Available online on 17.10.2020 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Open Access Research Article

Comparative Antimicrobial Activities of *Alchornea cordifolia* Leaf Crude Extracts and Cephalosporin Antibiotics on Some Pathogenic Clinical Isolates

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ABSTRACT

Comparative antimicrobial activities of the aqueous and ethanol leaf extracts of Alchornea cordifolia and some Cephalosporin antibiotics of different generations available in Uyo, LGA of Akwa Ibom state of Nigeria were evaluated using macro dilution assay to determine the Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of the plant aqueouse and ethanol leaf extracts and of the Cephalosporin antibiotics against some pathogenic Gram positive and Gram negative organisms. Results: The extraction yielded 59.9g for aqueouse leaf extract (ALE) and 74.10 g of the ethanol leaf extract. The MIC of the leaf extracts ranging from (1.953 mg/mL - 15.625 mg/ mL) and MBC ranging from (3.906 mg/mL – 62.50 mg/mL). The cephalosporin antibiotics; Ceftriaxone (Chupet®) MIC ranging from (0.0078-0.25 mg/mL), MBC (0.0312 mg/mL – 0.25 mg/mL), Cephalexin (Sporidex®) MIC ranging from (0.009766 mg/ mL - 0.625 mg/ mL), MBC (0.01953 mg/ mL -2.50 mg/ mL) and Cefuroxime with MIC ranging from (0.0078 mg/mL-0.25 mg/mL) and MBC (1.25 mg/mL - 2.5 mg/mL). Antimicrobial substances are considered as bactericidal agent when the ratio MBC/MIC ≤ 4 and bacteriostatic when the ratio MBC/MIC is > 4. The antimicrobial activities evaluated increased in the following order of potency; A. cordifolia leaf extracts > Ceftriaxone > Cefalexin > Cefuroxime considering the values of MBC/MIC.

Keywords: *Antimicrobial activities, bacteriostatic, bactericidal, cephalosporin, comparative.*

Article Info: Received 19 Aug 2020; Review Completed 27 Sep 2020; Accepted 08 Oct 2020; Available online 17 Oct 2020

Cite this article as:

Agboke AA, Nwosu CN, Obindo DO, Ekanem MH, Edet EV, Ubak IF, Comparative Antimicrobial Activities of *Alchornea cordifolia* Leaf Crude Extracts and Cephalosporin Antibiotics on Some Pathogenic Clinical Isolates, Journal of Drug Delivery and Therapeutics. 2020; 10(5-s):170-176 http://dx.doi.org/10.22270/jddt.v10i5-s.4363

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1. INTRODUCTION

The term antibiotic was coined from the word Antibiosis which literally means against life [1]. It was originally broadly defined as a substance produced by one micro-organism [2] or of biological origin which at low concentrations can inhibit the growth of, or are lethal to other micro-organisms [3]. These definitions have been modified in modern terms to include antimicrobials that are also produced partly or wholly through synthetic means or extracted from plants.

Infections were the major cause of death during the nineteenth century. The introduction of antibiotics not only helped in the treatment of infections but also have a major role in decreasing mortality and morbidity [4]. These drugs prescribed by the physicians have gained importance across the globe mainly because of an increase in antibiotic use, persistence of infections and drug resistance [5, 6].

Cephalosporin are a broad class of bactericidal antibiotics that include the beta-lactam ring and share a structural similarity and mechanism of action with other beta-lactam antibiotics e.g. penicillin, carbapenems, and monobactams [7]. They are a class of antibiotics routinely used for variety of infections, many of which are recommended first line therapies in North American Infectious Diseases Society Guidelines such as Infectious Diseases Society of America (IDSA) [8].They are widely used antibiotics because of their clinical efficiency and desirable safety profile.

Commonly available cephalosporin antibiotics in the Pharmaceutical chemist outlets in Uyo LGA are mostly unbranded products from Asian countries China and India. This is possibly due to cost effectiveness and availability of these antibiotics.

