

Full Length Research Paper

Pharmacological justification for the ethnomedical use of *Datura Stramonium* stem-bark extract in treatment of diseases caused by some pathogenic bacteria

M. H. Shagal*, U.U. Modibbo, and A. B. Liman

Department of Chemistry, Modibbo Adama University of Technology, P.M.B. 2076, Yola, Nigeria.

Accepted 11 January, 2020

Phytochemical screening and antimicrobial activity of the aqueous and ethanolic extract of the stem-bark of *Datura stramonium* was carried out. The extraction with the two solvents (water and ethanol) was carried out at room temperature. The phytochemical investigations include saponins, tannins, steroids, alkaloids, flavonoids, phenols and glycosides. The antimicrobial activity was investigation on *Staphylococcus aureus*, *Salmonella typhi*, *Shigella spp*, *Eschericia coli*, *Klebsiella pneumonia* and *Neisseria gonorrhoea*. The results revealed the presence of saponins, steroids, alkaloids, and glycosides in both the extracts. Flavonoid was present only in the ethanol extract. The antimicrobial activity revealed that ethanolic extract showed more antibacterial activity than the aqueous extract. It showed some activities against all the tested bacteria except *Neisseria gonorrhoea*. The aqueous extract only showed activity against *Staphylococcus aureus*.

Keywords: *Datura stramonium*, alkaloids, Microbes, antimicrobial activity, ethanolphytochemical screening.

INTRODUCTION

In recent years, secondary plant metabolites (phytochemicals), previously with unknown pharmacological activities, have been extensively investigated as a source of medicinal agents (Krishnaraju et al., 2005). Thus, it is anticipated that phytochemicals with adequate antibacterial efficacy will be used for the treatment of bacterial infections (Balandrin et al., 1985). Since time immemorial, man has used various parts of plants in the treatment and prevention of various ailments (Tanaka et al., 2002).

Medicinal plants represent a rich source from which antimicrobial agents may be obtained. Plants are used medicinally in different countries and are a source of many powerful drugs (Srivastava et al., 1996).

The interest in the scientific investigation of medicinal plants from Nigeria is based on the claims of their effective use for the treatment of many diseases. Therefore research into the effects of these local medicinal plants is expected to enhance the use of

these plants against diseases caused by the test pathogens.

Medicinal plants are of great importance to the health of individuals and communities, plants have provided source of inspiration for novel drug compounds. Modern scientist have made phenomenal step in developing this heritage handed over by our forefathers (Sofowora, 1986).

Plants usually contain physiologically active substances which are technically referred to as drugs and over the years these drugs have been exploited as traditional medicine for the treatment of various ailments afflicting man (Adebanjo et al., 1983). Antimicrobial substances are those substances that are capable of destroying or inhibiting the growth of microorganism (Houghton, 2002).

The drugs obtained from medicinal plants are termed crude drug of natural or biological origin as described by pharmacist and pharmacologist (Sofowora, 1982). Infectious diseases are the leading cause of death world-wide. Antibiotic resistance has become a global concern (Westh et al., 2004). The clinical efficacy of many existing antibiotics is being threatened by the emergence of multidrug-resistant pathogens (Bandow

*Corresponding author email: shagal2006@yahoo.com; Tel: 08052284456

Table 1. Phytochemical analysis of extracts from stem-bark of *Datura stramonium*

Bioactive compounds	Water extract	Ethanol extract
Saponins	+	+
Tannins	-	-
Steroids	+	+
Alkaloids	+	+
Flavonoids	-	+
Phenols	-	-
Glycosides	+	+

+ = present, - = absent

et al., 2003). Many Infectious diseases have been known to be treated with herbal remedies throughout the history of mankind. There is a continuous and urgent need to discover new antimicrobial compounds with diverse chemical structures and novel mechanisms of action for new and re-emerging infectious diseases (Rojas et al., 2003). Therefore, researchers are increasingly turning their attention to folk medicine, looking for new ways to develop better drugs against microbial infections (Benkeblia, 2004). The increasing failure of chemotherapeutics and antibiotic resistance exhibited by pathogenic microbial infectious agents has led to the screening of several medicinal plants for their potential antimicrobial activity (Colombo and Bosisio, 1996; Iwu et al., 1999).

The therapeutic activities of most plants are due to the presence of one or more of such components such as alkaloids, tannins, saponins, cardiac glycosides (Nweze et al., 2004).

