GSC Biological and Pharmaceutical Sciences, 2018, 02(01), 001–008

Available online at GSC Online Press Directory

GSC Biological and Pharmaceutical Sciences

e-ISSN: 2581-3250, CODEN (USA): GBPSC2

Journal homepage: https://www.gsconlinepress.com/journals/gscbps

(RESEARCH ARTICLE)

Evaluation of bioactivity of stem bark extracts of *Lovoa trichiliodes* (Harm) and *Trichilia heudelotii* Planc (Harm)

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Publication history**:** Received on 16 September 2017; revised on 18 October 2017; accepted on 07 November 2018

https://doi.org/10.30574/gscbps.2018.2.1.0019

Abstract

This study evaluated the bioactivity of the stem bark extracts of *Lovoa trichiliodes* and *Trichilia heudelotii* using standard methods. The highest yield of 10.20% was obtained from the stem bark extract of *T. heudelotii.* Qualitative phytochemical examination of the plant extracts indicated the presence of different secondary metabolites which remarkably inhibited the growth of *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Enterococcus faecalis*, *Klebsiella pneumoniae*, *Salmonella typhii*, *Aspergillus flavus*, *Candida albicans* and *Candida glabrata.* However, the cold water extract of *L. trichiliodes* exhibited no activity against the test pathogens. The highest mean (22.33±0.33 mm) zone of inhibition and minimum inhibitory concentration (MIC) of 2.5 mg/ml were exhibited by the acetone stem bark extract of *L trichiliodes against B. subtilis* ATCC6633. The results affirmed the traditional uses of the plants in the management and treatment of numerous diseases caused by the test pathogens.

Keywords: Antimicrobial; Phytochemical; Infectious diseases; *L. trichiliodes; T. heudelotii*

1. Introduction

Traditional medicine has been used for thousands of years with great contributions made by practitioners to human health particularly as primary health care providers at community level [1]. In Nigeria for example, herbal medicine is the first line of treatment for 60% of children with high fever from malaria, while 85% of Nigerians use and consult traditional medicine for health care, social and psychological benefits [2].

Medicinal plants have been playing a vital role in the health and healing of man and have been reported to possess various pharmacological activities like antibacterial and antioxidant [3]. Interestingly, demand for medicinal plants is progressively rising in industrialized nations as well is in developing countries. Phytochemicals are the natural bioactive compounds found in plants as secondary metabolites that work with nutrients to protect against pathogenic attack [4]. Amit and Hardeep reported that phytochemicals represent the most abundant and extensively distributed substances in the plant kingdom and that several plants and herb cells produce and gather this range of medicinal phytochemicals [5].

Lovoa trichiliodes (Harm) is the only West African species of the family *Meliaceae* that occurs in the thickest gallery forest and is commonly found in lakeside forest of Uganda. It is a large forest tree, up to 40 m high with a dark brown crown. The bark is grayish on younger tree, but brownish, thin and scally on older trees. The slash is reddish, cedar scented and produces a little sticky sap while *Trichilia heudelotii* Planc (Harm), also of the family *Meliaceae*, is found in understory of rain forest. The tree is rarely 4.0 feet high with dense crown and wide spreading branches. The bark is

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brown on exposure sweet, scented, exuding a watery sap with a small amount of dirty white latex. The wood is reddish or reddish-brown, hard but light in weight of medium texture and highly durable [6].

Based on the ethno medical information on the plants, the present investigation was aimed at screening for the presence of active phytochemicals and demonstrating the antimicrobial activities of the extracts from the test plants materials against some infectious diseases caused by human pathogens.

2. Material and methods

2.1. Collection of plants and extraction procedure

Fresh stem bark of *L. trichiliodes* (LVH3699) and *T. heudelotii* (LVH3617) were harvested from uncultivated farmlands located in Owo, Ondo State, and South-Western Nigeria in July, 2016. The plant materials were then authenticated at the Herbarium of the Department of Botany, University of Lagos and voucher specimens were deposited at the Department of Science Laboratory Technology, Rufus Giwa Polytechnic, Owo. The authenticated plant materials were washed and cleaned thoroughly with tap water and then air-dried under shade. The dried samples were then ground into coarse powder with the aid of a mechanical grinder and were stored in clean air- tight containers, and kept in a cool, dry place until required for use.

