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FTIR characterization, phytochemical, antibacterial, and antioxidant properties of *Pterocarpus Osun* stembark and leaf extracts

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ABSTRACT
Antimicrobial resistance threatens the prevention and treatment of an ever-increasing range of infections caused by microorganisms. It becomes necessary therefore, to determine compounds from natural sources that can be used to develop novel medicines with potent antimicrobial properties. Although, the stem bark of *Pterocarpus osun* has long been used to treat diarrhea, dysentery, and other gastrointestinal problems, there are no published pharmacological reports to authenticate these uses. The leaf and stem bark of *Pterocarpus osun* were extracted exhaustively and successively with n-hexane, ethyl acetate and methanol. The antioxidant capacities of the extracts were measured using the 2,2-Diphenyl-1-PicrylHydrazyl (DPPH) scavenging technique and IC50 calculated. The extracts were screened for secondary metabolites and antibacterial activities. The result of the DPPH scavenging activities of the crude fractions compared favorably with that of the ascorbic acid used as standard control. 85.0% activity was recorded at concentration of 62.5µg/mL for the methanol stem bark fraction and, the least activity of 62.7% for ethyl acetate leaf extract at a concentration of 1000µg/mL. Terpenes, saponins, steroids, alkaloids, tannins, and flavonoids were detected in the extracts. Four of the eleven human pathogens used for antimicrobial screening were sensitive, four others were resistant. Zones of inhibition measured ranged between 18 and 29mm. Minimum inhibitory concentration and minimal bacteria/fungicidal concentrations were measured between 1.25 to 5.00mg/mL. The FTIR spectra of the powdered samples and extracts' fractions reported.

Keywords: *Pterocarpus osun*, secondary metabolites, antimicrobial, DPPH, Fabaceae.

INTRODUCTION
Plant parts (leaf, stem bark, root, and root bark) have been used as herbal medicine since time immemorial due to their therapeutic potentials. Plant parts have medicinal capabilities due to bioactive chemicals contained within them. The most well-known bioactive secondary metabolites are alkaloids, tannins, flavonoids, saponins, and phenols (Shihabudeen et al., 2010). Their concentrations differ between plants, giving each one its own set of medical properties. Global interest in the study of many medicinal plants has exploded in recent decades due to their antibacterial and antioxidant benefits, low toxicity, and potential to be a cheaper alternative to synthetic pharmaceuticals (Chew et al., 2012). Antimicrobial compounds are unquestionably employed as sources of a wide range of natural and manufactured medicines for the treatment and control of infectious organisms (Shriram et al., 2018). However, only a few of these are available on the global market (Poulakou et al., 2018). The emergence of

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multidrug-resistant (MDR) bacteria has affected the effectiveness and affordability of several routinely prescribed antibiotic treatments (Van et al., 2017; Falcone et al., 2016) resulting in increased morbidity, mortality, and health-care expenditures [Fair and Tor, 2014). Each year, at least two million people in the United States develop serious infections caused by germs that are resistant to one or more antibiotics, according to the Centers for Disease Control and Prevention (CDC). The total economic cost of antibiotic resistance has been estimated to be as high as twenty billion dollars in direct treatment and $35 billion in productivity loss in a single year. The problem is particularly serious in low-income nations due to a lack of adequate surveillance systems, laboratory tests, and access to appropriate antimicrobials due to budgetary constraints. If no successful intervention in the quest for novel medicines occurs before 2050, the number of deaths will have increased to ten million, costing the global economy up to $100 trillion (Opperman and Nguyen, 2015; Morehead and Scarbrough, 2018). As a result, the search for novel antibiotics derived from natural products has become an important aspect of modern medicine in order to combat the socioeconomic and health problems posed by multidrug-resistant microorganisms (Bakal et al., 2017). Medicinal plants contain alkaloids, flavonoids, coumarins, phenolics, tannins, terpenoids, essential oils, polypeptides, and polyacetylenes (Valli et al., 2012; Parvin et al., 2014). These secondary metabolites are used to start the production of antibiotics used in treatment of infectious diseases (Rahman and Anwar (2007). In addition to their physiological functions in plants, phytochemicals have been demonstrated to have strong antioxidant, antibacterial, and herbicidal capabilities (Mierziak, et al., 2014; Takshak, 2018). As a result, locating medicinal plants and their natural bioactive compounds has become crucial in order to profit from natural products' potential added value. The stem bark of *Pterocarpus osun* has long been used to treat diarrhea, dysentery, and other gastrointestinal problems (Krishnaveni, 2000). *Pterocarpus spp* is one of such plants which have been used for treatment of type 2 diabetes. The grated root is mixed with tobacco and smoked in a pipe as a cough remedy. It has also been proven to help with fever (Mukherjee et al., 2006). Anti-insect qualities appear to be present in the leaves. The edible potential of the fruit is unknown, while the fruit of the closely related *Pterocarpus santalinoids* is said to be edible when cooked and intoxicating when not (Hutchinson et al., 1958). Intoxication has also been reported from the seeds (Sandrine, (2006). The powdered stem acts as an antiseptic for the freshly severed umbilical cord. It has been used to treat rheumatism, eczema, gonorrhea, candidasis, and acne (Gill, 1992). The stem is used in the treatment of sickle-cell illness and amenorrhea in traditional medicine (Upholf, 1948). Proximate and vitamin content has already been reported (Osuagwu, 2008). The antibacterial activity of numerous medicinal plants is of great interest these days, given the current global issue of developing antibiotic resistance in microbes. The indiscriminate use of commercial antimicrobial drugs is suspected to be increasing drug resistance in dangerous microorganisms. As a result, it is vital to find compounds that can be used to create new medicines with greater antibacterial properties. The purpose of this study is to investigate the antibacterial capabilities of *P. osun*, a plant that has traditionally been used to prevent and treat infectious diseases.

