subcultured on different media; Eosin Methylene Blue (EMB) agar for Mannitol Salt agar, MacConkey agar. Gram staining technique and biochemical tests as described Madigan *et al*., (2012) was used for identification. *Candida albicans* and *Aspergillus niger* were grown on Potato Dextrose Agar (PDA) supplemented with gentamycin to prevent bacterial growth. *Candida albicans* and *Aspergillus niger* were incubated at 25^{O}C for 3 days and 7 days respectively.

Collection and Identification of plant materials

Fresh green leaves and pods of *Mucuna pruriens* were collected from Ojoto, Idemili South Local Government Area in Anambra state. The leaves and pods of *Mucuna pruriens* were identified by Dr. Daniel Awomukwu of the Department of Biology, Faculty of Science, Federal University Otuoke, Bayelsa State,

Processing of plant materials

The leaves of the plant were washed thoroughly for 3 times with running water and then dried under sunlight for 5days and homogenized to a fine powder using a mechanical grinder, pods obtained were thrashed to obtain mature seeds, washed and dried for same period as leaves and homogenized to fine powder also using a mechanical blender.

Extraction of plant material

Different organic solvents; methanol, ethanol, acetone, chloroform and aqueous as solvents were used for the extraction of bioactive compounds. The seed and leaf powders (10g) of *Mucuna pruriens* were first extracted with petroleum ether for defatting using a soxhlet extractor. The defatted powdered sample of *Mucuna pruriens* were dried for 24 hours and successfully extracted with chloroform, ethanol, methanol, acetone and distilled water in a soxhlet apparatus. The extracts obtained were completely evaporated (Green, 2004). The concentrated extracts were used for testing of the antimicrobial activity.

Phytochemical Screening of Seed and Leaf of Mucuna pruriens

This was carried out using qualitative phytochemical analysis and quantitative phytochemical analysis

Qualitative Phytochemical Analysis

Qualitative phytochemical analysis involved tests for flavonoids, tannins, carbohydrates/ glycosides, saponins, resins, terpenoids and alkaloids, these tests were carried out using standard methods (Roopashree *et al*., 2008, Trease and Evans, 2001)

Quantitative Phytochemical Analysis

Quantitative Phytochemical analysis involved determination of Total Phenolic Content, Tannin content, Flavonoids content and monomeric anthocyanin. Total phenolic were determined using Folin-Ciocalteu reagent (FCR) as described by Velioglu *et al.* (1998), with slight modifications. Tannin content in each sample was determined using insoluble polyvinyl-polypirrolidone (PVPP), which binds tannins as described by Makkar *et al*. (1993). The flavonoids content was determined according to the method described by Kumaran and Karunakaran (2006) with slight modifications. Monomeric anthocyanin contents of the plant extracts were measured using a spectrophotometric pH differential protocol described by Giusti and Wrolstad (2001) and Wolfe *et al.,* (2003), with slight modifications.

Antimicrobial testing

Antibacterial assay

A gram of each crude extract was dissolved in 4 ml of 20% dimethylsulfoxide (DMSO) to obtain a concentration of 250 mg/ml of the extract, and then serially diluted in two folds to obtain the following extract concentrations: 250, 125, 62.5 and 31.25 mg/ml. The antibacterial activities of the plant extracts on isolates were determined using agar well dilution method. The inoculum was standardized for a susceptibility test, $BaSO_4$ (Barium tetraoxosulphate (IV) acid turbidity standard, equivalent to a 0.5 McFarland standards used was prepared as described in NCCLS (NCCLS, 2010). From the stock of 500mg/ml extract, two-fold serial dilutions were made to 250,125, 62.5, and 31.25 mg/ml. Each labeled Mueller Hinton agar plate was uniformly inoculated with a test organism by streaking the plate surface in a form that lawn growth could be observed. A sterile cork borer of 6mm diameter was used to make 5 wells on the medium in each plate. A 30µl of the 5 different extract concentrations were dropped into each well using a micropipette and tested for each organism. All antibacterial assays were performed on duplicate plates. The inoculated plates were kept in the refrigerator for 1 hour to allow the extracts to diffuse into the agar (Atata, 2003). The Mueller Hinton agar plates were incubated after 24 hours at 37°C. After overnight incubation, the diameters of the zones of inhibitions obtained were measured. A 30µl of 60µg/ml of gentamycin was used as positive control while 30µl of 2.5% DMSO was used as a negative control.