The powdered sample (100 g) was concurrently soaked in 300 ml of different solvents (acetone, ethanol and water) for 72hr with intermittent stirring using sterile spatula. The plant extracts were then filtered through Whatman No1 filter paper into bijou bottles and then dried using rotary evaporator at a temperature of 50 ˚C to yield crude extracts [7]. Different concentrations of the extracts were prepared by diluting 0.10, 0.20, 0.30, 0.40 and 0.50g of the extracts in 100 ml of 0.01% Tween-20 to obtain concentrations of 10, 20, 30, 40 and 50 mg/ml respectively [8].

2.2. Test microorganisms

The microorganisms employed in the study were fifteen clinical isolates (*Bacillus subtilis, Escherichia coli, Enterococcus faecalis, Klebsiella pneumonia, Pseudomonas aeruginosa, Salmonella typhii, Staphylococcus aureus, Staphylococcus epidermidis, Streptococcus pneumoniae, Streptococcus pyogenes, Aspergillus flavus, Candida albicans, Candida glabrata, Cryptococcus neoformans* and *Trichophyton rubrum*) and five cultures of the American Type Culture Collection (*Bacillus substilis* ATCC 6633, *Stapylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922, *Salmonella typhi* ATCC 6539 and *Candida albicans* ATCC 10231) obtained from Federal Medical Center, Owo and Federal Institute of Industrial Research, Oshodi, Lagos State, Nigeria respectively.

2.3. Qualitative phytochemical screening

The extracts of the different plant parts were subjected to qualitative phytochemical screening for the presence of tannins, phlobatannins, saponins, flavonoids, steroids, terpenoids, glycosides, alkaloids, anthraquinones, chalcones and phenol using standard procedures as described by Harborne [9] and Sofowora [10].

2.4. *In vitro* antimicrobial susceptibility test

The extracts obtained from the test plants were screened against the test organisms by agar well diffusion method [11]. A 25 ml aliquot of Mueller-Hinton agar (MHA, Lab Oratorios Britania, Argentinia) was poured into each Petri plate. When the agar solidified, test organisms were inoculated on the surface of the plates (1×10^6 *cfu*/ml and 1 x 10^6 *sfu*/ml for bacteria and fungi) respectively using a sterile glass spreader, allowed to set and punched with 6 mm cork borer. A portion of 50 µl of each of the extract concentrations was introduced into the wells. Control wells containing the same volume of 30% Dimethyl sulphoside (DMSO) served as negative control, while Chloramphenicol (100 µl) and Miconazole (100 µl) were used as positive controls for bacterial and fungal plates respectively. The tests were carried out in triplicates. Bacterial plates were incubated at 37 °C while fungal plates were incubated at 25 °C for 24 h and 72 h respectively. The diameters of the zones of inhibition were then measured in millimeters.

2.5. Minimum inhibitory concentration (MIC) assay

A modified two-fold serial dilution method of Essien et al., was employed [12].The extracts were prepared in Mueller-Hilton broth and Saboraud broth for bacteria and fungi respectively to achieve a decreasing concentrations ranging from the least concentration that produced clear zone of inhibition (10to 0.156mg/ml). All tubes including the controls were labeled accordingly. Each dilution was seeded with 1ml of standardized inoculums (1.0×10^6 *cfu*/ml for bacteria and 1.0×10^6 *sfu*/ml for fungi) incubated at 37 ˚C for 24 h and 25 ˚C for 72 h for bacteria and fungi respectively. A tube containing only seeded broth (i.e. without plant extracts) was used as the positive control while the un-inoculated tube

was used as negative control. The lowest concentration of each extract sample that showed a clear zone of inhibition when compared with the controls was considered as the MIC.