MATERIALS AND METHODS

The plant samples for this study were collected at the Sheda Science and Technology Complex (SHESTCO) biological garden in Kwali, Federal Capital Territory (FCT), Abuja, Nigeria. The *Pterocarpus osun* leaves were validated at the National Institute of Pharmaceutical Research and Development (NIPRD), FCT, Abuja, and given the herbarium number NIPRD/H/7251. The plant's fresh leaves and stem bark were plucked and air dried for two weeks before being pulverized into powdered samples. The powdered samples were kept in plastic bags in a dark cupboard until when needed. The reagents employed were of the highest analytical quality.

Extraction

The plant materials were extracted in the following order: n-hexane, ethyl acetate, and methanol. The extract was filtered and concentrated using a rotary evaporator after each sample fraction was cold macerated for 72 h. The weight of the dried extracts were recorded, and then kept in the refrigerator until needed.

Qualitative phytochemicals Screening

Standard procedure described by (Farnsworth, 1966) was used to screen the extract fractions from the stem bark and leaves of *P.osun* for phytochemical constituents.

Antioxidant measurements

The method described by (Sungthong & Srichaikul, 2018) for evaluating antioxidant capacity was utilized for the six crude fractions, using the DPPH radical as a reagent. Exactly, 5mL of the test extracts in methanol at concentrations ranging from 62.5µg/mL to 1000µg/mL were mixed with 0.3mL of 0.1mM DPPH in methanol, and the absorbance measured at 517 nm after 30 minutes of incubation at room temperature, and the absorbance was measured at 517nm. The concentrations of ascorbic acid, which was employed as a positive control, were the same. The following formula was used to compute the proportion of inhibition:

$$\text{Inhibition \%} = \frac{A_b - A_s}{A_b} \times \frac{100}{1}$$

Where A_b represents the absorbance of the blank solution and A_s represents the absorbance of the sample.

The IC_{50} was calculated from a non-linear regression graph of percent inhibition against log of concentration to determine the sample's antioxidant capability (Matuszewska et al., 2018).

Fourier Transform Infrared (FTIR)

FTIR is perhaps the most powerful tools for identifying the types of functional groups present in compounds. The extracts and powdered samples were scanned between the wavelength of 400 and 4000 cm^{-1}. Spectra of both the powdered samples and crude extracts were recorded on a ThermoFisher100 Fourier Transform Infrared Spectrophotometer (FT-IR).

Antimicrobial Screening

Human pathogenic microbes (*Methicillin Resistant Staph aureus, Vancomycin Resist Enterococci, Escherichia Coli, Vibrio Cholerea, Salmonella Typhi, Helicobacter Pylori, Campylobacter Jejuni, Candida Tropicalis, Candida albica, Candida Krusei*) obtained from

the department of Medical Microbiology Ahmadu Bello University, Zaria, Nigeria, were employed as test organisms. Sparfloxacin, Ciprofloxacin, and Fluconazole were employed as standard control antibiotics. These were used to determine the antimicrobial activities of the crude fractions of the extracts of *P.osun* in vitro. The extracts were screened using the diffusion method (Rios et al., 1998), with Mueller Hinton agar as the bacterial growth medium. The medium was prepared by sterilizing it at 121°C. After 15 minutes, it was transferred into sterile Petri plates and allowed to cool and solidify. The sterilized medium was inoculated with 0.1mL of the test microorganisms' standard inoculums. A sterile swab was used to spread each inoculum equally across the surface of the media, and a well was cut in the center of each inoculated medium with a standard cork borer of 6mm diameter. The extract was dissolved in 0.1 mL of water at concentrations of 5mg/mL and then introduced into the well on the inoculation medium. After a 24 h incubation period at 37°C, the plates were examined for the inhibited zones.

Minimum Inhibition Concentration (MIC)

The broth dilution method was used to assess the extract's minimum inhibitory concentration (MIC). After the Mueller Hinton broth was prepared, 10mL was poured into test tubes. Before being allowed to cool, the broths were sterilized for 15 minutes at 121°C. Extracts of leaf and stem bark were used to inoculate microbes. The turbidity (growth) was evaluated after 24 h of incubation at 37°C. The minimum inhibitory concentration was determined as the lowest concentration of the extract that showed no turbidity.