1.1. First generation

These are active against *Viridans Streptococci*, group A *haemolytic Streptococci, Staphylococcus aureus*, they don't work on E*nterococci* [9]. They are effective against *Escherichia Coli*, Proteus mirabilis, *Klebsiella pneumonia* though susceptibilities may vary [10]. They are not effective against multi-drug resistant *staphylococci* and penicillin resistant

Streptococci pneumonia. Examples: Cephalexin, Cephadrine, Cefadroxil, Cefazolin (intravenous and intramuscular)

1.2. Second generation

They are effective against strains of *M. catarrhalis, Neisseria species, proteus* and *klebsiella*, they also combat *Hemophilus influenza-A* cause of pneumonia and, sepsis and meningitis. However they have no activity against *Pseudomonas aeruginosa* [9]. Example of second generation cephalosporin includes; Cefuroxime, Cefaclor, Cefproxil, Cefoxitin.

1.3. Third generation

This cephalosporin are the major drugs used in the treatment of many important infections owing to their wide spectrum of activity, low potential for toxicity, high antibacterial potency and favourable pharmacokinetics. They are generally marked by their effectiveness against most of gram negative bacteria. Also, they are superior in nature, because they have higher beta-lactamase stability and can penetrate the cell wall of gram negative bacteria. Examples are Ceftriaxone, Cefixime, Ceftazidime [10].

1.4. *Alchornea cordifolia* leaf extracts

A. cordifolia is commonly used as a medicinal plant throughout its area of distribution. The plant has been locally used in ethno medicine as aqueouse and ethanol extracts for the treatment of a variety of ailments, including inflammatory disease states and disorders associated with microbial infection, without detailed scientific basis. The effectiveness of *A. cordifolia* has also been highlighted through its traditional use in the treatment of convulsions, prostatitis, leprosy, jaundice, conjunctivitis, pain and nervous troubles, hormonal-related gynecological disorders, infertility, urinary, respiratory and intestinal problems as well as malaria like fevers [11, 12].

The leaves stem bark, roots and fruits of *Alchornia cordifolia* contain terpenoids, steroid glycosides, flavonoids, phenolic acids, fatty acids, tannins, saponins, carbohydrates and the imidazo-pyrimidine alkaloids alchorneine, alchornidine, and several guanidine alkaloids. The plant parts also contain a range of hydroxybenzoic acids: gallic acid and its ethyl ester, gentisic acid, anthranilic acid, protocatechuic acid, and ellagic acid (alizarine yellow). A C20 homolog of vernolic acid named alchornoic acid can be found in the seed oil [13, 14].

Several pharmacological investigations have been carried out to validate some of the claimed ethnomedicinal uses of the plant. It has been reported to exhibit various pharmacological activities such as antibacterial, antifungal, antiplasmodial, anti-inflammatory, hepatoprotective, anticancer, antioxidant, wound healing, anti-diarrhoeal, antinociceptive, antidepressant, immunomodulatory, anxiolytic, antidiabetic and antispasmodic activities among others [15]. The anti-HIV potentials of the plant have been documented [16, 17].

A number of constituents responsible for the observed activities have also been mentioned in the literature review [18] reported that the parts of the plant mostly used for medicine are the leaves and stem bark but the leaves exhibit more potency. However, no comprehensive study has been carried out to confirm this. This research study is therefore geared towards validating or repudiating this claim. The antimicrobial activity of the leaves and stem bark extracts of *A. cordifolia* was evaluated and compared.

2. MATERIAL AND METHOD

2.1. Plant Collection and Aunthentication

Fresh leaves of *Alchornea cordifolia* (Schum. & Thonn) Müll. Arg. was collected from a farm land within Itak community in Ikono Local Government Area of Akwa Ibom State, Nigeria in the month of June 2018. The plant was identified and authenticated by Mr. O. U. Etefia, a naturalist of the Pharmacognosy Department, Faculty of Pharmacy, University of Uyo.

