Antimicrobial Evaluation of Extracts of Leaf and Root Wood of *Parkia biglobosa* (Jacq.) Benth. Against Some Human Pathogenic Bacteria

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Abstract: The use of alternate medicine to cure some diseases is now encouraged in Nigeria. However, various parts of the medicinal plants and methods are employed to extract the active ingredients of these plants. In this study aqueous and organic solvents (ethanol, petroleum ether and hexane) of crude extracts of the leaf and root wood of *Parkia biglobosa* were screened for antimicrobial activity with the intention of finding an alternative source of antimicrobial agent that can be used against some human pathogenic organisms. These extracts were subjected to antibacterial activity testing using some human pathogenic bacteria (*Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Salmonella typhi*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *and Streptococcus pyogenes)* by employing the agar well diffusion method. Results of antimicrobial activity of *P. biglobosa* leaf and root wood extracts showed that they were active against all the human pathogenic bacteria isolates (at 100mg/ml down to 40mg/ml) with the exception of root wood extract which was not active against *Salmonella typhi.* The minimum inhibitory concentration of the leaf extract was 40mg/ml for all the isolates while that of root wood extract was 100mg/ml for *Proteus mirabilis* alone and no effect on *S. typhi*. The zone of inhibition at 100mg/ml for the isolates ranged between 7mm and 32mm for leaf extract while it was between 0mm and 24mm for root wood extract. Standard antibiotics revealed that Streptomycin had the highest efficacy against gram positive bacteria showing the clear zone inhibition of 15mm and 19mm for *S. aureus* and *S. pyogenes* respectively and Ofloxacin had the highest efficacy against gram negative bacteria (*K. pneumoniae*, *S. typhi*, *E. coli*, *P. mirabilis* and *P. aeruginosa)* with zones of inhibition between 10mm and 25mm. The minimum inhibitory concentration of both the leaf extract and the root wood extract against the pathogenic bacteria under test ranged between 40mg/ml and 100mg/ml.
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Key words: *Parkia biglobosa;* medicinal plants; antimicrobial; human pathogen; antibiotics disc

1. Introduction

The growing misuse of antibiotics and many commonly used chemotherapeutic agents has led to the development of many strains of drug resistant pathogenic microorganisms. Because of this, a considerable proportion of people in both developed and developing countries have resorted to searching for new and efficacious antimicrobial substances in herbal medicines. Herbal medicines are known to serve the health needs of about 80% of the world's population; especially for millions of people in the vast rural areas of developing countries (WHO, 2001). Medicinal plants are relevant in both developing countries and developed nations of the world as sources of drugs or herbal extracts for various chemotherapeutic purposes (Alanis *et al.*, 2005). The effects of plant extracts on bacteria have been studied by a very large number of researchers in different parts of the world (Reddy *et. al.*, 2001; Adejuwon *et al.*, 2011).

Parkia biglobosa belongs to the family *Fabaceae*. The origin of *Parkia biglobosa* has been traced to the West African sub-region where it was first encountered by the Scottish surgeon, Mungo Park as he explored the Niger basin between 1795 and1799 (Janick, 2008). *Parkia biglobosa* is known in Yoruba as Igba, or Irugba, Dorowa in Hausa, Origili in lbo while in English it is called monkey cutlass tree. In French it is néré (Nair *et al.*, 2005). Recently, the attention of researchers has been drawn to the great potentials in *Parkia biglobosa* as a source of an antibacterial agent. *Parkia biglobosa* has also been known to serve as a remedy for quite a number of ailments. For instance, in Cote d' Ivoire and Nigeria, the bark infusion is used as a tonic against diarrhoea and also as an enema (Duker-Eshun *et al.,* 2001). Among the Hausa people of Northern Nigeria, it is used against bronchitis, pneumonia, diarrhoea, violent colic, vomiting, sores and ulcers. Also in Gambia the leaves are used for toothaches as well as for sore eyes (Banwo *et al*, 2004). The root of *Parkia biglobosa* has been reported to be used in lotions for sore eyes when combined with leaves. The leaves and roots are also known to be active against bronchitis, pile, cough, amoebiasis, dental carries and conjunctivitis (Millogo kone *et al.*, 2006). A decoction of the stem bark is

used as a mouthwash to steam and relieve toothache as well as a bath for fever (Ajaiyeoba, 2002). Most of the claims of antimicrobial efficacy of the extracts derived from *P. biglobosa* parts have been scientifically established, however there is scanty information on their effects on human microbial pathogens. The aim of this study is to evaluate the antimicrobial effects of the crude extracts of *P. biglobosa* leaves and wood of roots against some human pathogenic bacteria in order to determine which of the plants' part has the most antimicrobial activity.

