Phytochemical and Antibacterial Acivity of Three Medicinal Plants Found in Nasarawa State

Emgba Samuel Kafu*, Olonisakin Adebisi **

* Dept. Of SLT, Nasarawa StatePolytechnic, Lafia, Nasarawa State, Nigeria
** Dept. Of Chemical Sciences, Adekunle Ajasin University, Akungba-Akoko. Ondo State, Nigeria

Abstract- Phytochemical and antibacterial activity of Maytenus senegalensis, Mitracarpus scaber and Lecaniodescus cupanioides were carried out using hexane and ethanol as solvents. Phytochemical tests revealed the presence of alkaloids, flavonoids, glycosides and resins in all ethanolic extracts of the three plant samples. The results of the antibacterial activity using five pathogens revealed that Lecaniodescus cupanioides had the highest zone of inhibition of 30mm at 125µg/ml against Staphylococcus aureus. Maytenus senegalensis was active against Salmonella typhi with the zone of inhibition of 16mm at 62.50µg/ml, Staphylococcus aureus 8mm at 31.25µg/ml and streptococcus pneumonia 8mm at 62.5µg/ml. Mitracarpus scaber was active against Escherichia coli and salmonella typhi with zones of inhibition of 20mm at 15.62µg/ml and 15mm at 31.50µg/ml respectively. For hexane extract, only Lecaniodescus cupanioides was active against Staphylococcus aureus with zone of inhibition of 8mm at 7.8125µg/ml.

Index Terms- Medicinal plants, Phytochemical, Maytenus senegalensis, Mitracarpus scaber , Lecaniodescus cupanioides, pathogens and antibacterial.

I. Introduction

Our ancestors used all types of plants in their daily lives, and early in the history of the human race they learned-through trial and error- that certain plants could be used to support well being. Herbal preparation, usually made from roots, flowers, barks, or their extracts, were the only effective remedies available to our ancestors. Today 30 percent of conventional drugs are derived from plants. In spite of the cornucopia of modern medicines, more than 80 percent of the world's population still rely primarily on herbal medicines (Wondimu, 2007)

Medicinal plants are gaining wider recognition in recent initiatives for conservation and development at the global level. This is evident in the vision and mission statement of World Health Organization (WHO) on health improvement and in community-based conservation initiatives by international organizations, including the World Bank, the International Development Research Centre (IDRC) and United Nations Development programme (UNDP), for example. The effort by the WHO to recognize and promote the use of local medicinal plant knowledge systems in the health sector, particularly in developing countries, is prominent. The terminologies related to a use of plant-based medicine vary in different cultures, countries, and communities. The WHO, in its widely acknowledged report, used an umbrella term 'traditional medicine' to describe such uses and offers its working definition as 'diverse health practices, approaches, knowledge and beliefs incorporating plant, animal, and/or mineral based medicines, spiritual therapies, manual techniques and exercises applied singularly or in combination to maintain well-being, as well as to treat, diagnose or prevent illness' (WHO, 2002).

The World Bank report (Nickel, 2005) indicated that more than eighty percent of the population of South Asia uses plant-based medicines for maintaining and improving their health. The total reported usages of medicinal plants vary. For instance, the WHO (2002) study listed 21,000 plants with reported medicinal uses around the world, while Schippmann and co-workers (2002) estimated this figure as 52,885. Amidst these conflicting claims on numbers, the use of medicinal plants by local communities or groups has remained high especially in Nasarawa State where the predominant population are poor or peasant farmers who could not afford the modern drugs.

Several phytochemical surveys have been published, including the random sampling aproach which involved some plant accessions collected from all parts of the world. The major chemical substances of interest in these surveys were the alkaloids and steroidal sapogenins, however other diverse groups of naturally occuring phytocomponents such as flavonoids, tannins, unsaturated sterols, terpenoids, etc., have also been reported (Tin-Wa *et al*., 1971). There is currently a large and ever expanding global population base that prefers the use of natural products in treating and preventing medical problems because herbal plants have proved to have a rich resource of medicinal properties (Muregi *et al*., 2004). In this research preliminary phytochemical screening and antibacterial activity of three medicinal plants found in Lafia, Nasarawa State, Nigeria has been examined to evaluate their potency against some pathogens.

