Antimicrobial Activity of *Jatropha curcas* Extracts on Clinical Isolates from Wound Infection of Patients Attending Jahun General Hospital, Jigawa State, Nigeria

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Abstract: The study was aimed at evaluating phytochemical constituents and antimicrobial activities of *Jatropha curcas* extracts against patients with wound infections attending Jahun General Hospital, Jigawa State. The plant materials were sourced, identified and extracted using water and ethanol. Preliminary phytochemical screening of extracts was carried out using standard procedure. *Escherichia coli, Pseudomonas* sp. *Staphylococcus aureus, Aspergillus niger, Penicillium sp.* and *Candida* sp. were isolated and identified from ten (10) wound patients. Evaluation of antimicrobial activities of the extracts was also carried out. Results of phytochemical screening revealed the presence of saponins, tritepenes, anthraquinones, alkaloids, flavonoids and tannins in both seed and stem bark ethanol and aqueous extract with exception of flavonoids in stem bark extracts. The antimicrobial activities result shows that among the extracts, ethanol seed extracts has the highest antimicrobial activity compared with that of aqueous with the inhibition zone diameter of 15.0 ± 0.0mm and 13.0 ± 0.0mm respectively at 2000µg/ml concentration against *E. coli* and 13.0 ± 0.0mm and 12.0 ± 0.0mm against *Staphylococcus aureus* at 2000µg/ml concentration. Conclusively, ethanol could be considered as the best extracting solvent and *Jatropha curcas* seed extracts could be considered for further analysis on antimicrobial activity against pathogenic bacteria and fungi.
Key words: *Jatropha curcas,* Wound infections, Jahun

INTRODUCTION

The use of plants for medicinal purposes is an age old tradition in Africa, Asia and Latin America (Bibitha *et. al*., 2002). Roughly 80% of plants selected for analysis on the basis of ethno medicinal information have demonstrated significant pharmacological activity (Fatope, 2001). Medicinal plants are cheap and renewable source of pharmacologically active substances. Approximately 20% of the plants in the world have been subjected to pharmacological and/or biological evaluation and a substantial number of new antibiotics introduced into the market are obtained from natural or semi synthetic sources (Mothana and Lindequist, 2005). Despite the availability of different approaches for the discovery of therapeutic natural products still remain as one of the best reservoirs of new structural types.

Plants face many stresses in their life cycle and in the process produce secondary metabolites. These secondary metabolites are not important for the metabolic functions of the plant but help to face many stressful conditions like diseases, pests, etc. Some of these secondary metabolites have capacity to fight microorganisms and thus can be used for medicinal purposes. The active screening of natural products to yield synthetic pharmacologically active compounds is one of the most important aspects in drug development (Cragg *et al*., 1997). However, medicinal plants are the rich source of new medicines and are alternatives to the usual drugs. Medicinal plants had being used as antimicrobial and anti-inflammatory agents (Tepe *et al*., 2004) as such *Jatropha curcas* are among the medicinal plants

Jatropha originated from the hot region of Central and South America (Brazil) and is widely distributed in tropical and subtropical parts of the world belong to family Euphorbiaceae (Becker and Francis 2001). *Jatropha curcas* have been identified as a plant and widely used in traditional medicine

in various parts of Africa (Iwu, 1993). *Jatropha. curcas* variously known as physic nut, purging nut or pig nut (Uche and Aprioku, 2008; Igbinosa *et al*., 2009) is used in folklore remedies for treatment of various ailments such as skin infections, gonorrhea, jaundice and fever (Akinpelu *et al*., 2009). The methanolic leaves extract of *Jatropha curcas* shows antibacterial activity against 13 bacterial species including *E. coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* (Akinpelu *et al*., 2009).

Jatropha curcas is a source of secondary metabolites of medicinal importance (Orwa *et al*., 2009). The leaf, fruits, latex and bark contain glycosides, tannins, phytosterols, flavonoids and steroidal sapogenins that exhibit wide range of medicinal properties (Orwa *et al*., 2009).. The plant product exhibit antimicrobial activity (Orwa *et al*., 2009). The seed of the plant are not only the source of biodiesel but also contains several metabolites of pharmaceutical importance (Orwa *et al*., 2009).The seeds are also used in the treatment of syphilis (Orwa *et al*., 2009). However, due to the fact that many commercial antibiotics are become resistance to the patients and this plants (*Jatrophar curcus*) are used by herbalist to cure different diseases cause by microorganisms (El – Ghazali *et al.,* 2003; Njaronge and Kibunga, 2007), the present study has exploited to evaluate the phytochemical constituents and antimicrobial activities of *Jatropha curcas* extracts against patients with wound infections.