Antifungal activity testing

Turbidity of the inoculum was measured and adjusted to 0.5 McFarland densities, corresponding to that with 10^8CFU/ml. This standard suspension was used for agar diffusion assay (CLSI, 2006). Ketoconazole (10 mcg) was used as positive control whereas 2.5% DMSO was used as negative control. The diameter of the zone of inhibition were obtained for the two plates having the same concentration of the extract against a particular microorganism, and the average used.

Determination of minimum inhibitory Concentration

The minimal inhibitory concentrations (MICs) of the extracts on the bacterial isolates were determined by macro broth dilution techniques following the recommendation of the Clinical and Laboratory Standard Institute (CLSI, 2015). One gram of the extract was dissolved in 1ml of 20% DMSO the extract concentration of 250mg/ml, different serial dilutions were made from this stock solution in tubes of 1 ml sterile Mueller Hinton broths to get 125mg/ml, 62.5 mg/ml, and 31.25mg/ml. An overnight nutrient broth culture of the bacterial test isolate was standardized to 0.5 McFarland turbidity. Different dilutions of the suspension were made in a sterile normal saline to get a final inoculum concentration of 106 CFU/ml. Then 1 ml of this adjusted inoculum was added to each tube of the Mueller Hinton broth containing different concentration of the crude extract. Each tube was mixed and incubated at 37^0C for 24hours (Nweze and Onyishi, 2010). This experiment was done in duplicate for all the bacterial isolates. A tube of Mueller Hinton broth containing only the 1ml suspension of the isolate without extract and the tubes of Mueller Hinton broth containing different concentrations of the extract without the isolate were used as controls. The tubes were examined after 24hrs incubation. The MIC of the extract was taken as the lowest extract concentration that completely inhibited the growth of the bacterial isolates in the tubes.

Determination of minimum bactericidal concentration

Equal volume (5ml) of the various concentration of each extract and Mueller Hinton broth were mixed in tubes to make up 10ml of solution. 5ml of McFarland standard of the organism suspension was added to each tube (Shahidi-Bonjar, 2004). The tubes were incubated aerobically at 37°c for 24 hours. Two control tubes were maintained for each test organism. These included tubes containing extract without inoculum and the tube containing the growth medium and inoculum. The MBC was determined by sub culturing the test dilutions on Mueller Hinton Agar and further incubated for 24 hours. The lowest dilution that yielded no single bacterial colony was taken as the Minimum Bactericidal Concentration (Akinyemi *et al*., 2005). This was carried out for some of the extracts with high antimicrobial activity and some of the highly sensitive organisms.

Statistical Analysis

All experiments were done in duplicate and the data thus obtained were reported as mean ± standard error of mean. The statistical analysis was done using analysis of variance at 95% confidence level using Graph Pad PRISM Version 5.01 (Chao-Hsun *et al.*, 2010).

III. RESULT

Table 1 shows the identification of the test organisms used.

Table 2 shows the qualitative phytochemical constituent of *Mucuna pruriens, which* revealed the presence of important phytochemical constituents. Flavonoids, tannins, alkaloids saponins and carbohydrates were the major phytochemical constituents present in the seed extracts in relative abundance. While flavonoids, tannins, glycosides and proteins were the major phytochemical constituents present in the leaf extracts in relative abundance.

Table 3 shows quantitative phytochemical analysis of *Mucuna pruriens*. The amount of total phenolics was 0.702±0.005 and 0.964±0.052mgGAE/mg of dry plant leaf and seed extracts of *Aspilia africana* respectively. The total flavonoid content was 34.95±4.18 and 43.52±1.10 rutin equivalents/g dry weight plant leaf and seed extract of *Aspilia africana* respectively.

Table 4 shows the zones of inhibition of the positive control: Ketoconazole used against fungal test organisms.

Table 5 shows the zones of inhibition of the positive control: Gentamycin used against bacterial test organism. Zones of inhibition produced by the positive control were larger than the zones produced by the extracts.