2.6. Data Analysis

Data were presented as mean±standard error (SE). Significance difference between different groups was tested using two-way analysis of variance (ANOVA) and treatment means were compared with Duncan's New Multiple Range Test (DNMRT) using SSPS window 7 version 17.0 software. The significance was determined at the level of p≤ 0.05.

3. Results and discussion

The percentage yield of the extracts ranged from 3.90 to 6.53% and 9.63 to 10.20% for the *L. trichiliodes* and *T. heudelotii* stem bark acetone, ethanol and water extracts respectively. The differences in the yield obtained could be attributed to the polarity of the solvents and types of phytochemical present [13-14].

The present study showed that presence of phytochemical in the medicinal plant extract differs depending on the nature of solvent used for extraction. The tested plant materials revealed the presence of alkaloids, saponins, phenols, tannins, anthraquinone, and glycosides in their respective extracts (Table1). However, terpenes, cardenolides, and chalcones were completely absent except in the acetone stem bark extract of *T. heudelotii*.

Table 1 Phytochemical Properties of *L. trichiliodes* and *T. heudelotii* stem bark

Constituents	*L. trichiliodes*			*T. heudelotii*		
	W	**E**	**A**	**W**	**E**	**A**
Alkanes	+	+++	+++	+	+++	+++
Saponins	++	+++	+++	++	+++	+++
Tannins	+	++	+++	ND	++	++
Phlobatanins	+	+	++	ND	ND	+
Phenols	++	+++	+++	ND	+++	+++
Anthraquinone	+	++	+	+	++	+
Terpenes	ND	ND	ND	ND	ND	+
Cardenolides	ND	ND	ND	ND	+	+
Steroids	ND	+	+	ND	ND	+
Glycolides	+++	++	+	++	++	+
Chalcones	ND	ND	ND	ND	ND	+
Flavonoids	ND	ND	ND	ND	ND	ND

Legend: +++ = present in abundance, ++= present in moderate amount, += present in trace amount, ND = not detected

The presence of these various secondary metabolites in the plant materials justified their traditional uses in the treatment of various ailments and phytomedicines [15-18].Similar phytochemicals were also reported by Essama et al., in some members of the family *Meliaceae* and other medicinal plants [19]. Islam et al., corroborates the present findings in their work which revealed the presence of similar phytochemicals in *Bougainvillea glabra* flower and affirmed that extracts of medicinal plants possessed pharmacological properties and potential to develop natural compounds based pharmaceutical products [20].

The results obtained for the antimicrobial test performed on different extracts at the concentration of 10-15mg/ml as presented in tables 2-6 revealed that the activity of the plant materials possessed potential antibacterial activity against *B.subtilis, K. pnenmoniae, S. aureus, S. epidermidis, S. pyogenes, E. coli, E. faecalis, S. typhi, S. pneumoniae, P. aeruginosa* and antifungal activity against *C. albicans, C. glabrata, T. rubrum, A. flavus and C. neoformans* with varying zones of inhibition. The acetone stem bark extracts of *L. trichiliodes* exhibited the highest activity against *B. subtilis* ATCC (21.33± 0.33 mm) followed by *B. subtilis* (22.00± 1.00 mm) and *K. pneumonia* (21.33 ± 0.58 mm) respectively. The highest antifungal activity was also observed in the acetone stem bark extracts of *L. trichiliodes* against *C. albicans* ATCC10231 (19.33 ± 0.33 mm) and *T. heudeulotii* against *T. rubrum* (16.00 ± 0.33 mm) respectively at 50 mg/ml (Table 2). However, no activity was observed in the water extract of *L. trichiliodes* against the test microorganisms.