2.2. Sample preparation and extraction

The 650 g of the powdered leaves of *Alchornea cordifolia* was weighed and macerated in 1000 mL of distilled water and 70 % ethanol separately in 2000mL conical flasks at room temperature for 24 hours with intermittent stirring. The samples were filtered three times on sterile cotton wool and filter paper and the filtrates obtained was heat to dryness using a water bath at 40°C for about three days [19]. The extract obtained was 59.90 g for aqueouse leaf extract (ALE) and 74.10 g for ethanol leaf extract (ELE), the concentrated extracts were transferred to beakers sealed with aluminum foil, labeled appropriately as ALE and ELE and stored in the refrigerator pending analysis.

Table 1: Drug samples of some commercially available Cephalosporin in Uyo LGA

First generation	Second generation	Third generation
Sporidex (Cefalexin Capsule 500mg) Batch no: 3990692 Manufacturer: Sun Pharmaceutical Ltd, India Mfg date: December 2018 Nafdac Reg no: 04-1430	Axacef (Cefuroxime axetil Tablet 500mg) Batch no: 850001 Manufacturer: Medrieich Ltd, India. Mfg date: January 2018 Nafdac Reg no: 04-1430	Chupet (Ceftriaxone powder sodium 1g) Batch no: 180201 Manufacturer: Zhongnan Kelun Pharmaceutical Co.Ltd, China Mfg date: February 2018 Nafdac Reg no: A4-9142

2.3. Test organisms

The organisms used were pathogenic clinical isolates of three (3) Gram-positive bacteria (*Staphylococcus aureus, Streptococcus pneumonia, and Bacillus subtilis*), three (3) Gram-negative bacteria (*Escherichia coli, Pseudomonas aeruginosa, and Salmonella typhi*). They were obtained from the medical centre laboratory of University of Uyo, Uyo. Akwa Ibom, Nigeria.

2.4. Antibacterial assay

2.4.1. Inoculum standardization

Standard bacterial cultures were prepared by sub culturing a loopful of each of the bacteria into sterile Muller Hilton

broth and incubated at 37^{0}C for 24 hours. The suspensions were adjusted to a turbidity of 10^6 colony forming units (cfu)/mL which is equal to 0.5 McFarland standard using visual comparison.

2.4.2. Susceptibility test

The agar well diffusion method modified for its suitability [20] was used for the bacteria susceptibility test. The media used was prepared according to manufacturer's instructions and aseptically poured into sterile Petri dishes and allowed to solidify. An overnight culture of each of the test organisms adjusted to a turbidity of 10^6 using the 0.5 McFarland standard was introduced into each dish. A 4mm sterile cork borer was used to bore holes equidistant from each other on the plates. Using a sterile pipette, different concentrations of the extracts were introduced into the wells. 1 mg/mL of Cefalexin was introduced into the wells as control measures. The plates were allowed to stand for one hour before incubation to allow for the diffusion of the agent into the media. They were then incubated for 24 hours at 37^{o}C. The diameter of the zones of inhibition was then measured to the nearest millimeter confirming the susceptibility of the extracts

2.5. Determination of minimum inhibitory concentration (MIC)

The Minimum Inhibitory Concentration (MIC) of the aqueouse leaf extract (ALE), ethanol leaf extracts (ELE) and the antibiotics were determined using the broth dilution method, as described by Gatsing *et al.* [21] with some modifications. Stock solutions of the plant extracts were prepared at a concentration of 250mg/mL by reconstituting 2.5g (2500mg) of ALE and ELE respectively in 10ml of sterile water. The mixture was filtered through a filter paper to obtain a stock solution free of insoluble particles. Two-fold serial dilution of the stock solutions were carried out aseptically to obtain the resulting concentrations of the aqueouse extract (ALE) and (ELE) of 125 mg/mL, 62.5 mg/mL, 31.25 mg/mL, 15.625 mg/mL, 7.8125 mg/mL, 3.90625 mg/mL, 1.953125 mg/mL, 0.9765625 mg/mL, 0.48828125 mg/mL and 0.244140625 mg/mL respectively. Stock solution for each cephalosporin was prepared to be 5 mg/ML for Cefalexin,