II. MATERIALS AND METHODS

Collection and Processing of Samples

The leaves of *Mitracarpus scaber* and *Maytenus senegalensis* and the root of *Lecaniodiscus cupanioides* were collected and the plant samples were dried at room temperature, and then powdered. The powdered samples were extracted using soxhelet extractor with hexane and ethanol as solvents. The solvent was then evaporated using a rotary evaporator until a very concentrated extract was obtained.

Identification Tests

The tests were done using the extracts of the three plants to find the presence or absence of some secondary metabolites such as alkaloids, tannins, saponins, flavanoids, anthraquinones, glycosides, steroidal ring, cardiac glycosides, steroids/terpenes, phlobatannins and resins using standard methods as described Harborne, 1988 and Trease and Evans 1983.

Antibacterial Test

Preparation of Inoculum

The organisms used are *Staphylococus aureus*, *Streptococcus pneumonia, Pseudomonas aeroginosa*, *Escherichia coli, Shegella flexmeri and Salmonella typhi.*

Inoculum was prepared from a pure colony of the test organisms by suspending the colony in a tube containing 5ml Muller-Hitton broth and was incubated at 35^{o}c for 2-8 hours until turbidity reached 0.5 Macfarland Standard giving a load of 10^{5}-10^{6} organism/ml.

Broth Dilution Antimicrobial Susceptibility

Nutrient broth was prepared and 0.5g of extract was weighed into 2mls of nutrient broth to form neat.Twofold dilution was carried out till the 10th tubes. 0.2mls or a drop of standard Inoculum was dropped into all the tubes and incubated at 37^{o}c for 24 hours. After 24 hours incubation, subculture was made on Blood Agar for sterility or growth check. The lowest concentration showing visual inhibition of growth is (MIC) Minimum Inhibition Concentration.

III. RESULTS AND DISCUSSION

Table 1 shows some characteristics of the plant samples.The three plant samples produced coloured extracts. The ethanolic extracts of *M. senegalensis* produced dark brown colour, *M. scaber* produced light brown colour and *L. cupanioides* produced brown colour. The hexane extracts of *M. senegalensis* produced dark green colour, *M. scaber* produced dark brown colour and *L. Cupanioides* produced brown colour. The percentage yields of the ethanol extracts of the three plants are generally higher than that of the hexane extracts. *M. senegalensis* of ethanolic extract gave the highest yield (55.06 %) while the highest yield for hexane extract is also from *M. senegalensis* (7.86%). The ethanolic extracts of *M. Scaber* and *L. cupanioides* gave (15.11 %) and (31.72 %) yields respectively. *M. Scaber* produced the lowest amount of the extract for the ethanol while *L. Cupanioides* gave the least amount for hexane (2.68 %). The components of the extracts are more soluble in ethanol solvent than hexane, hence the highest yield. The hexane extracts gave the smallest percentage yield.

It was suggested that the addition of *M. senegalensis* root to milk and meat-based foods by Masai and Batemi populations of Tanzania reduced the incidence of cardiovascular diseases despite their high intake of fats and cholesterol (Johns *et al*., 1999). In Nigeria, the juice from the crushed plant is known to be applied topically for the treatment of skin diseases such as ringworm, lice, itching, craw-craw and other fungal diseases or applied to dressings for fresh cuts, wounds and ulcers (Fredrickson *et al*., 2004). It is also used as an ingredient in fish poison by some pagan tribes (Jawetz *et al*.,1978).