Table 2 Antimicrobial activity of acetone extract of *L. trichiliodes* stem bark on selected human pathogens

Organisms	Concentration (mg/ml)					Concentration (100 µg/ml)	
	10	20	30	40	50	Chl	Myz
B.S	8.67±0.58^{a}	12.33±0.58^{b}	16.33±0.58^{c}	19.33±0.58^{d}	22.00±1.00^{e}	11.33±0.58^{b}	N.A
B.S ATCC6633	8.33±0.33^{a}	13.00±0.58^{c}	16.67±0.33^{d}	19.67±0.33^{e}	22.33±0.33^{f}	14.67±0.58^{c}	N.A
S. A	3.67±0.58^{a}	6.33±0.58^{b}	10.33±0.58^{c}	14.67±0.58^{e}	19.67±0.58^{f}	13.67±1.00^{d}	N.A
S.A ATCC25923	3.33±0.33^{a}	6.67±0.33^{b}	10.67±0.33^{c}	15.00±0.58^{e}	20.00±0.58^{f}	15.33±0.33^{d}	N.A
E. C	6.33±0.58^{a}	10.33±0.58^{b}	13.33±0.58^{d}	15.67±0.58^{e}	19.33±0.58^{f}	11.33±0.58^{c}	N.A
E.C ATCC25922	6.33±0.33^{a}	10.67±0.33^{b}	13.00±0.00^{c}	16.00±0.58^{d}	19.67±0.33^{e}	14.33±0.67^{d}	N.A
K. P	5.33±0.58^{a}	9.67±0.58^{b}	13.33±0.58^{c}	16.33±0.58^{d}	21.33±0.58^{e}	13.33±0.58^{c}	N.A
S. T	NI	7.33±1.15^{a}	11.33±0.58^{b}	14.67±0.58^{c}	18.67±0.58^{d}	11.67±0.33^{b}	N.A
S.T ATCC6539	NI	7.67±0.33^{a}	11.67±0.33^{b}	15.33±0.33^{c}	19.33±0.33^{d}	14.33±0.67^{c}	N.A
Ps. A	9.00±0.00^{a}	12.33±0.58^{b}	16.33±0.58^{c}	18.67±0.58^{d}	20.33±0.58^{e}	11.67±1.00^{b}	N.A
A.F	NI	NI	6.00±0.00^{a}	8.33±0.58^{b}	10.67±0.58^{c}	N.A	10.00±1.00^{c}
C. A	7.67±0.58^{a}	11.33±0.58^{b}	13.67±0.58^{c}	16.33±0.58^{d}	18.33±0.58^{e}	N.A	11.00±0.00^{b}
C.A ATCC10231	7.67±0.33^{a}	12.33±0.33^{b}	14.67±0.67^{c}	16.67±0.33^{d}	19.33±0.33^{e}	N.A	13.67±0.33^{c}

Values are Mean±S.E.M (mm), Values followed by different alphabet along the rows are significantly different at p≤0.05.Legend: NI= No inhibition, N.A= Not applicable, Chl=Chloramphenicol, Myz=Miconazole, B.S= *Bacillus subtilis,* S.A= *Staphylococcus aureus,* E.C= *Escherichia coli,* K.P= *Klebsiella pneumoniae,* Ps.A= *Pseudomonas aeruginosa,* S.T= *Salmonella typhi,* A.F= *Aspergillus flavus,* C.A= *Candida albicans*

The response of the tested strains to the treatment with various plant extracts varied; as it was shown to be concentration dependent as greater inhibition was observed as the concentration of the extracts increased. This may be attributed to the differences in the concentrations and the types of phytocompounds of various secondary metabolites present in the extracts as well as the extracting ability of the solvents. The results also corroborated the observations of Bharet and Vidyasagar [21], Kashariet al., [22], Guerra-Boone et al., [23] and Opawale et al., [24]. The study suggests that the stem bark extracts of *L. trichiliodes* and *T. heudeulotii* have a broad spectrum of antibacterial activity, although the degree of susceptibility differed between microorganisms. Similar findings were posited by Maragathavalli et al., [25] and Raja et al., [26] on *Azadiractha indica* extracts.