5 mg/mL for Cefuroxime and1 mg/mL for Ceftriaxone respectively. Two-fold serial dilution of each stock solution was carried out aseptically. The resulting concentrations were: Cefalexin and Cefuroxime 2.5 mg/mL, 1.25 mg/mL, 0.625 mg/mL, 0.3125 mg/mL, 0.1563 mg/mL, 0.07813 mg/ mL, 0.03906 mg/ mL, 0.01953 mg/mL, 0.009766 mg/mL, 0.004883 mg/mL, while Ceftriaxone was 0.5 mg/mL, 0.25 mg/mL, 0.125 mg/mL, 0.0625 mg/mL, 0.0312 mg/mL, 0.0156 mg/mL, 0.0078 mg/mL, 0.0039 mg/mL, 0.0019 mg/mL and 0.00097 mg/mL. Each tube was aseptically inoculated with a loopful of the respective microbial suspensions and the tubes were incubated at 37°C for 24 hours after which they were observed visually for the presence or absence of turbidity as an indication of the presence or absence of growth respectively. The lowest concentration that inhibited the growth of the microorganisms after 24 hours of incubation was reported as the MIC of the leaf extract against the various test organisms.

2.6. Determination of minimum bactericidal concentration (MBC)

The Minimum Bactericidal Concentration (MBC) of ALE and Cephalosporin antibiotics were derived from the MIC tubes which showed no growth. A loopful aliquot from each tube was aseptically streaked on sterile antibacterial free Muller Hilton agar plates and were labelled appropriately with corresponding concentrations. The plates were further incubated at 37°C for 24 hours after which they were examined for the presence or absence of growth against the respective concentrations. The plate with the least concentration which killed the organisms (or allowed less than 0.1% of the original inoculums to survive) after 24 hours of incubation was taken as the MBC of the plant aqueouse leaf extract (ALE) and the antibiotics for the various test organisms.

3. RESULTS

3.1. Percentage yield

The aqueouse extract yielded 9.2 % with lower yield compared to ethanol extract of the leaf with 11.4 %.

3.2. Antimicrobial activities of *Alchornea cordifolia* leaf extract and Cephalosporin antibiotics

The antimicrobial activities of concentrations of each extract and antibiotics *against* the selected test organisms are recorded as shown below:

Table 2: Summary of minimum inhibitory concentrations of the plant extracts and the cephalosporin antibiotics against test organisms after 24 hours exposure

Concentrations of the cephalosporin antibiotics and plant extracts mg/mL					
Test organism	**Cefalexin (Sporidex®)**	**Cefuroxime (Axacef ®)**	**Ceftriaxone (Chupet ®)**	**ALE**	**ELE**
Staphylococcus aureus	0.01953	0.3125	0.0078	3.906	1.953
Streptococcus pneumoniae	0.009766	0.3125	0.0039	1.953	3.906
Bacillus subtilis	0.03906	0.625	0.0156	7.813	3.906
Escherichia coli	0.625	-	0.25	7.813	3.906
Pseudomonas aeruginosa	0.07813	0.625	0.0156	15.625	15.625
Salmonela spp	0.009766	-	0.25	15.625	7.813

ALE = Aqueous leaf extract ELE = Ethanol leaf extract

Table 3: Summary of minimum bactericidal concentrations of the plant extracts and the cephalosporin antibiotics against test organisms after 24 hours exposure

Concentrations of the cephalosporin antibiotics and plant extracts mg/mL					
Test organism	**Cefalexin (Sporidex®)**	**Cefuroxime (Axacef®)**	**Ceftriaxone (Chupet®)**	**ALE**	**ELE**
Staphylococcus aureus	0.01953	1.25	0.25	7.813	3.906
Streptococcus pneumoniae	1.25	2.5	0.0312	3.906	7.813
Bacillus subtilis	2.5	2.5	0.25	15.625	7.813
Escherichia coli	>2.5	-	0.5	> 125	> 125
Pseudomonas aeruginosa	0.3125	2.5	0.125	62.50	31.25
Salmonela spp	0.625	-	0.25	31.25	15.625