Table 2 shows the phytochemistry of the extracts which revealed the presence of many bioactive compounds. The ethanol extracts generally contained the highest bioactive compounds with glycosides, flavonoids, saponnins, alkaloids and resins present in large quantities while anthraquinones were absent. Tannins and anthraquinones were absent in the ethanolic extract of *Maytenus senegalensis.* Alkaliods, anthraquinones and phlobatannins were absent in ethanolic extact of *Mitracarpus scaber* while saponnins, anthraquinones, and steroids/terpenes were absent in *Lecaniodescus cupanioides.* On the other hand, the hexane extracts contained the lowest bioactive Compounds with the alkaloids, saponins, tannins, anthraquinones, glycosides, and phlobatannins being absent. It is notable that secondary metabolites are extremely diverse; many thousands have been identified in several major classes. Each plant family, genus, and species produced a characteristic mix of these chemicals, and can sometimes be used as taxonomic characteristics in classifying plants. Humans use some of these compounds as medicines, flavourings, or recreational drugs (Jorge *et al*., 2004).

From the antibacterial analyses (Table 3), the results show that the extracts are active against the test organisms. The ethanolic extracts are more active than the hexane extracts. The ethanolic extracts of *Maytenus senegalensis* was active on *Salmonella typhi* with the zone of inhibition of 16mm at 62.50µg/ml, *Staphylococcus aureus* has 8mm at 31.25µg/ml and *streptococcus pneumoniae* also has 8mm at 62.5µg/ml as zones of inhibition. Thus, following the traditional use of the plant in Sudan, Kenya or Tanzania, it was demonstrated that the leaf, root and stem bark extracts of *M. senegalensis* posses *invitro* antiplasmodial (Gessler *et al*., 1995; El -Tahir *et al*., 1999), antileishmanial (El -Tahir *et al*., 1998), and antibacterial activities (Matu and van Staden, 2003). *Mitracarpus scaber* was active against *Escherichia coli* and *salmonella typhi* with zones of inhibition of 20mm at 15.62µg/ml and 15mm at 31.50µg/ml respectively. It is claimed that *Mitracarpus scaber* possesses antimicrobial activities when crude extracts from the plant is used (Gundidza *et al*., 1994). Recent studies have shown that alcoholic extracts of the aerial parts of *Mitracarpus scaber* had i*nvitro* antimicrobial activity against Dermatophilus congilensis (Bussman and Sharon, 2006). *Lecaniodescus cupanioide*s was active against *Staphylococcus aureus* with the highest zone of inhibition of 30mm at 125µg/ml which is as active as the ceftriaxone sodium (standard drug).

For the hexane extracts, only *Lecaniodescus cupanioides* was active against *Staphylococcus aureus* at with a zone of inhibition of 8mm at 7.8125µg/ml. This result shows that the principles or constituents responsible for the antibacterial activity tend to reside more in the ethanol extracts as shown by the ethanolic extracts of *Lecaniodescus cupanioides* which have the same potency with the standard (ceftriaxone sodium 30 mg) on *staphylococcus aureus* with 30mm zone of inhibition. The standard, cetriaxone sodium is sensitive to *Escherichia coli, Staphylococcus aureus* and *Salmonella typhi.*

Table 4 shows the minimal inhibitory concentration (MIC) (µg/ml) of the three extracts. The ethanolic extract of *Lecaniodescus cupanioides* has the highest MIC of 16µg/ml against *Staphylococcus aureus* followed by ethanolic extract of *Maytenus senegalensis* and *Mitracarpus scaber* which have MIC values of 8µg/ml each against *Escherichia coli* and *Salmonella* *typhi* respectively. Ethanolic extract of *Maytenus senegalensis* and *Mitracarpus scaber* also had MIC values of 4µg/ml against *Streptococcus pneumonia* and *Salmonella typhi* in that order. The lowest MIC is 2 µg/ml of the ethanolic extract of *Maytenus senegalensis.* The only MIC on the hexane extract is that of *Lecaniodescus cupanioides* which is 2µg/ml against *Staphylococcus aureus.*