Both the methanol leaf and seed extracts showed activity against all bacterial test organisms, with the seed extracts having the largest zone of inhibition with diameter of 27mm against *E. coli* at a concentration of 500mg/ml and leaf extract having the largest zone of inhibition of 14mm ($P< 0.05$). *P. aeruginosa* was inhibited by the seed having the largest zone of inhibition with diameter of 15mm and the leaf having the highest zone of inhibition with diameter of 12mm both at concentrations of 500mg/ml. *S. aureus* was also inhibited by methanol extracts with the seed having the largest zone of inhibition with diameter of 15mm and the leaf having the largest zone of inhibition with diameter of 12mm both at concentrations of 500mg/ml. The extract also showed activity against *P. vulgaris* with the seed extract having the largest zone of inhibition with diameter of 21mm and the leaf extract having the largest zone of inhibition with diameter of 15mm both at concentration of 500mg/ml ($P< 0.05$). The methanol extract also showed activity against *A. niger* with zone of inhibition of 15mm at 500mg/ml while it failed to inhibit the growth of *C. albicans* as shown in *Figure 1*.

The ethanol extracts of the seed and leaf of *M. pruriens* showed activity against *E. coli* with zones of inhibition of 15mm as the largest zones at a concentration of 500mg/ml. Only the ethanol extract of the seed was able to inhibit the growth of *S. aureus* with 20mm as the largest zone of inhibition at concentration of 500mg/ml. The ethanol extracts of *M. pruriens* failed to inhibit the growth of *P. aeruginosa*

and *C. albicans* and only the ethanol leaf extract inhibited *P. vulgaris* having a zone of inhibition of 10mm as the largest zone at a concentration of 500mg/ml (P< 0.05) as shown in *Figure 2.*

Both the seed and leaf extracts showed activity against *E. coli* at all concentrations, while *S. aureus* was inhibited only by the leaf extract with the largest zone of inhibition having a diameter of 15mm at a concentration of 500mg/ml but did not show activity for the seed extract. *P. vulgaris* was inhibited by both the seed and leaf extracts at all concentrations with the largest zone of inhibitions having diameters of 18mm and 26mm for seed and leaf respectively at concentrations of 500mg/ml. Seed extract failed to inhibit growth of *P. aeruginosa* but was inhibited by the leaf extract with the largest zone of diameter having diameter of 14mm (P< 0.05). Acetone extract did not show any activity towards the fungal test organisms as shown in *Figure 3.*

The chloroform seed extract failed to inhibit all the test organisms, while the leaf extract only inhibited *E.* coli; with the largest zone of inhibition having a diameter of 19mm at a concentration of 500mg/ml, *S. aureus*; with the largest zone of inhibition having a diameter of 13mm, *P. vulgaris* with the largest zone of inhibition having a diameter of 15mm and *A. niger* with the largest zone of inhibition having a diameter of 18mm all at concentrations of 500mg/ml (P< 0.05). Acetone extracts of *M. pruriens* did not show activity against *C. albicans* as shown in *Figure 4.*

The aqueous seed extract did not show activity against the test organisms. The aqueous leaf extract inhibited *E. coli* with the largest zone of Inhibition having a diameter of 15mm at concentration of 500mg/ml, *S. aureus* inhibited with the largest zone of inhibition having a diameter of 15mm, *P. vulgaris* inhibited with the largest zone of inhibition having a diameter of 17mm, *P. aeruginosa* inhibited with the largest zone of inhibition having a diameter of 14mm, all at a concentration of 500mg/ml (P< 0.05) as shown in *Figure 5.*

Table 6 shows the minimum inhibitory concentration (MIC) values of extract of *Mucuna Pruriens* against the test organisms. The lowest MIC was obtained with acetone extracts against all bacterial species, whereas *Candida albicans* was not inhibited by the extracts of *Mucuna pruriens.* Growth of *Aspergillus niger* was only inhibited at very high concentrations of the extracts.

Table 7 shows the minimum bactericidal/fungicidal concentration of extract of *Mucuna pruriens* against the test organisms. Only the methanol seed extract of 500mg/ml had bactericidal effect against *E. coli*.

Table 1: Identification of Test Organisms

Organisms	Gram	CAT	INDO	OXI	COA	SFT
E. coli	_	+	+	_	_	+
S. aureus	+	+	_	_	+	+
P. aeruginosa	_	+	_	+	_	_
P. vulgaris	_	+	+	_	_	+

Key: Gram=Gram staining technique

CAT = Catalase test

INDO = Indole test

OXI = Oxidase test

COA = Coagulase test

SFT = Sugar fermentation test

+ = Positive result

= Negative result

Table 2: Qualitative phytochemical constituents of *Mucuna pruriens*

Constituents	*M. pruriens* (Seed)	*M. pruriens* (leaf)
Flavonoids	+++	++
Tannins	++	+
Alkaloids	++	+
Terpenoid	-	++
Glycoside	+	++
Saponins	++	+
Carbohydrate	++	+
Resin	-	-
Protein	+	++