ALE = Aqueuos leaf extract ELE = Ethanol leaf extract

3.3. Antimicrobial activities of the plant leaf extracts and cephalosporin antibiotics.

Antimicrobial substances are considered as bactericidal agent when the ratio MBC/MIC ≤ 4 and bacteriostatic when the ratio MBC/MIC is > 4 (Joseph *et al.*, 2015) [22]

Table 4: Antimicrobial activity of aqueous leaf extract of *Alchornea cordifolia* against selected test organisms

Test Organism	ALE MIC (mg/mL)	ALE MBC (mg/mL)	R = MBC/MIC	Inference
Staphylococcus aureus	3.906	7.813	2.00	Bactericidal
Streptococcus pneumoniae	1.953	3.906	2.00	Bactericidal
Bacillus subtilis	7.813	15.625	1.99	Bactericidal
Escherichia coli	7.813	> 125	>16	Bacteriostatic
Pseudomonas aeruginosa	15.625	62.50	4.00	Bactericidal
Salmonela spp	15.625	31.25	2.00	Bactericidal

R = Ratio

Table 5: Antimicrobial activity of ethanol leaf extract of *Alchornea cordifolia* against selected test organisms

Test Organism	ELE MIC (mg/mL)	ELE MBC (mg/mL)	R = MBC/MIC	Inference
Staphylococcus aureus	1.953	3.906	2.00	Bactericidal
Streptococcus pneumoniae	3.906	7.813	2.00	Bactericidal
Bacillus subtilis	3.906	7.813	2.00	Bactericidal
Escherichia coli	3.906	> 125	> 32	Bacteriostatic
Pseudomonas aeruginosa	15.625	31.25	2.00	Bactericidal
Salmonela spp	7.813	15.625	1.99	Bactericidal

R = Ratio

Table 6: Antimicrobial activity of first generation cephalosporin (Cefalexin) against selected test organisms

Test Organism	Cefalexin (Sporidex®) MIC (mg/mL)	Cefalexin (Sporidex®) MBC (mg/mL)	R = MBC/MIC	Inference
Staphylococcus aureus	0.01953	0.01953	1.0	bactericidal
Streptococcus pneumoniae	0.009766	1.25	ND	ND
Bacillus subtilis	0.03906	2.5	64	bacteriostatic
Escherichia coli	0.625	>2.5	> 4	bacteriostatic
Pseudomonas aeruginosa	0.07813	0.3125	3.9	bactericidal
Salmonela spp	0.009766	0.625	64	bacteriostatic

R = Ratio ND = Not Determined

Table 7: Antimicrobial activity of second generation cephalosporin (Cefuroxime) against selected test organisms

Test Organism	Cefuroxime (Axacef ®) MIC (mg/mL)	Cefuroxime (Axacef ®) MBC (mg/mL)	R = MBC/MIC	Inference
Staphylococcus aureus	0.3125	1.25	4	bactericidal
Streptococcus pneumoniae	0.3125	2.5	8	bacteriostatic
Bacillus subtilis	0.625	2.5	4	bactericidal
Escherichia coli	-	-	ND	ND
Pseudomonas aeruginosa	0.625	2.5	4	bactericidal
Salmonela spp	-	-	ND	ND

R = Ratio ND = Not Determined

Table 8: Antimicrobial activity of third generation cephalosporin (Ceftriaxone) against selected test organisms

Test Organism	Ceftriaxone (Chupet ®) MIC (mg/mL)	Ceftriaxone (Chupet ®) MBC (mg/mL)	R = MBC/MIC	Inference
Staphylococcus aureus	0.0078	0.25	32	bacteriostatic
Streptococcus pneumoniae	0.0039	0.0312	8	bacteriostatic
Bacillus subtilis	0.0156	0.25	16	bacteriostatic
Escherichia coli	0.25	0.5	2	bactericidal
Pseudomonas aeruginosa	0.0156	0.125	8	bacteriostatic
Salmonela spp	0.25	0.25	1	bactericidal

R = Ratio ND = Not Determined

Table 9: Comparative antimicrobial activities of aqueouse and ethanol leaf extract of *A. cordifolia* and some cephalosporin antibiotics against pathogenic clinical isolates