Table 1: Some Characteristics of the Plant Materials

S/No	Plant Sample	Local name	Family	Common Name	Used Part	Local Usage	% Yield	Solvent	Colour
1.	*Maytenus senegalensis*	Kahanri	*Celatraceae*	Spike thorn	Leaves	Additive of milk and meat based foods	55.06	Ethanol	Dark Brown
							7.86	Hexane	Dark Green
2.	*Mitracarpus scaber*	Nashie	*Rubiaceac*	Button grass	Leaves	Treatment of skin disease	15.11	Ethanol	Light Brown
							5.38	Hexane	Dark Brown
3	*Lecaniodescus cupanioides*	Ohua	*Sapindaceace*	Ginger Lilly	Root	Medicine/Agriculture	31.72	Ethanol	Brown
							2.68	Hexane	Brown

Local name is from the Eggon tribe in Nasarawa State, Nigeria

Table 2: Phytochemical Screening of Hexane and Ethanol Extracts of the Three Plants Samples

Test	Ethanolic extracts			Hexane extracts		
	MS	MT	LC	MS	MT	LC
Alkaloids	_	+++	++	_	_	_
Saponins	_	+++	_	_	_	_
Flavonoids	++	++	++	+	+	++
Tannins	++	_	+	_	_	_
Anthraquinones	_	_	_	_	_	_
Glycosides	_	_	_	_	_	_
Steroids/Terpenes	+++	+	_	++	+	+
Resins	+	+	+++	+++	_	_
Cardiac glycosides	+++	++	++	++	+	+
Steroidal	+	+	+	+	_	+
phlobatannins	_	++	+	_	_	_

MT = *Maytenus senegalensis* , MS= *Mitracarpus scaber,* LC = *Lecaniodescus cupanioides*
(+) score was recorded if the reagent produced only a slight opaqueness
(++) score was recorded if a definite turbidity, but no flocculation was observed
(+++) score was recorded if a definite heavy precipitate or flocculation was produced

Table 3: Antibacterial activity of Ethanolic and Hexane Extracts of the Three Plant Samples

Organisms	Zone of Inhibition (mm)						
	MSE	MTE	LCE	MSH	MTH	LCH	STD
Escherichia Coli	_	20	_	_	_	_	32
Staphylococcus aureus	8	_	30	_	_	8	30
Streptococcus pneumoniae	8	_	_	_	_	_	_
Shigella flexmeri	_	_	_	_	_	_	_
Pseudomonas aeroginosa	_	_	_	_	_	_	_
Salmonella typhi	16	15	_	_	_	_	22

MSE = *Maytenus senegalensis* ethanolic extract, MTE =*Mitracarpus scaber* ethanolic extract, LCE = *Lecaniodescus cupanioides* ethanolic extract
MSH = *Maytenus senegalensis* hexane extract, MTH = *Mitracarpus scaber* hexane extract, LCH = *Lecaniodescus cupanioides* hexane extract
- No activity
STD = Standard (30 µg ceftriaxone)

Table 4: Minimal Inhibition Concentration (MIC) (µg/ml) of the Three Extracts

Organisms	MSE	MTE	LCE	MSH	MTH	LCH
Escherichia Coli	_	8	_	_	_	_
Staphylococcus aureus	2	_	16	_	2	_
*Streptococcus pneumonia*e	4	_	_	_	_	_
Shigella flexneri	_	_	_	_	_	_
Pseudomonas aeroginosa	_	_	_	_	_	_
Salmonella typhi	8	4	_	_	_	_

MSE = *Maytenus senegalensis* ethanolic extract, MTE =*Mitracarpus scaber* ethanolic extract, LCE = *Lecaniodescus cupanioides* ethanolic extract,
MSH = *Maytenus senegalensis* hexane extract, MTH =*Mitracarpus scaber* hexane, extract, LCH = *Lecaniodescus cupanioides* hexane extract

REFERENCES

[1] Bussman, R.W. and Sharon D. (2006).Traditional medicinal plant use in Northern Peru. Journal of Ethnobiology and Ethnomedicin, 47:11-17

[2] El Tahir, A., Ibrahim, A.M., Satti, G.M.H., Theander, T.G., Kharazmi, A. and Khalid, S.A. (1998). The potential antileishmanial activity of some Sudanese medicinal plants. Phytother. Res., 12: 576-579.