Table 3 Antimicrobial activity of ethanol extract of *L. trichiliodes* stem bark on selected human pathogens

Organisms	Concentration (mg/ml)					Concentration (100 µg/ml)	
	10	20	30	40	50	Chl	Myz
B. S	3.67±0.58^{a}	7.33±0.58^{b}	9.67±0.58^{c}	11.00±0.00^{d}	13.00±0.00^{e}	11.33±0.58^{d}	N.A
B.S ATCC6633	4.00±0.58^{a}	7.67±0.33^{b}	10.33±0.67^{c}	12.00±0.00^{d}	14.00±0.58^{e}	13.00±0.58^{de}	N.A
S. A	6.00±0.00^{a}	11.67±0.58^{b}	14.33±0.58^{c}	17.33±0.58^{d}	18.00±0.00^{d}	13.67±1.00^{c}	N.A
S.A ATCC25923	6.33±0.58^{a}	11.67±0.33^{b}	14.33±0.33^{c}	17.33±0.33^{d}	18.00±0.58^{d}	15.00±0.58^{c}	N.A
E. C	6.67±0.58^{a}	10.33±0.58^{b}	13.67±0.58^{d}	15.33±0.58^{e}	17.67±0.58^{f}	11.33±0.58^{c}	N.A
E. C ATCC25922	7.33±0.33^{a}	11.00±0.00^{b}	14.33±0.33^{c}	16.33±0.33^{dd}	18.33±0.33^{e}	13.00±0.58^{c}	N.A
E. F	6.33±0.58^{a}	7.00±0.00^{a}	9.33±0.58^{b}	11.67±0.58^{c}	12.00±0.00^{c}	15.00±0.00^{d}	N.A
K. P	7.33±0.58^{a}	12.67±0.58^{b}	15.00±0.00^{c}	16.00±0.00^{c}	18.33±0.58^{d}	13.33±0.58^{b}	N.A
S. T	NI	NI	10.67±0.58^{a}	13.33±0.58^{c}	15.67±0.58^{d}	11.67±0.33^{b}	N.A
S. T ATCC6539	NI	NI	10.67±0.88^{a}	13.67±0.33^{b}	16.67±0.33^{c}	13.33±0.33^{b}	N.A
Ps. A	7.67±0.58^{a}	10.67±0.58^{b}	13.33±0.58^{d}	15.67±0.58^{e}	18.33±0.58^{f}	11.67±1.00^{c}	N.A
A.F	NI	6.33±0.58^{a}	8.00±0.00^{b}	10.67±0.58^{c}	11.00±0.00^{c}	N.A	10.00±1.00^{c}
C. A	NI	6.33±1.15^{a}	10.67±0.58^{b}	13.67±0.58^{c}	15.67±0.58^{d}	N.A	11.00±0.00^{b}
C. A ATCC10231	NI	6.33±0.33^{a}	11.33±0.33^{b}	14.00±0.58^{c}	16.00±0.58^{d}	N.A	13.33±0.33^{c}

Values are Mean±S.E.M (mm). Values followed by different alphabet along the rows are significantly different at p≤0.05.Legend: NI= No inhibition, N.A= Not applicable, Chl=Chloramphenicol, Myz=Miconazole, B.S= *Bacillus subtilis,* S.A= *Staphylococcus aureus,* E.C= *Escherichia coli,* E.F= *Enterococcus faecalis,* K.P= *Klebsiella pneumoniae,* Ps.A= *Pseudomonas aeruginosa,* S.T= *Salmonella typhi,* A.F= *Aspergillus flavus,* C.A= *Candida albicans*

Table 4 Antimicrobial activity of *T. heudelotii* stem bark water extract on selected human pathogens