Concentrations of the cephalosporin antibiotics and plant extracts mg/mL					
Test organism	**Cefalexin (Sporidex®)**	**Cefuroxime (Axacef ®)**	**Ceftriaxone (Chupet®)**	**ALE**	**ELE**
Staphylococcus aureus	bactericidal	bactericidal	bacteriostatic	Bactericidal	Bactericidal
Streptococcus pneumoniae	ND	bacteriostatic	bacteriostatic	Bactericidal	Bactericidal
Bacillus subtilis	bacteriostatic	bactericidal	bacteriostatic	Bactericidal	Bactericidal
Escherichia coli	bacteriostatic	ND	bactericidal	Bacteriostatic	Bacteriostatic
Pseudomonas aeruginosa	bactericidal	bactericidal	bacteriostatic	Bactericidal	Bactericidal
Salmonela spp	bacteriostatic	ND	bactericidal	Bactericidal	Bactericidal

ND = Not Determined

4. DISCUSSION

Medicinal plants constitute an important source of bioactive compounds because of the chemical diversity found in several species. In recent years, certain plants have been successfully evaluated for their antibacterial activity worldwide [23].

Though, the aqueouse extract gave higher yield than ethanol extract of the leaf of A. *cordifolia,* they are both very potent. A number of constituents responsible for the observed activities of *A. cordifolia* have also been mentioned in the literature review [18, 24] reported that the parts of the plant mostly used for medicine are the leaves and stem bark but the leaves exhibit more potency. However, no comprehensive study has been carried out to confirm this. This research study is therefore geared at comparing the antimicrobial activities of the crude extracts of leaves of *A. cordifolia* with the activity of standard antibiotics of Cephalosporin to justify the ethnomedical use of the leaves of *A. cordifolia* [15].

The results of the comparative activity studies were reflected in Tables 2-9:

In table 2 and 3, minimum inhibitory concentrations (MIC) and minimum bactericidal concentrations (MBC) of the plant extracts and the cephalosporin antibiotics on the test organisms were reported. The MIC and MBC of Ceftriaxone was lower in all the bacteria than other cephalosporin

antibiotics and the crude leaves extracts of *A. cordifolia*, except against *Salmonella spp* and *S. aureus* that the Cefalexin had the lowest concentration in MIC and MBC respectively. This is in agreement with (Newton and Abraham, 1954) [25] that Cephalosporins showed antibiotic activity against *S. aureus*, *S. typhi.* The MIC and MBC results confirmed that all the Cephalosporin antibiotics and the crude leaves extracts of *A. cordifolia* [14] had antimicrobial activities against the test bacteria.

The antimicrobial activities of aqueous leaf extract (ALE) on the Gram positive organisms

(*S. aureus*, *S. pneumoniae*, *B. subtilis*) were bactericidal with the ratio (R) MBC/MIC ≤ 2, also bactericidal for two of the Gram negative organisms (*P. aeruginosa*, *Salmonela spp*), but the antimicrobial property for *Escherichia coli* was bacteriostatic as shown in (Table 4).The effect of ethanol leaf extract (ELE) was similar to that of ALE on Gram positive and Gram negative bacteria including for *E. coli* as observed in (Table 5). The result obtained from the aqueous leaf extract is in line with the work of Ebenyi, *et al* [23] who assessed the antibiotic activities of the aqueous and ethyl acetate extracts of the leaves of *A. cordifolia* against *S.aureus*, *S.pneumoniae*, *E. coli*, *P.aeruginosa* and *K. pneumoniae* through antimicrobial susceptibility testing, MIC and killing rate studies. In their study, the result of the effect of aqueous extract on bacteria killing rate showed that the extract is bactericidal to *S.aureus*, *S.pneumoniae*, *P.aeruginosa* and *K. pneumoniae* but bacteriostatic to *E. coli*.

The comparative antimicrobial activities of the *A. cordifolia* leaves crude extracts with the cephalosporin antibiotics in tables 6-8 were summarized in table 9 and the results presented in order of potency or spectrum of activities as follows; The plant extracts showed better spectrum of antimicrobial activities against all the test bacteria. The extracts were bactericidal against *S. aureus*, *S. pneumonia*, *B. subtilis, P. aeruginosa* and *Salmonela spp* but bacteriostatic against *E. coli*, this was in agreement with Agboke *et al* 2020 [26].