[3] El Tahir, A., Satti, G.M.H. and Khalid, S.A. (1999). Antiplasmodial activity of selected Sudanese medicinal plants with emphasis on Maytenus senegalensis (Lam.). Journal of Ethnopharmacol, 64:227-233

[4] Fredrickson,J.K., Zachara,J.M. and Balkwill, D.L. (2004). Journal of Applied and Environmental Microbiology, 70 (7):4230–41.

[5] Gessler, M.C., Tanner, M., Chollet, J., Nkunya, M.H.H. and Heinrich, M. (1995). Tanzanian medicinal-plants used traditionally for the treatment of malaria--in vivo antimalarial and in vitro cytotoxic activities. Phytother. Res., 9: 504-508.

[6] Gundidza, M., Chinyanganya, F., Chagonda, L., De Pooter, H.L. and Mavi, S. (1994). Phytoconstituents and antimicrobial activity of the leaf essential oil of clausena anisata (Willd.). Flavor and Fragrance Journal, 10: 9-12.

[7] Harborne, J.B. (1988). Phytochemical methods. Chapman and Hall, London. 3rd Edition. P. 61, 191

[8] Jawetz, E., Janet, S., Nicholas, L. and Edwards, E. (1978). Skin micro organism In Medical Microbiology. Lange InternationaL Journal. 25 -27.

[9] Johns, T., Mahunnah, R. L. A., Sanaya, P., Chapman, L. and Ticktin, T. (1999). Saponins and phenolic content in plant dietary additives of a traditional subsistence community, Tanzania. Journal of Ethnopharmaco, 66:1-10.

[10] Jorge, R.M., Leite, J.P.V., Oliveira, A.B. and Tagliati, C.A., (2004). Evaluation of antinociceptive, anti-inflammatory and antiulcerogenic activities of Maytenus ilicifolia. Journal of Ethnopharmacol, 94: 93-100.

[11] Matu, E.N. and Van Staden, J. (2003). Antibacterial and anti-inflammatory activities of some plants used for medicinal purposes in Kenya.
Journal of Ethnopharmacol, 87:35-41.

[12] Muregi, F.W., Chhabra, S.C., Njagi, E.N.M., Lang'at-Thoruwa, C.C., Njue, W.M., Orago, A., Omar, S.A. and Ndiege,I.O. (2004).Anti-plasmodial activity of some Kenyan medicinal plant extracts singly and in combination with chloroquine, 18:379-384.

[13] Nickel, W. and Sennhauser, E. (2005). Medicinal Plants: Local heritage withGlobalimportance. World Bank Group, South Asia; http://lnweb18.worldbank.org/sar/sa.nsf Accessed 21 August,2005.

[14] Tin-Wa, M., Farnsworth, N.R., Fong, H.H.S., Blomster, R.N., Trojanek, J., Abraham, D.J., Persinos, G.J. and Dokosi, O.B., (1971). Biological and phytochemical evaluation of plants. Lloydia , 34: 79-87.

[15] Trease, G.E and Evans, W.C (1983). Pharmacognopsy. Bailiere Tindal. London. 12th Edition. Pp. 26-29

[16] Wondimu ,T., Asfaw, Z. and Kelbessa, E. (2007) Ethnobotanical study of medicinal plants around 'Dheeraa' town. Journal of Ethnopharmacology.112: 152-161.

[17] World Health Organization (2002). Traditional Medicines Strategy, Geneva. 22-25

[18] World Health Organization (2002). Traditional Medicines Strategy, Geneva. 22-25

AUTHORS

First Author – Emgba Samuel Kafu, M.Sc. Industrial Chemistry, Dept. Of SLT, Nasarawa StatePolytechnic, Lafia, Nasarawa State, Nigeria, arimangba@yahoo.com
Second Author - Olonisakin Adebisi, M. Sc. and PhD Organic Chemistry, Dept. Of Chemical Sciences, Adekunle Ajasin University, Akungba-Akoko. Ondo State, Nigeria

Correspondence Author - Emgba Samuel Kafu, arimangba@yahoo.com, +2348034490135