Key: + = Present ++ = Moderately present

+++ = Abundant - = Absent

Table 3: Quantitative phytochemical constituents of *Mucuna pruriens*

Extract	Phenolic contents *			Total anthocyanin †	Total flavonols ‡	Total flavonoids ‡
	Total Phenols	Non-tannins	Tannins			
M. pruriens (Leaf)	0.702 ±0.005	0.458±0.005	0.307±0.004	0.33 ± 0.09	8.19±1.92	34.95± 4.18
M. pruriens (Seed)	0.964 ±0.052	0.468±0.003	0.472±0.005	3.12 ± 0.35	29.52± 0.34	43.52± 1.10

Data represented as Mean ± SD (n = 3)

* Expressed as mg gallic acid equivalents (GAE) / mg dry weight plant extract

† Expressed as mg cyanidin 3-glucoside equivalents (CGE) /100g of dry weight extract

‡ Expressed as mg rutin equivalents (RE) / g dry weight plant extract

Table 4: Zones of Inhibition (mm) of Ketoconazole against test fungal organisms

Zone of Inhibition (mm)		
Test Organisms	Concentration(µl)	Ketoconazole
C. albicans	10.00	27.90
A. niger	10.00	22.50

Key:
µl = microliter
mm = millimeter

Table 5: Zones of Inhibition (mm) of Gentamycin against test bacterial organisms

Zone of Inhibition (mm)		
Test Organisms	Concentration(µl)	Ketoconazole
E. coli	60.00	31.00
S. aureus	60.00	28.00
P. aeruginosa	60.00	26.00
P. vulgaris	60.00	20.00

Key:
µl = microliter
mm = millimeter

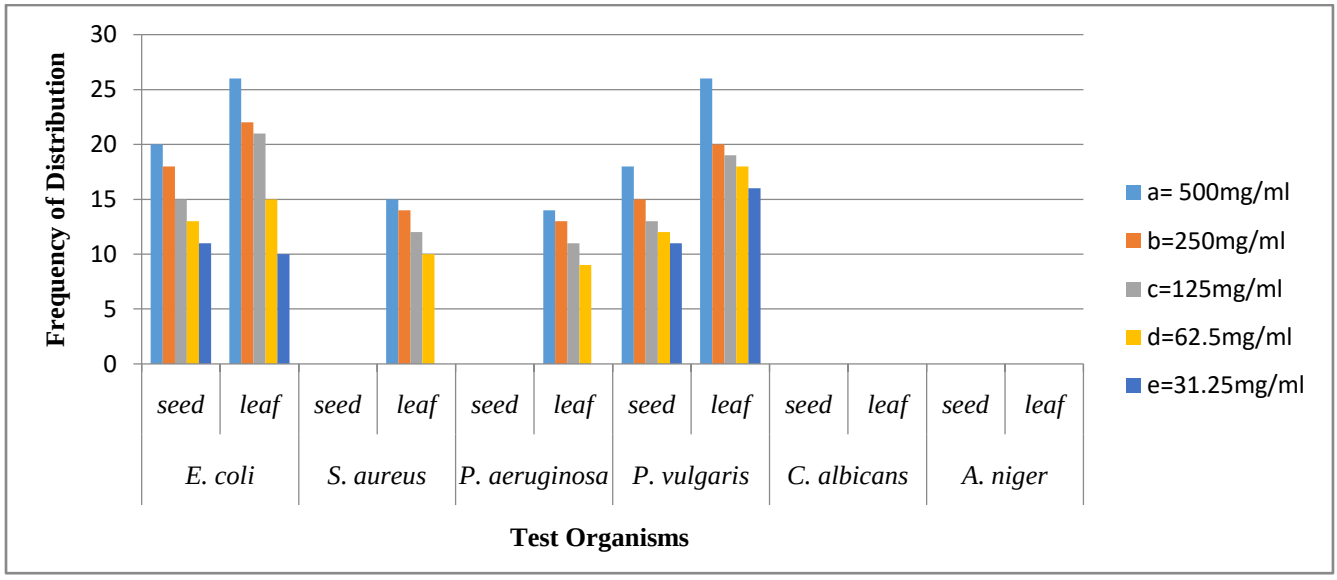

Figure 1: Mean zone of inhibition for methanol seed and leaf extract of *M. pruriens* against test organisms