The primary psychoactive substances in *Datura stramonium* are alkaloids such as atropine and scopolamine (Giral and Hildalgo, 1983). Scopolamine is available by prescription primarily for treating motion sickness. The anti-inflammatory property of all parts of the plant accounts for its other medicinal uses, (Spring, 1989), stimulation of the central nervous system (Guharov and Barajas, 1991), respiratory decongestion (Zagari, 1992), treatment of dental and skin infections and also in the treatment of tooth ache and alopecia (Darias et al, 1986; Abebe, 1986).

The aim of this study was therefore designed to evaluate the phytochemical constituents and antimicrobial potentials of the stem- bark of this plant against some pathogenic bacteria

MATERIALS AND METHODS

Sampling and sample preparation

Fresh stem-bark of *Datura stramonium* were collected in May 2011 from Bajabure housing estate, Viniklang, Gerei Local Government Area of Adamawa State and

were authenticated by Dr. D. A. Jauro of Forestry Department, School of Agriculture and Agricultural Technology, Modibbo Adama University of Technology, P.M.B. 2076 Yola, Nigeria. The identified plant parts were washed with tap water and air-dried. The dried parts were chopped into pieces, milled into fine powder by pounding manually with a clean and sterile pestle and mortar. The powdered sample was collected into sterile cellophane bag. The samples were kept in cool dry place till further use. The powdered sample was used for extraction purposes.

Extraction procedure

250ml of distilled water was added to 50g of the powdered sample in a flask. The soaked sample was stirred, sealed with aluminium foil and allowed to stand for 72 hrs. The content was then filtered with Whatman No. 1 filter paper. The filtrate was concentrated using rotary evaporator at 40°C and the concentrated extract was stored in a universal bottle and refrigerated at 4°C prior to use.

The same procedure was followed with fresh sample as described above except that ethanol was used as solvent in place of distilled water.

Phytochemical Screening

Phytochemical screening for major constituents was undertaken using standard qualitative method as described by (Harborne, 1992), (Odebiyi and Sofowora, 1990) and (Fadeyi et al., 1989). Alkaloids, tannins, flavonoids, phenols, saponins, steroids and glycosides tests were conducted in the fraction. Results are shown in Table 1.

Test for Saponins

5ml of extract was vigorously shaken with 10ml of water in a test tube. Frothing which persisted was taken as an evidence for the presence of saponins.

Test for Tannins

Extract plus 4ml of water and drops of ferric chloride. Immediate green precipitate was taken as evidence for the presence of tannins.

Test for Flavonoids

Extracts plus small quantity of Magnesium chips plus drops of concentrated hydrochloric acid down the side of test tube. Reddish coloration was taken as evidence

Table 2. Antimicrobial activity of stem-bark extracts of *Datura stramonium* against human pathogens (Diameter of zone of inhibition in mm)

Fraction	Microorganisms					
	<i>S. aureus</i>	<i>Shigella</i>	<i>K. pneumonia</i>	<i>E. coli</i>	<i>S. typhi</i>	<i>N. gonorrhoea</i>
Water	10.0	R	R	R	R	R
Ethanol	12.0	7.0	13.0	7.0	5.0	R
Gentamicin (control)	17.0	13.0	15.0	12.0	14.0	16.0

R=Resistance

for the presence of flavanoids.

Test for Alkaloids

2 ml of the extract plus picric acid. An orange colouration was taken as evidence for the presence of alkaloids.

Test for phenols

Equal volume of the extract was added to equal volume of ferric chloride, a deep bluish green solution was taken as a positive test for the presence phenols.

Test for glycosides

5ml of extract plus 25ml of dilute sulphuric acid were poured into a test tube. The mixture is boiled for 15 minutes, cooled and neutralized with 10% sodium hydroxide and 5 ml of Fehling solution was added. Brick red precipitate is a positive test for the presence of glycosides

Antimicrobial investigation

Clinical isolates of *Salmonella typhi* (ST22011FMC), *Escherichia coli* (EC32011FMC), *Staphylococcus aureus* (SA42011FMC), *Neisseria gonorrhoea* (NG12011FMC), *Shigella sp* (SS62011FMC) and *Klebsiella pneumonia* (KP72011FMC) were obtained from the Microbiology laboratory of Federal Medical Centre, Yola.