Organisms	Concentration (mg/ml)					Concentration (100 µg/ml)
	10	20	30	40	50	Chl
S. A	7.67±0.58[a]	11.33±0.58[b]	13.67±0.58[c]	15.67±0.58[d]	16.00±0.00[d]	20.00±0.00[e]
S. A ATCC25923	7.33±0.33[a]	11.33±0.033[b]	13.67±0.88[c]	16.00±0.58[d]	16.33±0.33[d]	22.33±0.88[e]
E. C	NI	NI	5.67±0.58[a]	7.67±0.58[b]	8.00±0.00[b]	14.00±0.00[c]
E. C ATCC25922	NI	NI	6.00±0.58[a]	8.33±0.33[b]	8.33±0.88[b]	15.67±0.33[c]
E. F	6.67±0.58[a]	8.67±0.58[b]	11.33±0.58[c]	13.33±0.58[d]	14.00±0.00[d]	11.00±0.00[c]

Values are Mean±S.E.M (mm). Values followed by different alphabet along the rows are significantly different at p≤0.05, NI= No inhibition, N.A= Not applicable, Chl=Chloramphenicol, S.A= *Staphylococcus aureus,* E.C= *Escherichia coli,* E.F= *Enterococcus faecalis*

The activity of the plant materials on *C. albicans, C. neoforman and T. rubrum* agreed with the work of Richa and Ayushi [27] who confirmed similar activity of natural products derived from plants against dermatophytes. Aladesanmi et al., [28] had earlier affirmed the broad activity of *T. heudeulotii* leaf solvent extracts on *E. coli* and *P. aeruginosa*. The zones of inhibition obtained were comparable with chloramphenicol and myconazole used as antibiotic positive standards for bacteria and fungi respectively.

Table 5 Antimicrobial activity of acetone extract of *T. heudelotii* stems bark on selected human pathogens

Organisms	Concentration (mg/ml)					Concentration (100 µg/ml)	
	10	20	30	40	50	Chl	Myz
B. S	NI	5.67±0.58[a]	8.00±0.00[b]	11.00±0.00[c]	13.33±0.58[d]	11.00±0.00[c]	N.A
B.S ATCC6633	NI	6.00±0.00[a]	8.33±0.67[b]	11.33±0.33[c]	13.67±0.33[d]	12.67±0.33[d]	N.A
S. A	3.33±0.58[a]	6.67±0.58[b]	10.33±0.58[c]	12.67±0.58[d]	14.33±0.58[e]	20.00±0.00[f]	N.A
S.A ATCC25923	4.00±0.00[a]	7.67±0.33[b]	11.33±0.33[c]	11.33±0.33[c]	14.33±0.33[e]	22.33±0.33[f]	N.A
S. E	NI	7.00±0.00[a]	10.67±0.58[b]	12.67±0.58[c]	13.00±0.00[c]	11.00±0.00[b]	N.A
E. C	NI	6.67±0.58[a]	9.67±0.58[b]	11.67±0.58[c]	14.00±0.00[d]	14.00±0.00[d]	N.A
E.C ATCC25922	NI	7.33±0.33[a]	10.33±0.33[b]	11.67±0.33[c]	14.33±0.33[d]	15.33±0.33[e]	N.A
E. F	NI	NI	8.00±0.00[a]	12.00±0.00[b]	12.00±0.00[b]	11.00±0.00[b]	N.A
S. T	4.67±0.58[a]	7.00±0.00[b]	9.00±0.00[c]	10.00±0.00[cd]	10.67±0.00[d]	12.00±0.00[e]	N.A
S.T ATCC6539	5.33±0.33[a]	7.33±0.33[b]	9.33±0.33[b]	11.33±0.33[c]	10.00±0.58[c]	14.00±0.58[e]	N.A
Ps. A	NI	5.67±0.58[a]	8.33±0.58[b]	10.67±0.58[c]	11.00±0.00[cd]	12.00±0.00[d]	N.A
C. N	NI	7.33±0.58[a]	11.00±0.00[b]	12.67±0.58[c]	15.67±0.58[d]	N.A	17.33±0.58[e]
T. R	9.00±0.00[a]	11.33±0.58[b]	13.00±0.00[c]	15.33±0.58[d]	16.00±0.00[d]	N.A	20.00±0.00[e]