MATERIALS AND METHODS

Collection and identification of Plant Materials

The seed and stem bark of *J. curcas* were collected from Sabongarin Takanebu Miga Local Government Area of Jigawa State in March, 2018. The plant was authenticated at the herbarium unit of the Department of Plant Biological, BUK, Kano (Voucher no. 1911). Seed and the stem bark were air dried at room temperature for 21 days. The dried seed and stem bark were pulverized to coarse powder using mortar and pestle and sieved with 20 mesh (British standard). The fine powder was stored for further analysis.

Extraction of Plant Material

Extraction of plant material was done according to methods described by Fatope *et al.,* 1993. One hundred grams (100g) powder of seed and stem bark were percolated in 1000ml ethanol in separate 2L capacity conical flasks, stoppered and kept for two weeks with intermittent shaking. The percolates were filtered with Whatman's No 1 filter paper. The extract were concentrated at water bath in the Post graduate Lboratory Bayero University, Kano. The same quantity of plant material was again percolated with distilled water for one week and after filteration, the aqueous extract was concentrated in hot oven at 40^{o}C (Fatope *et al.,* 1993). The pure extract were transfer into airtight container and store at 40^{o}C prior to use.

Phytochemical Analysis of plant extracts

Phytochemical analysis of the extracts for qualitative detection of alkaloids, flavonoids, tritepenes, tannins, anthraquinones and saponins was performed as described by Trease and Evans (1989).

Preparation of Concentration of the Extracts

Stock solution (20mg/ml) of the plant extract was prepared by dissolving 0.2g of the plant extract in 10ml of DMSO. Four concentrations were prepared from the stock solution using serial doubling dilution to obtain 250µg/ml, 500µg/ml, 1000 µg/ml and 2000µg/ml respectively.

Isolation and identifications of the bacterial and fungal isolates

Bacterial isolates

Clinical bacterial isolates (*Pseudomonas aeruginosa, Staphylococcus aureus, Escherichia coli*) were obtained from Laboratory Department of Jahun General

Hospital, Jigawa State and were identified using Gram Staining (Todar *et al*. (2005); Motility Test (Todar *et al*. 2005).

Biochemical Tests: Biochemical test such as indole test, methyl red test, citrate utilization test, voges proskauer test, catalase test, Oxidase and Urease test were carried out for the identifications of the isolates as described by Musliu and Salawudeen (2012).

Fungal isolates

Clinical fungal isolates (*Aspergillus* spp, *Candida* spp., *Penicillium* spp.) were obtained and a loopful of homogenate was streaked onto already prepared Potato Dextrose Agar (PDA) plates and kept at room temperature for 7days Murugan *et al*. (2007). Colonies that developed on the medium were identified using cultural and morphological characteristics. Microscopic identification of fungi using cotton-blue in lactophenol was used and the fungal structure (mycelium, fruiting bodies, etc) were examined, using 4x and 10x objective lens Murugan *et al*. (2007).

Antibacterial and Antifungal Activity Assay

The susceptibilities of the bacterial isolates to the plant extracts were assayed as described by Aliyu, *et al*. (2009). Bacterial isolates grown on nutrient agar incubated at 37°C for 18hr were suspended in saline solution (0.85% NaCl) and adjusted to match a turbidity of 0.5 McFarland standard (10^8 cells/ml). The standardized suspension was used to inoculate the surfaces of Mueller Hinton agar plates (9.0mm in diameter) using sterile cotton swab. Six (6) millimeter diameter wells were punched using cork borer in agar and filled with the desired concentrations (2000µg/ml, 1000µg/ml, 500µg/ml and 250µg/ml) of the aqueous and ethanol extracts and a commercial antibiotic (Ciprofloxacin 30µg) was used as reference standard. The plates were allowed to stand for 5 hours at room temperature for extract to diffuse into the agar and then incubated at 37°C overnight and antibacterial activities were evaluated by measuring inhibition zone diameters.