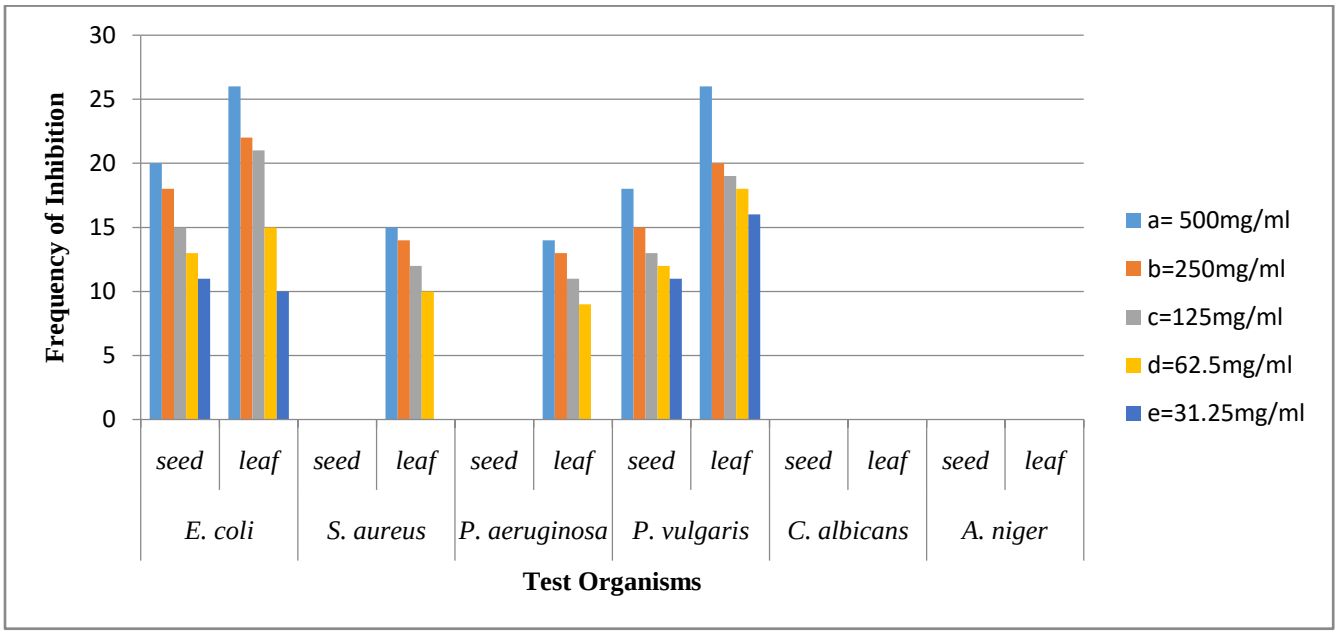

Figure 2: Mean zone of inhibition for ethanol seed and leaf extract of *M. pruriens* against test organisms