2. Materials and Methods

2.1 Collection of Plant Materials

The extract used for these studies was the leaves and root-wood of *Parkia biglobosa*. These materials were obtained from the University of Ibadan botanical garden, Ibadan, Oyo State. The materials were washed thoroughly with distilled water, air-dried and milled into powder form for experimental use.

2.2 Collection of the Test Organisms

Pure cultures of bacterial isolates to be used for the in vitro antimicrobial assay were obtained from the Medical Microbiology Laboratory, University College Hospital, Ibadan, Oyo State. The organisms collected were *Staphylococcus aureus*, *Streptococcus pyogenes*, *Escherichia coli*, *Proteus mirabilis*, *Klebsiella pneumoniae*, *Salmonella typhi*, *Pseudomonas aeruginosa*.

2.2.1 Sterilization of glassware

All glassware used for the laboratory work such as, conical flasks, glass stirring rod, beakers, measuring cylinders and pipette were thoroughly washed with detergent solution, rinsed with distilled water, drained, dried and further sterilized using hot air oven operating at 160^{o}C for 2hours after being wrapped with aluminium foil. Similarly, materials such as McCartney bottles and bijou bottles were wrapped with aluminium foil paper and sterilized in an autoclave operating at a temperature of 121^{o}C for 15minutes. The pressure used was 15 Pounds per square inch (psi) (Maheshwari, 2005). Also, inoculating wire loop and cock borer (8mm) used were sterilized by heating to red hot in a spirit lamp flame at regular intervals during use.

2.2.2 Preparation of nutrient agar

According to the manufacturer's instruction 28g of nutrient agar powder was weighed using an electronic weighing balance and then poured into 1000ml of distilled water in a 1000ml conical flask. A stopper made with cotton wool wrapped with aluminium foil was used to plug the mouth of the conical flask. It was swirled to mix and then homogenized by placing it in water bath at 95^{o}C for 15minutes. The conical flask containing the homogenized nutrient agar was wrapped with aluminium foil and then sterilized in an autoclave for 15minutes at 121^{o}C at a pressure of 15psi. After autoclaving, the medium was allowed to cool to 47^{o}C before dispensing gently and aseptically into sterile petri dishes where it solidified thereafter.

2.3 Test Organisms

The microorganisms used are: *Staphylococcus aureus*, *Streptococcus pyogenes*, *Escherichia coli*, *Proteus mirabilis*, *Klebsiella pneumoniae*, *Salmonella typhi*, *Pseudomonas aeruginosa*. These bacteria were maintained on nutrient agar slants and kept in the refrigerator at about 4^{o}C. These organisms were further subcultured into nutrient agar slants as well as nutrient agar plate using streaking method. Gram staining procedure and other relevant biochemical tests (catalase, starch hydrolysis, oxidase, urease, indole and citrate) were carried out on each of the bacteria isolates to establish the validity and viability of the test bacteria (Harrigan and McCane, 2003).

2.4 Plant Extracts Preparation

Ten grams of milled extract powder of each of the plant parts (leaves and root-wood) were weighed and dissolved in different 500ml beaker containing 100ml of each of the different solvents. The beaker was then covered with aluminium foil and left for 24hours. It was however stirred at 8hours interval. The solvents were aqueous distilled water, ethanol, hexane and petroleum ether. After 24hours, the extract solution was stirred using glass rod stirrer. Thereafter, the supernatant was filtered with filter paper into 100ml beaker using separation buchner funnel. This was then used immediately and the remaining extract stored in the refrigerator for further study (Olayemi and Opaleye, 2002).

2.5 Antimicrobial Tests for the Bacteria Isolates Used

2.5.1 Agar well diffusion technique

The extracts were tested for antimicrobial activity using the agar well diffusion method. This method depends on the diffusion of extracts from cavity through the solid medium in the petri dish such that growth of the cultured organism is inhibited for a zone, forming a circular area around the extract. This is shown by forming a zone of clearance and the diameter of such clearance is directly proportional to the efficacy of the extracts (Oboh and Masodje, 2009; Dairo and Adanlowo, 2010; Valya *et al*., 2010; Nwinyi *et al*., 2010).