Fungal susceptibility testing, the extracts were incorporated into Potato Dextrose Agar (PDA) and subsequently standardized fungal spores suspension was swabbed on the media and a commercial antifungal drug (Ketoconazole 30µg) was used as reference standard. The sensitivity of the fungi to the test extracts and control was recorded by measuring the zone of inhibitions as described by Murugan *et al.* (2007).

Minimum Inhibitory Concentration (MIC)

The minimum inhibitory concentration (MIC) was determined according to the National Committee for Clinical Standard (1999). Each extract from aqueous and ethanol was separately dissolved in sterile distilled water and 2ml of sterile Mueller Hinton broth was transferred into a set of 5 tubes and a concentrations of 500µg/ml, 250µg/ml, 125µg/ml, 62.5µg/ml and 31.3µg/ml of the extracts were added into a 5 set of test tubes containing 2ml of sterile Mueller Hinton broth respectively. The test organism was inoculated into the labeled tube except the control; the tubes were incubated at 37°C for 18hours. The MIC was taken as the lowest concentration that prevented visible growth. The above procedure was repeated for each of the test organisms.

Minimum Bactericidal and Fungicidal Concentration (MBC/MFC)

The minimum bactericidal and fungicidal concentration (MBC/MFC) was determined according to the National Committee for Clinical Standard (1999). From the test tubes used in the determination of MIC, the tubes that showed no visible growth were sub cultured onto freshly prepared Mueller Hinton agar and incubated at 37°C for 48. The least concentration at which the organisms did not recover and grow was taken as the minimum bactericidal concentrations (MBC) and minimum fungicidal concentrations (MFC).

RESULTS

Table 1hows the physical characteristics of the various *Jatropha curcas* extracts. The aqueous extracts of the stem bark extracts (AESBJC) had the highest percentage yield of 15.1%, followed by aqueous extract of the seed (AESJC), and the least was recovered from ethanol extract of stem bark (EESBJC) with 11.7%. The ethanol extracts of the seed (EESBJ) gave 12.1% (Table 1). The colour was observed to be coffee and dark for ethanol and aqueous extracts of seed and honey for ethanol and aqueous of stem bark extracts respectively (Table 4.1). The texture was observed as creamy for both ethanol and aqueous seed extracts and gummy for both extracts of stem bark (Table 1).

Table 1: Physical Characteristics of the *Jarthropha curcas* Extracts.

Plant Extract	Quantity (g)	%Yield	Physical Properties	
			Colour	Texture
EESJC	100	12.1	12.1	Coffee
AESJC	100	13.8	13.8	Dark
EESBJC	100	11.7	11.7	Honey
AESBJC	100	15.1	15.1	Honey

Key: EES = Ethanol extract of Seed, AESJC = Aqueous extract of Seed, EESB = Ethanol extract of Stem bark, AESB = Aqueous extract of Stem bark, JC = *Jathropha curcas*

Table 2 shows the physicochemical constituents of the extracts of *Jatropha curcas*. The aqueous and ethanol seed and stem bark extracts revealed the presence of saponnins, anthraquinones, alkaloids, tannins, triterpenes and flavonoids (Table 2). However, flavonoid was not present in stem bark ethanol and aqueous extracts.

Table 2: Phytochemical constituents of extracts of *Jathropha curcas* extracts

Phytochemical Constituents	**Extracts**			
	EESJC	**AESJC**	**EESBJC**	**AESBJC**
Saponnins	+	+	+	+
Anthraquinones	+	+	+	+
Alkaloids	+	+	+	+
Tannins	+	+	+	+
Flavonoids	+	+	-	-
Triterpenes	+	+	+	+

Key: EESJC=Ethanol extract of Seed, AESJC= Aqueous extract of Seed, EESBJC= Ethanol extract of Stem bark, AESBJC= Aqueous extract of Stem bark, JC = *Jatropha curcas*, **+ =** Presence**, - =** Absence

The antibacterial and antifungal activities of the aqueous and ethanol seed extracts of the plant was shown in Table 3. The Table revealed that, all the six (6) isolates were susceptible to various concentrations of both the aqueous and ethanol seed extract of the plant, although at the concentration of 250ug/ml the aqueous seed extract did produce any activity on any of the isolates. Table 3 also, shows that the activity of the extracts reduces as their concentration reduces producing lower inhibition zones. The Table further shows that the ethanol seed extract produces higher inhibition zones against the isolates at various concentrations compared to the aqueous extract. Specifically, the highest zone of inhibitions of 15.0±0.0mm and 13.0±0.0mm was produced against *E. coli* by ethanol and aqueous seed extracts at the concentration of 2000µg/ml respectively (Table 3).