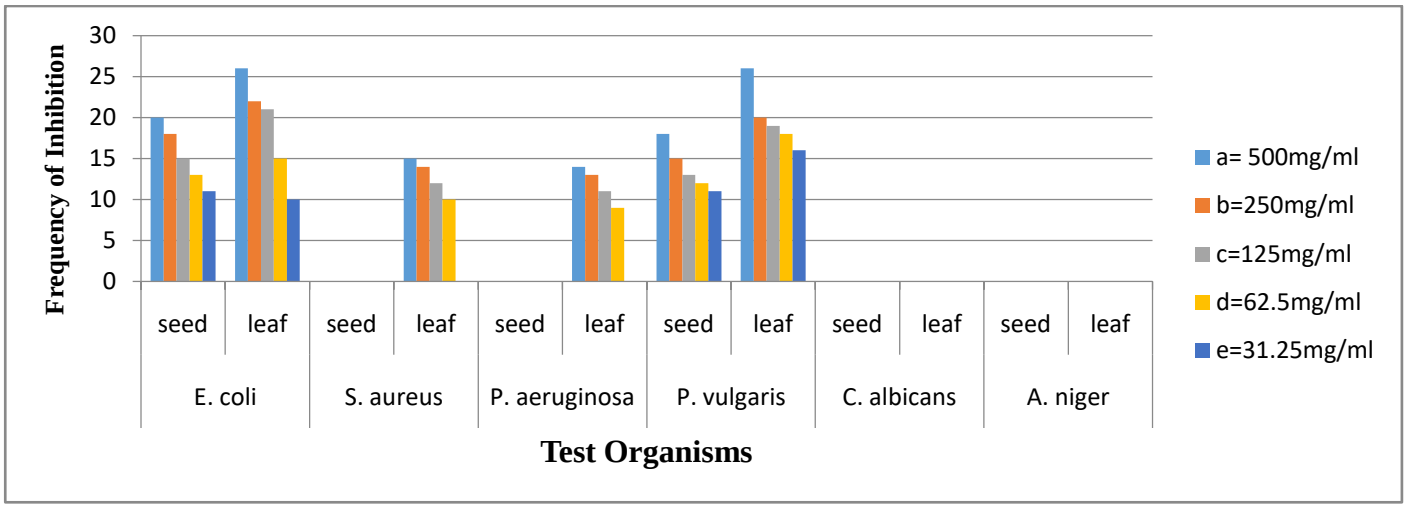

Figure 3: Mean zone of inhibition for acetone seed and leaf extract of *M. pruriens* against test organisms

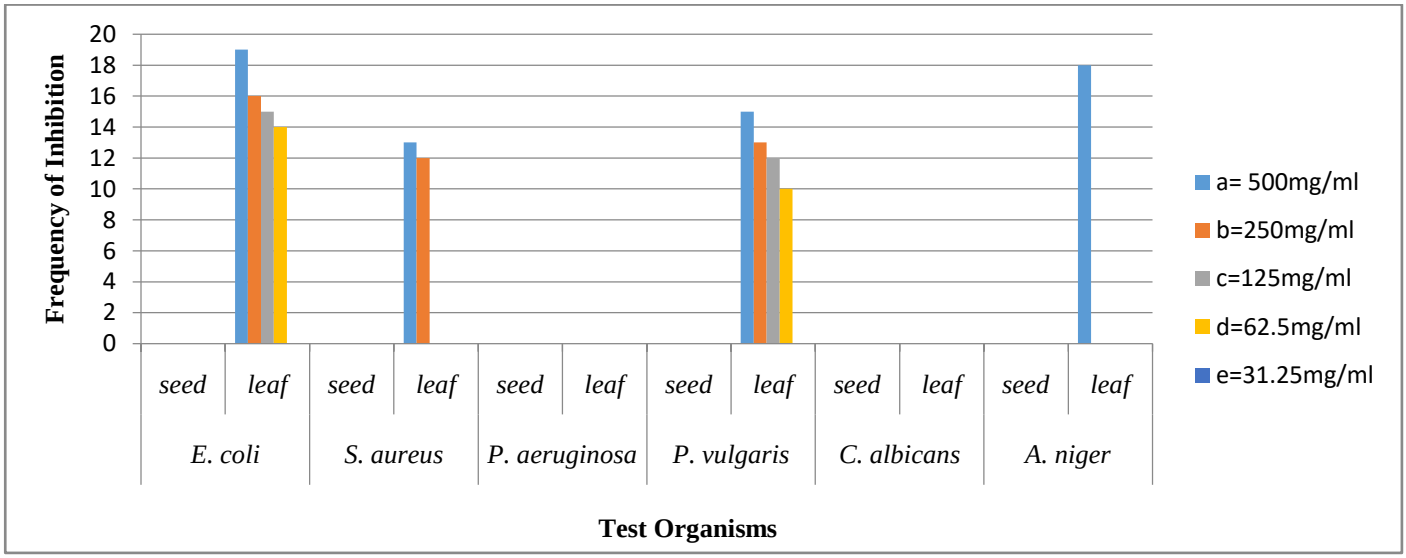

Figure 4: Mean zone of inhibition for chloroform seed and leaf extract of *Mucuna pruriens* against test organisms