2.5.2 Antibiotic susceptibility test

Antibiotic susceptibility testing was done with the use of antibiotic discs (gram positive and gram negative) by the disk diffusion methods (Bauer *et al*., 1966), using broad spectrum antibiotics. Before each antibiotic disc was placed on each of the media surface, the pathogenic bacterial isolates were streaked on each of the nutrient agar plates after which the

antibiotic discs were aseptically placed on each of the agar plates using sterile forceps. The agar plates were incubated at 37°C for 24hours. Afterwards, the plates were examined for zones of inhibition. The zones of inhibition around each antibiotic disc were then measured in millimeters. Antibiotic susceptibility was evaluated from the readings obtained from each of the zones of inhibition observed on the agar plates.

2.5.3 Inhibitory tests for bacteria

The test organism was streaked on solid nutrient agar until it covers the surface area of the petri dish using sterile inoculating loop. A sterile cork borer of 8mm in diameter was used to cut deep and make five uniform wells on the agar gel. Each well was then filled with each of the plant extracts prepared in different concentrations. The petri dishes were allowed to stand for 45minutes at room temperture to allow proper diffusion. The control experiments were then set up using each of the solvents (without extracts). Sterilized distilled water was equally used as aqueous control sample. The culture plates were then incubated for 24hours at 37°C. Zones of clearance around each of the wells were noted and their diameter measured in millimetre (mm) value using transparent metre rule. The minimum inhibitory concentration (MIC) was determined by comparing the difference in concentration of the extracts with the control (Satish, 2003; Harrigan and McCane, 2003).

2.5.4 Determination of minimum inhibitory concentration (MIC)

The Minimum Inhibitory Concentration (MIC) was determined using the agar streak technique (Nester *et al*., 2004). The concentration around the agar well that gave the least inhibitory zone was regarded as the minimum inhibitory concentration.

3. Results

Minimum Inhibitory Concentration (MIC)

Table 1: The zone of inhibition (mm) of the leaf extract of *Parkia biglobosa*

Isolate used	Solvent used for extraction	Undiluted extract (100mg/ml)	Control
Escherichia coli	Ethanol	30	-
	Petroleum ether	24	-
	Hexane	20	-
	Aqueous	12	-
Klebsiella pneumoniae	Ethanol	23	-
	Petroleum ether	20	-
	Hexane	15	-
	Aqueous	10	-
Pseudomonas aeruginosa	Ethanol	31	-
	Petroleum ether	28	-
	Hexane	24	-
	Aqueous	25	-
Staphylococcus aureus	Ethanol	32	-
	Petroleum ether	-	-
	Hexane	7	-
	Aqueous	18	-
Proteus mirabilis	Ethanol	27	-
	Petroleum ether	19	-
	Hexane	-	-
	Aqueous	10	-
Salmonella typhi	Ethanol	19	-
	Petroleum ether	17	-
	Hexane	15	-
	Aqueous	12	-
Streptococcus pyogenes	Ethanol	26	-
	Petroleum ether	19	-
	Hexane	-	-
	Aqueous	16	-

Key: - negative, n = 3

Table 2: The zone of inhibition (mm) of the root wood extract of *Parkia biglobosa*

Isolate used	Solvent used for extraction	Undiluted extract (100mg/Ml)	Control
Escherichia coli	Ethanol	18	-
	Petroleum ether	19	-
	Hexane	16	-
	Aqueous	11	-
Klebsiella Pneumonia	Ethanol	23	-
	Petroleum ether	21	-
	Hexane	17	-
	Aqueous	12	-
Pseudomonas aeruginosa	Ethanol	24	-
	Petroleum ether	15	-
	Hexane	15	-
	Aqueous	13	-
Staphylococcus aureus	Ethanol	18	-
	Petroleum ether	17	-
	Hexane	13	-
	Aqueous	-	-
Proteus mirabilis	Ethanol	12	-
	Petroleum ether	-	-
	Hexane	-	-
	Aqueous	-	-
Salmonella typhi	Ethanol	-	-
	Petroleum ether	-	-
	Hexane	-	-
	Aqueous	-	-
Streptococcus pyogenes	Ethanol	16	-
	Petroleum ether	11	-
	Hexane	10	-
	Aqueous	-	-

Key: - negative, n = 3

Table 1 shows the Minimum Inhibitory Concentration of the leaf extracts (measured in millimeters) while Table 2 shows the Minimum Inhibitory Concentration of the root wood extracts. Minimum Inhibitory Concentration (MIC) is the lowest concentration of extract required to completely inhibit test organism up to 48hours incubation or lowest concentration that can result to significant decrease in inoculum viability greater than 90% (Andrews, 2001).