The activity of ethanol and aqueous seed extracts at the concentration of 2000µg/ml on *Pseudomonas* spp. produces inhibition zones of 13.0±0.0mm and 12.0±1.0mm respectively, whereas no activity was recorded at the concentrations of 250 and 500µg/ml (Table 3).

Table 3 further revealed that at the concentration of 2000µg/ml, the aqueous seed extract produces the highest inhibition zone of 15.0±2.0mm against *Aspergillus* spp., while the lowest inhibition zone of 9.0± 0.0mm at the concentration of 250µg/ml was produced against *Penicillium* spp. respectively. Table 3 further revealed that, *Aspergillus* spp. and *Penicillium* spp. were not susceptible to all concentrations of the ethanol seed extract used in the study. However, the ethanol seed extract produces its highest inhibition zone against *Candida* sp. of 10.0±0.0mm at the concentration of 2000µg/ml.

Table 3: Antimicrobial activity of *Jatropha curcas* seed extracts on bacterial and fungal isolates

	Antibacterial activity (Mean Zone diameter of inhibition, mm)								
	Aqueous (Conc=µg/ml)				Ethanol (Conc=µg/ml)				
Isolates	250	500	1000	2000	250	500	1000	2000	**Control**
E. coli	7.5±0.5	10.5±1.5	13.0± 0.0	15.0±0.0	0.0±0.00	6.5±0.5	7.5±0.50	13.0±0.50	[a]17.0±0.5
Pseudomonas sp.	6.5±0.5	9.0± 1.0	11.0± 0.0	13.0±1.0	0.0±0.00	0.0±0.0	8.0±1.0	12.0±1.0	[a]15.0±0.2
S. aureus	10.5±0.5	11.5±0.5	11.5±0.5	13.0±1.2	0.0±0.00	0.0±0.0	9.5±0.5	12.0±0.5	[a]18.0±0.5
Aspergillus sp.	9.5±0.5	12.0±0.0	13.5±10.0	15.0±2.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	[b]16.0±0.3
Candida sp.	10.0±1.0	12.5±0.5	13.5±0.0	15.0±1.0	0.0±0.0	6.5±0.5	8.5±0.5	10.0±0.0	[b]16.0±0.4
Penicillium sp.	9.0± 0.0	11.0±1.0	12.5± 2.5	14.0±1.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	[b]17.0±0.5

Key: a=Ciprofloxacin (30µg), b=Ketoconazole; Note: Well diameter =6mm; Values are mean ± standard deviation.
Conc=Concentration

Table 4. Shows the antibacterial and antifungal activity of the aqueous and ethanol stem bark extracts. Both the ethanol and aqueous stem bark extracts produces the highest inhibition zone of 14.5±0.0mm and 14.0±0.5mm against *E. coli* at the concentration of 2000µg/ml respectively (Table 4). Table 4 also shows that at 2000µg/ml, the ethanol and aqueous stem bark extracts produces an inhibition zone of 11.0±1.0mm and 10.5±0.5mm against *S. aureus* respectively.

In relation to fungal species, the highest zone of inhibition of 14.0±0.5mm against *Penicillium* sp was produced at a concentration of 2000µg/ml by ethanol stem bark extract and the lowest inhibition zone of 11.0±1.0mm was against *Candida* spp. (Table 4).