Values are Mean±S.E.M (mm). Values followed by different alphabet along the rows are significantly different at p≤0.05, NI= No inhibition, N.A= Not applicable, Chl=Chloramphenicol, Myz=Miconazole, B.S= *Bacillus subtilis,* S.A= *Staphylococcus aureus,* E.C= *Escherichia coli,* E.F= *Enterococcus faecalis,* Ps.A= *Pseudomonas aeruginosa,* S.T= *Salmonella typhi, C.N= Cryptococcus neoformans, T.R= Trichophyton rubrum. S.E= Staphylococcus epidermidis*

The results of the minimum inhibitory concentration (MIC) of the extracts as presented in Table 7 revealed that the antimicrobial activity of the extracts depended on the plant materials, extracting solvent concentrations and the tested microbial strains. Interestingly, it was discovered that *B. subtilis, P. aeruginosa* and *T. rubrum* as the most sensitive strains with the lowest MIC value of 2.5 mg/ml against the acetone stem bark extracts of *L. trichiliodes and T. heudeulotii*. This is closely followed by *S. aureus, E. coli* and *K. pneumoniae* with MIC of 5 mg/ml. The values of MIC obtained for the tested plant materials were lower than those reported by Yusha'u [29], Maragathavalli et al., [25] and Essien et al., [12] on similar medicinal plants.

Results were in agreement with the reports of Ram et al., [30] and Oladipoet al., [31]. In regard to the results of this research work, it can be deduced that *L. trichiliodes* and *T. heudeulotii* are good sources of antimicrobial agents with interesting activity on versatile multi resistant strains which might be due is the presence of different phytocompounds.

Table 6 Antimicrobial activity of ethanol extracts of *T. heudelotii* stem bark on selected pathogens

Organisms	10	20	30	40	50	Chl (100µg/ml)	Myz (100µg/ml)
B. S	NI	NI	6.00±0.00^{a}	8.67±0.58^{b}	11.33±0.58^{c}	11.33±0.58^{c}	N.A
B. S ATCC6633	NI	NI	6.33±0.33^{a}	9.33±0.33^{b}	12.00±0.58^{c}	13.00±0.58^{c}	N.A
S. A	7.67±0.58^{a}	11.00±0.00^{b}	13.67±0.58^{c}	15.00±0.00^{c}	15.00±0.00^{c}	13.67±1.00^{c}	N.A
S. A ATCC25923	8.33±0.33^{a}	11.33±0.33^{b}	14.33±0.33^{c}	15.33±0.33^{d}	17.00±0.58^{a}	15.00±0.58^{c}	N.A
S. P	5.67±0.58^{a}	9.00±0.00^{b}	11.67±0.58^{c}	14.33±0.58^{d}	15.67±0.58^{e}	11.67±0.33^{c}	N.A
SSP	NI	NI	6.67±0.58^{a}	9.67±0.58^{b}	11.67±0.58^{c}	10.33±1.15^{b}	N.A
E. C	6.33±0.58^{a}	9.33±0.58^{b}	12.33±0.58^{c}	14.33±0.58^{d}	15.00±0.00^{d}	11.33±0.58^{c}	N.A
E. C ATCC25922	6.67±0.33^{a}	9.33±0.33^{b}	12.67±0.33^{d}	14.00±0.00^{e}	14.67±0.33^{e}	13.00±0.58^{cd}	N.A
S. T	NI	4.00±0.00^{a}	6.33±0.58^{b}	9.67±0.58^{c}	11.33±0.58^{d}	11.67±0.33^{d}	N.A
S. T ATCC6539	NI	4.33±0.33^{a}	6.67±0.33^{b}	10.00±0.58^{c}	11.67±0.33^{d}	13.67±0.33^{e}	N.A
Ps. A	NI	5.67±0.58^{a}	9.33±0.58^{c}	13.00±0.00^{d}	15.67±0.58^{e}	11.67±1.00^{c}	N.A
A. *F*	NI	NI	6.00±0.00^{a}	8.33±0.58^{b}	10.67±0.58^{c}	N.A	10.00±1.00^{c}
C. A	6.33±0.58^{a}	9.33±0.58^{b}	13.33±0.58^{d}	14.00±0.00^{d}	16.00±0.00^{e}	N.A	11.00±0.00^{c}
C. A ATCC10231	6.67±0.33^{a}	9.33±0.33^{b}	13.33±0.33^{d}	14.33±0.88^{de}	15.67±0.33^{e}	N.A	13.00±0.58^{c}
T. R	NI	5.67±0.58^{a}	8.00±0.00^{b}	11.00±0.00^{c}	13.00±0.00^{d}	N.A	9.00± 0.00^{b}