Table 3 shows the sensitivity of the isolates to Standard Antibiotic Disc that is commercially available. The diameter of clearance was also taken to compare with the extract used. Gram positive bacteria (*S. aureus* and *S. pyogenes*) resisted Tetracycline, Chloramphenicol, Cotrimoxazole, Erythromycin and Augmentin. However, *S. aureus* was sensitive to Streptomycin and Gentamicin with 15mm and 11mm clear zone of inhibition respectively while *S. pyogenes* was sensitive to Streptomycin and Gentamicin with 19mm and 12mm clear zone of inhibition respectively. *Samonella typhi* resisted Augmentin, Amoxycillin and Cotrimoxazole but sensitive to Tetracycline, Nitrofurantoin, Nalidixic acid, Ofloxacin and Gentamicin with 13mm, 13mm, 13mm, 25mm and 13mm inhibition zone in that order. *Esherichia coli* was resistant to Augmentin (AUG), Tetracycline (TET), Amoxicillin (AMX), Cotrimoxazole (COT) but sensitive to Nitrofurantoin (NIT), Nalidixic acid (NAL), Ofloxacin (OFL) and Gentamicin ((GEN) with 12mm, 15mm, 30mm and 13mm zone of inhibition in that order. *Klebsiella pneumoniae* was sensitive to NIT, NAL and OFL with 10mm, 15mm, 15mm zone of inhibition in that order but resisted AUG, TET, AMX, COT and GEN. *Proteus mirabilis* was resistant to AUG, AMX, COT, NIT and NAL but susceptible to TET, OFL and GEN with 6mm, 13mm and 8mm in that order. *Pseudomonas aeruginosa* resisted AUG, TET, AMX, COT, NIT and NAL but sensitive with 10mm and 6mm clear zone respectively (Tables 5 and 6).

Table 3: The Minimum Inhibitory Concentration (MIC) of the leaf extract of *Parkia biglobosa*

Isolate used	Solvent used for extraction	Undiluted extract (100mg/ml)	10ml + 5ml (66.7mg/ml)	10ml+10ml (50mg/ml)	10ml+15ml (40mg/ml)	Control
Escherichia coli	Ethanol	30	22	13	7	-
	Petroleum ether	24	18	13	10	-
	Hexane	20	15	13	10	-
	Aqueous	12	11	10	-	-
Klebsiella pneumoniae	Ethanol	23	18	13	12	-
	Petroleum ether	20	14	11	7	-
	Hexane	15	10	-	-	-
	Aqueous	10	-	-	-	-
Pseudomonas aeruginosa	Ethanol	31	27	23	14	-
	Petroleum ether	28	24	18	17	-
	Hexane	24	20	19	12	-
	Aqueous	25	21	19	17	-
Staphylococcus aureus	Ethanol	32	28	24	12	-
	Petroleum ether	-	-	-	-	-
	Hexane	7	-	-	-	-
	Aqueous	18	12	11	-	-
Proteus mirabilis	Ethanol	27	18	14	11	-
	Petroleum ether	19	13	-	-	-
	Hexane	-	-	-	-	-
	Aqueous	10	-	-	-	-
Salmonella typhi	Ethanol	19	16	15	13	-
	Petroleum ether	17	12	11	-	-
	Hexane	15	11	-	-	-
	Aqueous	12	9	-	-	-
Streptococcus pyogenes	Ethanol	26	21	15	11	-
	Petroleum ether	19	17	12	-	-
	Hexane	-	-	-	-	-
	Aqueous	16	13	12	10	-

Key: - negative, n = 3

Table 4: The Minimum Inhibitory Concentration of the root wood of *Parkia biglobosa*