Table 4: Antimicrobial activity of *Jarthropha curcas* stem bark extracts on bacterial and fungal isolates

	Antibacterial activity (Mean Zone diameter of inhibition, mm)								
	Aqueous (Conc=µg/ml)				Ethanol (Conc=µg/ml)				
Isolates	250	500	1000	2000	250	500	1000	2000	**Control**
E. coli	2.5±0.5	7.5±0.5	13.0±0.0	14.0±0.5	6.0±0.0	8.5±0.5	11.5±0.0	14.5±0.0	[a]17.0±0.5
Pseudomonas sp.	8.0±1.0	12.5±0.5	13.0±0.0	13.5±0.0	7.5±0.50	10.5±0.5	12.5±0.5	14.0±0.0	[a]15.0±0.2
S. aureus	3.0±0.0	5.0±0.0	7.0±0.0	10.5±0.5	5.0±0.0	3.5±2.5	9.0±1.0	11.0±1.0	[a]18.0±0.5
Aspergillus sp.	7.5±0.5	9.0±0.0	11.0±0.0	12.0±0.5	8.5±0.0	11.0±1.0	11.0±1.0	13.0±1.0	[b]16.0±0.3
Candida sp.	7.0±0.0	8.5±0.5	10.0±0.0	11.0±0.0	6.50±0.5	9.5±0.5	10.5±0.5	12.5±1.0	[b]16.0±0.4
Penicillium sp.	8.5±0.5	8.5±0.0	9.0±0.0	10.0±0.0	9.0±0.0	10.5±0.5	11.5±1.5	14.5±0.5	[b]17.0±0.5

Key: a=Ciprofloxacin (30µg), b=Ketoconazole; Note: Well diameter =6mm; Values are mean ± standard deviation.
Conc=Concentration

Table 5 revealed that the minimum inhibitory concentration (MIC) of ethanol seed extract against *E. coli*, *Pseudomonas* sp., *S. aureus* and *Candida* sp. was recorded at the concentration of 250µg/ml. For *Aspergillus* sp. and *Penicillium* sp. The MIC was recorded at the concentration of 125µg/ml (Table 5). In case of aqueous seed extract, the MIC was observed at 125µg/ml against *E. coli*, *Aspergillus* sp. and *Penicillium* sp. respectively and for Pseudomonas sp., *S. aureus* and *Candida* sp. the MIC was observed at 250µg/ml respectively (Table 5).

Table 5: Minimum Inhibitory Concentration (MIC) of Seed of *Jarthropha curcas* Extracts on Bacterial and Fungal isolates

	Minimum Inhibitory Concentration (MIC) of Seed Extracts of *Jathropha curcas*									
	Aqueous (concentration, µg/ml)					Ethanol (concentration, µg/ml)				
Isolates	31.3	62.5	125	250	500	31.3	62.5	125	250	500
E. coli	+	+	+	-	-	+	+	-	-	-
Pseudomonas spp.	+	+	+	-	-	+	+	+	-	-
S. aureus	+	+	+	-	-	+	+	+	-	-
Aspergillus spp.	+	+	-	-	-	+	+	-	-	-
Candida spp.	+	+	+	-	-	+	+	+	-	-
Penicillium spp.	+	+	-	-	-	+	+	-	-	-

KEY: += Growth (No inhibition), - = Inhibition (Growth)

Table 6 shows the minimum bactericidal and fungicidal concentrations (MBC/MFC). The Table revealed that the MBC of ethanol seed extracts against *E. coli, Pseudomonas* sp. and *S. aureus* was recorded at the concentrations of 500µg/ml. The minimum fungicidal concentration (MFC) was observed at a concentration of 250µg/ml of ethanol seed extract against *Aspergillus* sp. and *Penicillium* sp., whereas a concentration of 500µg/ml was recorded against *Candida* sp. (Table 6). For the aqueous seed extract, the MBC was recorded at a concentration of 250µg/ml against *E. coli, Pseudomonas* sp. and 500µg/ml against *S. aureus* (Table 6). For the fungal isolates, the MFC was recorded at a concentration of 500µg/ml against *Aspergillus* sp. and 250µg/ml against *Candida* sp. and *Penicillium* sp. respectively (Table 6).