Ceftriaxone a third generation cephalosporin antibiotic is the next potent antibiotic with more promising antimicrobial activities against all the test organisms compared to other two first and second generations cephalosporin antibiotics, this can be attributed to its wide spectrum of activity as a third generation cephalosporin. According to Devansh and Anuj (2016) [13], third generation cephalosporins have marked effectiveness against most gram negative bacteria and better gram positive coverage. This was confirmed as this drug showed great activity against both gram-positive and gram-negative bacteria used. It is bacteriostatic against all the Gram positive test organisms, *Staphylococcus aureus, Streptococcus pneumonia, Bacillus subtilis* and bactericidal against the Gram negative test organisms, *Escherichia coli* and *Salmonela spp*, but bacteriostatic against *Pseudomonas aeruginosa*.

Cefalexin a first generation cephalosporin antibiotic is the next potent cephalosporin after Ceftriaxone against the test organisms used for this study with bactericidal activity against *S. aureus* G+ve *and P. aeruginosa* G-ve but *bacteriostatic* against *B. subtilis* G+ve and *Salmonela spp* G-ve. Its activity against *Streptococcus pneumonia* G+ve was not determined. According to Kalman *et al.* (1990) [27], first generation cephalosporin have good antimicrobial activity against gram-positive and gram-negative bacteria but for this study it has almost equal activities against gram positive and gram-negative species used in this study.

Cefuroxime a second generation cephalosporin antibiotic happened to be the least potent compared to the first and third cephalosporin considered for this study, but seems to have better antimicrobial activities against the gram positive bacteria than the gram negative used for this study. It was bactericidal against *S. aureus*, *B. subtilis and bacteriostatic* against *S. pneumoniae all gram positive and bactericidal against P. aeruginosa but E. Coli and Samonella spp were not determined.*

First generation cephalosporins are predominantly active against gram-positive bacteria while the second and third generations have increased activity against gram-negative bacteria

(Harrison and Bratcher, 2008) [28]. The result obtained is in line with this except for Cefuroxime which had no activity against two gram-negative bacteria considered in this study, *E. coli* and *Salmonella spp.*

5. CONCLUSION

Comparative antimicrobial activities of the aqueouse and ethanol leaf extracts of *Alchornea cordifolia* and some Cephalosporin antibiotics available in Uyo LGA of Akwa Ibom state were evaluated using macro dilution assay to determine the Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of the plant aqueous and ethanol leaf extracts and of the Cephalosporin antibiotics against some pathogenic Gram positive and Gram negative bacteria.

The results showed that the *A. cordifolia* leaf extracts has the highest antimicrobial activities on the test bacteria used for this study, this was followed by the third generation cephalosporin antibiotic Ceftriaxone that showed broad spectrum activities against the bacteria after the plant extracts, then the first generation cephalosporin antibiotic Cefalexin that showed better spectrum antimicrobial activities against the test bacteria and lastly the second generation cephalosporin Cefuroxime that was active against the gram positive and one of the gram negative bacteria and not active against the remaining gram negative bacteria used for this study.

The antimicrobial activities is in the following order of potency; *A. cordifolia* leaf extracts > Ceftriaxone > Cefalexin > Cefuroxime. The need for isolation of active bioactive compound of *A. cordifolia* leaves is necessary to produce a new generation of broad spectrum antibiotics.

The results of this study justified the ethnomedical use of the aqueouse and ethanol extracts of the leaves for treatment of different infectious diseases in Nigeria and Africa as a whole.

6. ACKNOWLEDGEMENT

We acknowledged the assistance of Mr. O. U. Etefia, a naturalist of the Pharmacognosy Department, Faculty of Pharmacy, University of Uyo and Mr Samuel Noah the Medical laboratory scientist of University of Uyo medical centre.

CONFLICT OF INTEREST

Authors have declared that no conflicts of interests exist.

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