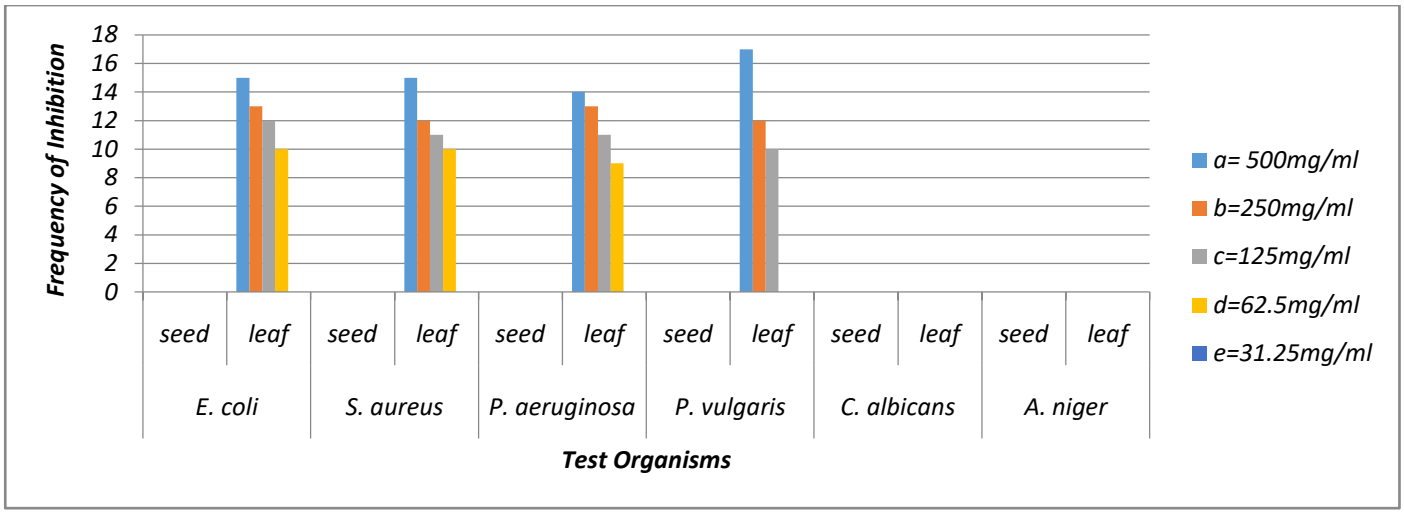

Figure 5: Mean zone of inhibition for aqueous seed and leaf extract of *Mucuna pruriens* against test organisms

Table 6: Minimum inhibitory concentration (MIC) values of extract of *Mucuna pruriens* against test organisms

Organism	Plant part	Minimum Inhibition Concentration (mg/ml)				
		Methanol	Ethanol	Acetone	Chloroform	Aqueous
E. coli	Seed	31.00	125.00	31.00		
	Leaf	31.00	62.50	31.00	62.00	62.00
S. aureus	Seed	62.50	125.00	-	-	-
	Leaf	250.00	-	62.00	-	62.00
P. aeruginosa	Seed	250.00	-	31.00	-	-
	Leaf	-	-	62.00	-	-
P. vulgaris	Seed	31.00	-	-	62.00	-
	Leaf	125.00	250.00	31.00		125.00
C. albicans	Seed	-	-	-	-	-
	Leaf	-	-	-	-	-
A. niger	Seed	500.00	500.00	-	-	-
	Leaf	-	-	-	250.00	-

Key: mg/ml = milligram per milliliter
- = no MIC value obtained

Table 7: Minimum bactericidal/fungicidal concentration of extract of *Mucuna pruriens* against test organisms

Organism	Plant part	Conc. (mg/ml)	Minimum Inhibition Concentration (mg/ml)				
			Methanol	Ethanol	Acetone	Chloroform	Aqueous
E. coli	Seed	500.00	No growth	Growth	Growth	Growth	Growth
	Leaf	250.00	Growth	Growth	Growth	Growth	Growth
S. aureus	Seed	500.00	Growth	Growth	Growth	Growth	Growth
	Leaf	250.00	Growth	Growth	Growth	Growth	Growth
P. aeruginosa	Seed	500.00	Growth	Growth	Growth	Growth	Growth
	Leaf	250.00	Growth	Growth	Growth	Growth	Growth
P. vulgaris	Seed	500.00	Growth	Growth	Growth	Growth	Growth
	Leaf	250.00	Growth	Growth	Growth	Growth	Growth
C. albicans	Seed	500.00	Growth	Growth	Growth	Growth	Growth
	Leaf	250.00	Growth	Growth	Growth	Growth	Growth
A. niger	Seed	500.00	Growth	Growth	Growth	Growth	Growth
	Leaf	250.00	Growth	Growth	Growth	Growth	Growth

Key: mg/ml = milligram per milliliter

IV. DISCUSSION

In our study, we observed that methanol extract of the seed showed high activity against the four bacterial test organisms; *Pseudomonas aeruginosa, Proteus vulgaris, Escherichia coli, Staphylococcus aureus* and one fungal organism; *Aspergillus niger*. The methanol extract proved to be most potent and promising as seen by its high inhibitory activity against the clinical isolates. This could be attributed to the high presence of some of the polyphenolic compound identified (total flavonoids content of 43.52±1.10 and 34.95±4.18 mg rutin equivalents/g dry weight of seed and leaf of *Mucuna pruriens* respectively). The phenolic extracts of plants are always a mixture of various classes of phenols, which solubility are selective in solvents. This finding is in accordance with previous work by Alaje *et al.,* (2014).