The stocks were maintained on nutrient agar slant and sub-culture in nutrient both for incubation at 37°C prior to each antimicrobial testing. Inoculation of the test organisms on nutrient agar prepared plates was achieved by flaming a wire loop on a spirit lamp, cooling the wire loop (air cooling) and fetching the test organisms. The discs were prepared using a whatman

filter paper and putting in vials-bottles and sterilizing in an oven at 150°C for 15 minutes. Prepared discs containing the various extracts were carefully placed on the inoculated plates using a sterilized forceps in each case (Fatope, 1993). The plates were then turned upside-down and inoculate at 37°C for 24 hours in an incubator. After incubation, the inoculated plates were observed for zones of inhibition (in mm diameter).

The result was taken by considering the zone of growth and inhibition of the organisms by the test fractions (Mackie and McCartney, 1989). Activity and inactivity were observed in accordance with the standard and acceptable method. Results are shown in Table 2

RESULTS AND DISCUSSION

The phytochemical constituents of stem- bark of *Datura stramonium* are summarized in Table 1. The result clearly revealed that, the stem bark of the plant contains all the phytochemicals screened for with the exception of tannins, and phenols in both extracts and flavonoids in the aqueous extract. It is not surprising that there may be differences in the phytochemicals screened compare with others; this might be due to geographical locations of the plant. The results of antimicrobial activity of the stem bark extracts of the plant are summarized in Table 2. The result showed that the stem bark extract exhibited different inhibitory activities on the tested microorganisms. Ethanol extract exhibited the highest inhibitory activity against *K. pneumonia* with activity of 13.0mm followed by *S. aureus* with activity of 12.0mm. *S. typhi* showed the least activity (5.0mm). The aqueous extract showed activity on only *S. aureus* (10mm), while *N. gonorrhoea* was resistant to both extracts. The stem bark contains high amount of saponins, which helps to monitor diabetes by lowering the absorption of cholesterol and immune booster (Duke, 1985). Saponin also helps to reduce the risk of certain forms of cancer, enhance functions of the lungs and lower sugar level. Thus making the stem bark of the plant useful in case of late onset of diabetes

(Sofawora, 1982).

The results obtained from the antimicrobial activity showed that all the extracts exhibited different inhibitory activities against the different tested microorganisms. These inhibitory activities could be due to the presence of phytochemicals in the different extract (Nweze *et al.*, 2004). Thus the stem bark could be a source of synthetic drugs (Sofowora, 1993). The result also showed that ethanol is more suitable solvent for extraction of the stem bark of *D. Stramonium*. Hence the stem bark could be useful in the treatment of diseases like Pneumonia, Diarrhoea, Gonorrhoea and so on (Duke, 1983).

This study has provided some biochemical basis of the medical use of the extracts from *D. Stramonium* in the treatment of infections, as a potential source of useful drugs and phytochemicals. Identification of specific phytochemical from class of bioactive agent found in the plant is therefore crucial towards exploiting the enormous benefits of *D. Stramonium* to mankind especially with regard to the growing resistance of most pathogens to the activities of the common antimicrobials.

CONCLUSION

The study has shown that the extracts of *D. Stramonium* possess metabolites that enhances its activity as an antimicrobial agent, which was found to be effective against these pathogenic microorganisms involved in causing some diseases. Therefore the results of this study provide a rationale for the use of the plant parts in traditional medicine practice in Nigeria. The activity of this plant should further be investigated against wide range of microorganisms. Thorough pharmacological studies should be carried out on pure extracts of the stem bark of *D. Stramonium* so as to ascertain their mode of actions and toxicological effects on various animal organs. Overdose of the stem bark extracts should be avoided by patients. This is because high dose of the extracts may have adverse effects on organs like liver or kidney.

Also, purification and toxicological studies should be carried out with a view of sourcing antimicrobial agents for drug development.