Isolate Used	Solvent used for Extraction	Undiluted Extract (100mg/ml)	10ml + 5ml (66.7mg/ml)	10ml+10ml (50mg/ml)	10ml+15ml (40mg/ml)	Control
Escherichia coli	Ethanol	18	14	13	12	-
	Petroleum ether	19	17	14	9	-
	Hexane	16	14	14	12	-
	Aqueous	11	-	-	-	-
Klebsiella pneumoniae	Ethanol	23	20	17	12	-
	Petroleum ether	21	17	13	12	-
	Hexane	17	14	11	9	-
	Aqueous	12	11	9	-	-
Pseudomonas aeruginosa	Ethanol	24	19	16	12	-
	Petroleum ether	15	12	11	-	-

	Hexane	15	13	11	-	-
	Aqueous	13	10	-	-	-
	Ethanol	18	15	10	-	-
Staphylococcus aureus	Petroleum ether	17	15	10	-	-
	Hexane	13	11	-	-	-
	Aqueous	-	-	-	-	-
	Ethanol	12	-	-	-	-
Proteus mirabilis	Petroleum ether	-	-	-	-	-
	Hexane	-	-	-	-	-
	Aqueous	-	-	-	-	-
	Ethanol	-	-	-	-	-
Salmonella typhi	Petroleum ether	-	-	-	-	-
	Hexane	-	-	-	-	-
	Aqueous	-	-	-	-	-
	Ethanol	16	12	-	-	-
Streptococcus pyogenes	Petroleum ether	11	10	-	-	-
	Hexane	10	-	-	-	-
	Aqueous	-	-	-	-	-

Key: - negative, n = 3

Table 5: The zone of inhibition of gram positive bacteria isolates by the standard antibiotics disc

Antibiotics	Code	Concentration	*Staphylococcus aureus*	*Streptococcus pyogenes*
Streptomycin	STR	10µg	15mm	19mm
Tetracycline	TET	30µg	-	-
Chloramphenicol	CHL	10µg	-	-
Cotrimoxazole	COT	25µg	-	-
Cloxacillin	CXC	5µg	-	-
Erythromycin	ERY	5µg	-	-
Gentamicin	GEN	10µg	11mm	12mm
Augmentin	AUG	30µg	-	-

Key: - negative, n = 3

Table 6: The zone of inhibition of gram negative bacteria isolates by the standard antibiotics disc

Antibiotics	Code	Concentration	*Salmonella typhi*	*Escherichia* coli	*Klebsiella pneumoniae*	*Proteus mirabilis*	*Pseudomonas aeruginosa*
Augmentin	AUG	30µg	-	-	-	-	-
Tetracycline	TET	30µg	-	-	-	6mm	-
Amoxicillin	AMX	25µg	-	-	-	-	-
Nitrofurantoin	NIT	30µg	13mm	12mm	10mm	-	-
Nalidixic acid	NAL	30µg	13mm	15mm	15mm	-	-
Ofloxacin	OFL	30µg	25mm	30mm	15mm	13mm	10mm
Gentamicin	GEN	10µg	13mm	13mm	-	8mm	6mm
Cotrimaxazole	COT	25µg	-	-	-	-	-

Key: - negative, n = 3

4. Discussion

The antimicrobial activity of the four extracts of *Parkia biglobosa* leaf and root wood on seven selected human pathogenic bacteria showed the evaluation of the potency of the plant parts from the result of inhibition zones which occurred on the plates. It is now a known fact that resistance to antibiotics has become a major problem to both developed and developing countries. The discovery that reasonably low concentrations of the crude extracts of parts of *Parkia biglobosa* can be used to inhibit their growth is therefore of tremendous interest. Notably there has been no known report of *P. biglobosa* toxicity which

is the major problem encountered with most medicinal plants (Levy and Marshal, 2004).