Acetone leaf extract showed activity against the four bacterial test organisms. The chloroform, methanol and aqueous leaf extracts showed activity against *Proteus vulgaris, Escherichia coli* and *Staphylococcus aureus*. The ethanol leaf and acetone seed extracts showed activity against *Proteus vulgaris* and *Escherichia coli*, with ethanol seed showing activity against *Escherichia coli* and *Staphylococcus aureus*. In addition, all extracts had no activity against *Candida albicans*.

The findings also indicated the presence of flavonoids, tanins, non-tanins, alkaloids, glycosides, saponins, carbohydrates, proteins, anthocyanin and flavonols in the seeds and leaves of *Mucuna pruriens*. The antimicrobial activity of the plant could be attributed to these compounds, which also has been reported by Shanmugavel and Krishnamoorthy, (2015) and Krishnaveni *et al*., (2017). The presence of flavonoids found in relative abundance and could be responsible for the antimicrobial activity of the plant against the isolates, which agrees with the previous study by Yiyi *et al*., (2015).

Chloroform and aqueous extracts of the seed of *Mucuna pruriens* had no antimicrobial activity against *E. coli*. The highest antimicrobial activity of seed extracts of *M. pruriens* on *E. coli* was seen with methanol and acetone extracts with zones of inhibition of 27mm and 20mm at a concentration of 500mg/ml respectively. These extracts were effective in inhibiting the growth of *E. coli* with a MIC<30mg/ml. Also, similar results were seen in methanol and acetone leaf extracts with MIC of <30mg/ml.

From the agar dilution assay, *S. aureus* was susceptible to the methanol and ethanol extracts of the seeds of *M. pruriens* only. The methanol and ethanol seed extracts were able to inhibit the growth of *S. aureus* with an MIC of 62.5mg/ml and 125mg/ml respectively, while the inhibition aqueous and acetone leaf extracts was at MIC of 62.5mg/ml respectively. This result indicates that both the leaf and seed extracts of *M. pruriens* have potent antimicrobial compounds against *S. aureus*. However, there are variations in the extraction capabilities of the different solvents utilized.

Pseudomonas aeruginosa was susceptible only to the methanol seed extract with MIC value of 250mg/ml and acetone leaf extract with MIC value of 62.5mg/ml.

Proteus vulgaris was susceptible to only methanol and acetone seed extracts with MIC values < 31.25mg/ml while it showed susceptibility to all leaf extracts of methanol, ethanol and aqueous with MIC values of 125mg/ml, while the acetone and chloroform leaf extracts have MIC values of < 31.25mg and 62.5mg respectively.

The acetone, choloform and aqueous extracts of both seed and leaf showed no significant antifungal activity against *Aspergillus niger* and *Candida albicans*, however, the leaf and seed extracts of both methanol and ethanol showed antifungal activity against *Aspergillus niger*, with MIC values at 500mg/ml respectively. These extracts with high MIC values may not be very useful as therapeutic agents, as the high concentrations of the extracts may be toxic for consumption. It can be deduced from the results that *M. pruriens* do not possess any inherent utilizable antifungal properties at least through this method of assay as reported by Mbajuka *et al*., (2014).

V. CONCLUSION

The search for an ideal biologically active ingredient has encouraged this study on the antimicrobial activity and phytochemical constituents of *M. pruriens.* This research has shown the potency of different extracts of *M. pruriens* to inhibit the growth of clinically important bacterial species including *Pseudomonas aeruginosa, Proteus vulgaris, Escherichia coli, Staphylococcus aureus* and the fungi *Aspergillus niger*. Hence, formulations of this plant and seeds could be enhanced and used to treat ailments caused by these organisms. Even though the conventional antibiotics (ketoconazole and gentamycin) used as positive controls in the agar-well dilution assay showed greater zones of inhibition and activity against the test organisms, the plant extracts of *M. pruriens* may be a better alternative to these antibiotics as it indicated lower toxicity and may contain other compounds, which could be of health benefits and in the treatment of diseases.

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