REFERENCES

- Abebe W (1986). A Survey of Prescriptions used in traditional Medicine in Gondar region North-West Ethiopia General Pharmaceutical Practice J. *Ethnopharmacol* 18:147 -165
- Adebanjo AO, Adewumi CO, Essiene EE (1983). Anti-infective agents of higher plants. 5 International symposium on medical plants university of Ife Nigeria. Pp 152 -158.
- Balandrin MF, Kjocke AJ, Wurtele E (1985). Natural plant chemicals: sources of industrial and mechanical materials. *Science* 228:1154-1160.
- Bandow JE, Brotz H, Leichert LIO (2003). Proteomic approach to understanding antibiotic action. *Antimicrob Agents Chemother.* 47: 948-955.
- Benkeblia N (2004) Antimicrobial activity of essential oil extracts of various onions (*Allium cepa*) and garlic (*Allium sativum*). *Lebensm-Wiss u-Technol* 37: 263-268.
- Colombo ML, Bosisio E (1996). Pharmacological activities of *Chelidonium majus* L (Papaveraceae). *Pharmacol. Res.* 33: 127-134.
- Darias V, Brovol, Barquine. Horrera DM, Fraile C (1986). Contribution to the ethnopharmacological study of the canary Islands J. *Ethnopharmacol.* 18: 169-193.
- Duke JA (1985). *Medicinal plant science.* London. Macmillan press limited 229; 1036.
- Fadeyi MG, Adeoye AC, Olowokodejo JD (1989) Epidermal and Phytochemical Studies with genus *Boerhavia* (nyetanginaceae) *Crude Drug Res.* 29: 178-184.
- Fatope MO, Adoum OA (1993). "Bioactivity of some savannah plants in the brine shrimp lethality test and in-vitro anti-microbial Assays". *Int. J. pharmacognosy.* 35(5): 334-33.
- Giral F, Hidalgo CC (1983). Presence of Alkaloids in Mexiplants. *ml J. Crude Drug Res.* 2:1 —13.
- Guharov SR, Barajas M (1991). Intense Stimulant Effect atropine intoxication from the ingestion and smoking of Jemson weed (*Datura Stramonium*). *Vet. Toxicol.*33:588 589.
- Harborne JB (1992). *Phytochemical Methods* . Chapman and Hall publication Pp. 7-8
- Houghton M (2002): *The American Heritage (Stamens Medical Dictionary).* Houghton Mifflin Publishers.
- Iwu MW, Duncan AR, Okunji CO (1999). New antimicrobials of plant origin. In: Janick J. ed. *Perspectives on New Crops and New Uses.* Alexandria, VA: ASHS Press; pp. 457-462.
- Krishnaraju AV, Rao TVN, Sundararaju D (2005). Assessment of bioactivity of Indian medicinal plants using Brine shrimp (*Artemia salina*) lethality assay. *Int. J. Appl. Sci. Eng.* 2: 125-134.
- Mackie R, McCartney C (1989), *Practical Medicinal Microbiology* 3rd edition, Vol. 2 Churchill Livingstone (publishers), London and New York Pp. 100 – 106,121, 141, 163-167, 303, 432-491
- Nweze EL, Okafor JL, Njoku O (2004). Antimicrobial activity of methanol extract of trune guineensis (Schumm and thorn) and morinda icida Benth used in Nigerian Herbal Medicinal Practice. *J. Biol. Res. Biotechnol,* 2(1):39-46
- Odebiyi A, Sofowora AE (1990). Phytochemical Screening of Nigerian Medicinal Plants. Part III. *Lloyida.* Pp. 234 – 246.
- Rojas R, Bustamante B, Bauer J (2003). Antimicrobial activity of selected Peruvian medicinal plants. *J. Ethnopharmacol* 88: 189-204.
- Sofawora A (1982). *Medicinal Plants and Traditional Medicine in African.* John Wiley and sons Ltd, New York. Pp. 6, 14, 55, 142-177, 191, 234-251.
- Sofowora A (1993). *Medicinal Plants and Traditional Medicine in African* book Ltd, Ibadan Nigeria 289.
- Sofowora, A. (1986). *The State of Medicinal Plants Research in Nigeria,* published by spectra books limited, Ibadan, pages 1-11, 56, 65-70, 74, 87-89, 138, 24-251, 261-264, 360-362.
- Spring M A (1989). *Ethnopharmacologic Analysis of Medicinal Plants Used by L. aotLan 1-Imong refugees in minesota* J. *Ethnopharmacol* 26:65-91.
- Srivastava, J., Lambert, J., and Viemeyer, N.(1996). *Medicinal plants: An expanding role in development.* World Bank Technical Paper, 320.
- Tanaka H, Sato M, Fujiwara S (2002). Antibacterial activity of isoflavonoids isolated from *Erythrina variegata* against methicillin resistant *Staphylococcus aureus*. *Lets. Appl. Microbiol.* 35: 494-498.
- Westh H, Zinn CS, Rosdahi VT (2004). An international multicenter study of antimicrobial consumption and resistance in *Staphylococcus aureus* isolates from 15 hospitals in 14 countries. *Microb. Drug Resist.* 10: 169-176.
- Zagari A (1992). *Medicinal Plants* Vol. 3, 5th ed. Tebran University Publication, No Tebran, Iran. Pp 889.