Results obtained showed that the leaf extract was much active than the root extract when extracted with the same extractants (ethanol, hexane, petroleum ether and aqueous). This disagrees with an earlier report of Millogo-Kone *et al*., (2006) when he compared the effects of the extracts of the leaf and stem bark of the same plant against clinical isolates of *Staphylococcus aureus*. Also, among all the extracts used, ethanol extract was found to be the most active against the tested bacteria strains followed by petroleum ether. This is similar to the findings of Obi and Onuoha (2000), who reported that alcohol was the best organic solvent for the extraction of most plant bioactive principles of medical importance. It was observed that when the leaf extract of *P. biglobosa* was extracted with ethanol, it reacted effectively on all the test bacterial isolate used. Petroleum ether extract was not effective on *Staphylococcus aureus* but effective on other bacterial isolates though at various concentrations. For instance, for *Escherichia coli*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* the MIC was at 40mg/ml and *Salmonella typhi* and *Streptococcus pyogenes* at 50mg/ml respectively while *Proteus mirabilis* at 66.7mg/ml. Hexane extract was not effective on both *Streptococcus pyogenes* and *Proteus mirabilis* though it was effective on *Escherichia coli* and *Pseudomonas aeruginosa* at 40mg/ml, *Klebsiella pneumoniae* and *Salmonella typhi* at 66.7mg/ml, and *Staphylococcus aureus* at 100mg/ml. Moreover, aqueous extract was effective on *Streptococcus pyogenes* and *Pseudomonas aeruginosa* at 40mg/ml, *E. coli* and *S. aureus* at 50mg/ml, *S. typhi* at 66.7mg/ml, *K. pneumonia* and *P. mirabilis* at 100mg/ml.

Using the root wood extract of *P. biglobosa*, it was observed that ethanol extract was not effective on *S. typhi* but effective on *E. coli*, *K. pneumoniae*, *P. aeruginosa*, *S. aureus* and *S. pyogenes* at 40mg/ml respectively and *P. mirabilis* at 100mg/ml. Petroleum ether was effective against *E. coli* and *K. pneumoniae* at 40mg/ml, *P. aeruginosa* and *S. aureus* at 50mg/ml respectively, *S. pyogenes* at 66.7mg/ml. It was however not effective on both *S. typhi* and *P. mirabilis*. Hexane extract was not effective on *P. mirabilis* and *S. typhi* but effective on *E. coli* and *K. pneumoniae* at 40mg/ml respectively, but *P. aeruginosa* and *S. aureus* at 50mg/ml, while *S. pyogenes* at 100mg/ml. Though aqueous extract reacted on *K. pneumoniae* at 50mg/ml, *P. aeruginosa* at 66.7mg/ml and *E. coli* at 100mg/ml, it was not effective on *S. pyogenes*, *S. typhi*, *P. mirabilis* and *S. aureus*. This result is similar to the findings of Ajaiyeoba (2002) who also reported *Parkia* leaf extracts active on *S. auerus, E. coli* and *P. aeruginosa*. From all these results, it can be inferred that the activity of the extract is concentration dependent (100mg/ml - 40mg/ml). This is in agreement to an earlier report by Aspen, (2000) that an increase in the concentration of an antimicrobial agent might result in an increase in its effectiveness.

The alcohol extracts showed greater antimicrobial activity than the corresponding aqueous, hexane and petroleum extracts. These findings is interesting in that the traditional method of treating a bacterial infection was by administering a decoction of the plant parts in water whereas according to this results, preparing an extract with an organic solvent is shown to provide a better antimicrobial activity which is in accordance with the results obtained by Nair *et al*., (2005). As a result, reports that traditional healers and herbalists use aqueous solution to extract biologically active compounds due to its easy availability (Shale *et al*., 1999) has been contradicted by these findings which alcoholic extracts recorded greater antimicrobial activity.

Findings from this experiment showed that both gram positive bacteria and gram negtive bacteria excepts *S. typhi* were susceptible to the plant extracts (leaf and root wood). This contradicts previous reports by Kamatou and Viljoen (2005), Tepe and Daferera (2005), and Delmare and Moschen-Pistorello (2007) that plant extracts are more active against gram positive bacteria than gram negative bacteria.

Conclusion

The rich diversity of *Parkia biglobosa* in bioactive constituents, screening of the various natural organic compounds and its identification to reveal the active principle by isolation and characterization of its antimicrobial constituents, must be considered as a fruitful approach in the search for new herbal drugs for folkloric usage. The antimicrobial activities can be better defined if the active compounds are purified and adequate dosage determined for proper administration. This may go a long way in preventing the administration of inappropriate concentrations, a common practice among folklore medical practitioners. It is advisable to use the leaves since the leaf showed much higher activity than the root wood.

Recommendation

The leaf of *P. biglobosa* should be investigated for the formulation of antibiotics for cure of pathogenic bacterial infection. Finally, further work should be carried out in order to isolate, characterize and purify the bioactive constituents of the plant with a view to determining its spectrum of activity as well as adding it to already established antimicrobial agents especially those that are active against resistant strains of bacteria.

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