Table 6: Minimum Bactericidal and Fungicidal concentration (MBC/MFC) of seed of *Jathropha curcas* extracts on Bacterial and Fungal isolates

	Minimum Inhibitory Concentration (MIC) of Seed Extracts of *Jathropha curca*									
	Aqueous (concentration, µg/ml)					**Ethanol (concentration, µg/ml)**				
Isolates	31.3	62.5	125	250	500	31.3	62.5	125	250	500
E. coli	+	+	+	+	-	+	+	+	-	+
Pseudomonas sp.	+	+	+	+	-	+	+	+	-	+
S. aureus	+	+	+	+	-	+	+	+	+	-
Aspergillus sp.	+	+	+	-	+	+	+	+	+	-
Candida sp.	+	+	+	+	-	+	+	+	-	+
Penicillium sp.	+	+	+	-	+	+	+	+	-	+

KEY: + = Growth (No bactericidal/fungicidal activity); - = No Growth (Presence of bactericidal/fungicidal activity)

The minimum inhibitory concentration (MIC) in Table 7 revealed that the MIC against all the 3 bacterial isolates were recorded at the concentrations of 250µg/ml for both ethanol and aqueous stem bark extracts. For the fungal isolates, the MIC of the ethanol stem back extracts of 125µg/ml, 500µg/ml and 250 was recorded against *Aspergillus* sp., *Candida* sp. and *Penicillium* sp. respectively (Table 7). For the aqueous extracts, the MIC was observed at concentrations of 250µg/ml against *Aspergillus* sp. and *Candida* sp. and 125µg/ml against *Penicillium* sp. (Table 7).

Table 7: Minimum inhibitory concentration (MIC) of stem bark of *Jarthropha curcas* extracts on Bacterial and Fungal isolates

	Minimum Inhibitory Concentration (MIC) of Seed Extracts of *Jathropha curcas*									
	Aqueous (concentration, µg/ml)					**Ethanol (concentration, µg/ml)**				
Isolates	31.3	62.5	125	250	500	31.3	62.5	125	250	500
E. coli	+	+	+	-	-	+	+	+	-	-
Pseudomonas spp.	+	+	+	-	-	+	+	+	-	-
S. aureus	+	+	+	-	-	+	+	+	-	-
Aspergillus spp.	+	+	+	-	-	+	+	-	-	-
Candida spp.	+	+	+	-	-	+	+	+	+	-
Penicillium spp.	+	+	-	-	-	+	+	+	-	-

KEY: += Growth (No inhibition), - = Inhibition (Growth

Table 8 shows that the MBC of both the ethanol and aqueous stem bark extract against *E. coli*, *Pseudomonas* sp. and *S. aureus* was observed at the concentrations at 500µg/ml. The MFC of 250µg/ml by the ethanol extract was recorded against *Aspergillus* sp., whereas a concentration of 500µg/ml was recorded against *Candida* sp. and *Penicillium* sp. respectively. A concentration of 500µg/ml against *Aspergillus* sp. and *Candida* sp. was recorded as the MFC of the aqueous seed extracts, whereas a concentration of 250µg/ml was recorded against *Penicillium* sp.

Table 8: Minimum Bactericidal and Fungicidal concentration (MBC/MFC) of stem bark of *Jarthropha curcas* extracts

	Minimum Inhibitory Concentration (MIC) of Seed Extracts of *Jathropha curca*									
	Aqueous (concentration, µg/ml)					**Ethanol (concentration, µg/ml)**				
Isolates	31.3	62.5	125	250	500	31.3	62.5	125	250	500
E. coli	+	+	+	+	-	+	+	+	+	-
Pseudomonas sp.	+	+	+	+	-	+	+	+	+	-
S. aureus	+	+	+	+	-	+	+	+	+	-
Aspergillus sp.	+	+	+	+	-	+	+	+	-	-
Candida sp.	+	+	+	+	-	+	+	+	+	-
Penicillium sp.	+	+	+	-	-	+	+	+	+	-

KEY: + = Growth (No bactericidal/fungicidal activity); - = No Growth (Presence of bactericidal/fungicidal activity)

DISCUSSION

The phytochemical constituents of seed and stem bark extracts of *Jartropha curcus* identified are saponnins, anthraquinones, flavonoids, alkaloids, tannins and triterpenens and the pathogenic bacteria and fungi isolated and identified in this study are *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas* sp., *Aspergillus niger*, *Candida* spp. and *Penicillium* sp. these are similar with that of Leonard *et al*., (2013) whose works on Antimicrobial activity of extracts of *Jatropha curcas* and *Calotropis procera* leaves against pathogenic isolates from motorcycle helmets in Lagos metropolis and similar to that reported by (Adamu *et al*., 2012).