Values are Mean±S.E.M (mm). Values followed by different alphabet along the rows are significantly different at p≤0.05, NI= No inhibition, N.A= Not applicable, Chl=Chloramphenicol, Myz=Miconazole, B.S= *Bacillus subtilis,* S.A= *Staphylococcus aureus,* E.C= *Escherichia coli,* Ps.A= *Pseudomonas aeruginosa,* S.T= *Salmonella typhi,* A.F= *Aspergillus flavus,* C.A= *Candida albicans, T.R= Trichophytonrubrum. S.P= Streptococcus pyogenes, SSP= Streptococcus species*

Table 7 The MIC of theextracts on the selected human pathogens (mg/ml)

Pathogens	*L. trichiliodes*			*T. heudelotii*		
	E	A	W	E	A	W
Bacillus subtilis	10	2.5	ND	25	15	100
B.subtilis ATCC6633	10	2.5	ND	25	15	100
Staphylococcus aureus	5	5	ND	5	10	5
S.aureus ATCC25923	5	5	ND	5	10	5
Staphylococcus pyogenes	200	100	ND	5	ND	ND
Staphylococcus epidermidis	100	100	ND	200	12.5	ND
Streptococcus pneumoniae	100	100	ND	25	ND	ND
Escherichia coli	5	5	ND	5	12.5	25
E.coli ATCC25922	5	5	ND	5	12.5	25
Enterococcus faecalis	5	200	ND	ND	25	7.5
Klebsiellapneumoniae	5	5	ND	ND	ND	ND
Salmonella typhi	25	15	ND	15	7.5	ND
S.typhi ATCC6539	25	15	ND	15	7.5	ND
Pseudomonas aeruginosa	5	2.5	ND	15	12.5	ND
Aspergilusflavus	15	25	ND	25	ND	ND
Candida albicans	15	5	ND	5	ND	ND
C.albicans ATCC10231	15	5	ND	5	ND	ND
Candida glabrata	ND	100	ND	ND	ND	ND
Cryptococcus neoformans	ND	100	ND	ND	12.5	ND
Trichophytonrubrum	ND	200	ND	15	2.5	ND

ND= not detected

4. Conclusion

The stem barks of the plants have the potential to act as a source of useful drugs due to the presence of the identified phytochemicals such as alkaloids, saponins, tannins, phenols, anthraquinone and glycosides. The plant materials exhibited wide spectrum antimicrobial activities, which justified their usage in folk medicine to treat ailments such as urinary and gastrointestinal tracts infections, candidiasis and dermatophytoses. They may therefore, be exploited for discovery as development of new therapeutic agents.

Compliance with ethical standards

Acknowledgments

The authors thank the Managements of Rufus Giwa Polytechnic and TeTFund Nigeria for providing the enabling environment and funding for this research work respectively. The Directors of Federal Institute of Industrial Research, Lagos and Federal Medical Centre, Owo are also appreciated for the supply of the test pathogens.

Disclosure of conflict of interest

The authors declare no conflict of interest of any form.

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How to cite this article

Opawale B, Oyetayo M and Adaramola-Ajibola M. (2018). Antimicrobial and phytochemical screening of stem bark extracts of *Lovoa trichiliodes* (Harm) and *Trichilia heudelotii* Planc (Harm). GSC Biological and Pharmaceutical Sciences, 2(1), 01-08.