Previous studies have reported the antimicrobial activity and medicinal importance of *Jatropha curcas* plant parts (Igbinosa *et al*., 2009; Sharma *et al*., 2010; Arekemase, 2011; Narayani *et al*., 2012; Oloyede *et al*., 2012; Rachana *et al*., 2012; Omoregie and Folashade, 2013). Its antimicrobial activity has been attributed to the presence of certain phytochemicals which include saponins, tannins, alkaloids and glycosides (Arekemase, 2011; Namuli *et al*., 2011).

The seed ethanol and aqueous extracts of *Jatropha curcas* inhibits the growth of tested bacterial and fungal species with exceptions of *Aspergillus* and *Penicillium* species in aqueous extracts this may be due to the fact that ethanol had the high extracting solvent potentials with the highest antimicrobial activity against clinical bacterial and fungal isolates a similar observations was reported by Kareem *et al.*, (2008) as the ethanol extracts of *C. procera* and *J. curcas* leaves had larger zones of inhibition in almost all the test isolates.

Ethanol extracts of *C. procera* leaf was reported to be the extracting solvent with the highest antimicrobial activity against clinical bacterial and fungal isolates. (Kareem *et al.*, 2008). A similar observation was made in this study as the ethanol extracts of *C. procera* and *J. curcas* leaves had larger zones of inhibition in almost all the test

isolates. Arekemase (2011) observed that high levels of phytochemicals were detected in the ethanol extracts than in aqueous and hexane extracts. Similarly, a number of studies have also reported the antimicrobial efficacy of ethanol extracts of other plants (Wojtyczka, 2013).

The stem bark ethanol and aqueous extracts of *Jatropha curcas* inhibits the growth of all the tested bacterial and fungal species. Similarly, Igbinosa *et al*. (2009) reported the antimicrobial activity of stem bark aqueous extract of *J. curcas* against a wide range of bacterial isolates excluding *Klebsiella pneumonia*. In in contrary to this study by Narayani *et al*. (2012) reported that no antimicrobial activity against *E. coli*, *Proteus* sp., *S. aureus* and *P. aeruginosa* was observed from aqueous leaf extract of *J. curcas.* Similarly, Mills-Roberson *et al*. (2012) reported that chloroform extract of *Cryptolepis sanguinolenta* inhibited the growth of test ATCC standard bacterial strains, including *S. aureus*, *S. saprophyticus*, *S. typhi*, *S. typhimurium*, *Proteus mirabilis*, *E. coli*, *Pseudomonas aeruginosa* and *Klebsiella pneumonia*. However, Oloyede *et al*. (2012) reported that aqueous extracts of *J. curcas* (up to a concentration of 500mg/ml) showed antimicrobial activity against *K. pneumonia*, *E. coli* and *P. aeruginosa.* The disparities in the different reports may be attributable to differences in extract preparation and concentrations, and as well as strain differences Microbial antibiotics sensitivity patterns have been reported to be strain-dependent within a given species (Kwon and Lu, 2007). For example, certain strains of *Staphylococcus aureus* are resistant to methilicin (Methicillin-resistant *Stapylococcus aureus*, MRSA), whereas some are not.

The antimicrobial activities observed in this study are in agreement with and comparable to that of earlier reports (Kamboj and Saluja, 2009; Arekemase, 2011; Namuli *et al*., 2011; Afzal *et al*., 2012) reported that the aqueous extract of *C. procera* exhibited antimicrobial activity against known pathogenic test isolates.

The Minimum inhibitory concentrations (MICs) and Minunum Bactericidal and Fungicidal Concentrations (MBC/MFC) of solvent extracts against the tested isolates were observed at lower concentration of 125µg/ml and 250µg/ml respectively for few tested isolates and the remaining isolates was observed at concentration of 250µg/ml and 500µg/ml respectively, this slight discrepancy may be attributable to a possible difference in the characteristics of bacterial and fungal strains used and differences in solvents species used.. A lower MICs values (0.5-1.0 mg/ml) were reported by Kawo *et al*. (2009) for ethanol extracts of *C. procera* leaf against *E. coli* and *S. aureus.* Also similar results was also reported by Igbinosa *et al*. (2009) for stem bark extracts of *J. curcas*. Conclusively, ethanol would be considered as the best extracting solvent and seed extracts of *Jartropha curcus* for antimicrobial activity against pathogenic bacteria and fungi isolated from wound infections.

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