Minimum Bacterial/Fungicidal Concentration (MBC/MFC)

Mueller Hinton agar was made, sterilized at 121°C for 15 minutes, then placed into sterile Petri plates to cool and harden. The MBC/MFC test was used to see if the test microorganisms were destroyed or if merely their growth was slowed. Dilution of the MIC with water and culture media was followed by incubation at 37°C for 24 h, after which the plates of the medium were examined for growth. MBC/MFC ere the plates with the lowest concentration of the extract that did not show colony growth.

RESULTS

Table 1: Phytochemical screening of extract fractions

Phytochemical screening test was done to determine the secondary metabolites that exhibit bioactivities in plants (Hasti et al., 2022).

Phytochemicals	HB	HL	EB	EL	MB	ML
Alkaloids	+	+	+	+	+	+
Flavonoids	+	+	+	+	+	+
Tannins	-	-	-	-	+	+
Phenols	-	-	-	-	+	+
cardiac glycoside	+	+	+	+	+	+
Saponins	-	-	+	+	+	+
Steroids	+	-	+	-	+	+
Terpenoids	+	+	+	+	+	+

Key: ML- methanol leaf extract, MB- methanol stem bark extract, EL- ethyl acetate leaf extract, EB- ethyl acetate stem bark extract, HL - hexane leaf extract, HB- hexane stem bark extract.

Table 2: Antioxidants activities (DPPH method) and IC50 of ascorbic acid and extract fractions

Conc (µg/mL)	ASA %	ML %	MB %	EL %	EB %	HL %	HB %
62.5	81.24	83.87	85.00	80.12	84.18	83.67	81.54
125	79.77	83.27	81.34	80.22	83.77	81.74	81.74
250	79.40	83.47	83.37	71.40	84.79	83.57	82.45
500	77.82	82.56	82.45	65.38	82.15	80.73	83.16
1000	79.03	79.31	80.22	60.71	77.89	76.27	84.58
IC 50 (µg/mL)	128	334	196	48	216	59	264

Key: ASA - ascorbic acid,ML- methanol leaf extract,MB- methanol stem bark extract, EL- ethyl acetate leaf extract, EB- ethyl acetate stem bark extract, HL- hexane leaf extract, HB- hexane stem bark extract, IC50 = Inhibitory concentration at 50%.

Table 3: Qualitative antimicrobial activities of leaves and stem bark extract's fractions against the test organisms

Test organism	HL	HB	EL	EB	ML	MB	SX	CX	FZ
Methicillin resist staph aureus	S	R	S	R	S	R	S	R	R
S. aureus	S	S	S	S	S	S	R	S	R
Vancomycin resist enterococci	R	R	R	R	R	R	S	R	R
E. coli	S	S	S	S	S	S	R	S	R
V.cholerea	R	R	R	R	R	R	R	S	R
Salmonella typhi	S	S	S	S	S	S	R	S	R
Helicobacter pylori	S	S	S	S	S	S	R	S	R
Campylobacter Jejuni	R	R	R	R	R	R	S	R	R
Candida tropicalis	R	R	S	S	S	S	R	R	R
Candida albica	R	R	R	R	R	R	R	R	S
Candida krusei	R	R	R	R	R	R	R	R	S

key: S= Sensitive; R =Resistant; SX = Sparfloxacin; CX = Ciprofloxacin; FZ =Fluconazole ML = methanol leaf extract, MB = methanol stem bark extract, EL = ethyl acetate leaf extract, EB = ethyl acetate stem bark extract, HL = hexane leaf extract, HB = hexane stem bark extract

Table 4: Zones of inhibition (mm) of extract's fractions and control drugs against test microorganisms

Test organism	HL	HB	EL	EB	ML	MB	SX	CX	FZ
Methicillin resist staph aureus	18	0	27	0	23	0	30	0	0
Staphylococcus aureus	23	20	29	25	26	23	0	29	0

Vancomycin resist enterococci	0	0	0	0	0	0	32	0	0
Escherichia coli	21	22	26	28	24	25	0	37	0
Vibro cholerea	0	0	0	0	0	0	0	29	0
Salmonella typhi	23	20	25	24	24	24	0	39	0
Helicobacter pylori	22	24	27	26	25	24	0	30	0
Campylobacterjejuni	0	0	0	0	0	0	31	0	0
Candida tropicalis	0	0	24	25	23	22	0	0	32
Candida albicans	0	0	0	0	0	0	0	0	32
Candida krusei	0	0	0	0	0	0	0	0	34

Key: SX = Sparfloxacin; CX = Ciprofloxacin; FZ =Fluconazole ML = methanol leaf extract,MB= methanol stem bark extract, EL = ethyl acetate leaf extract, EB = ethyl acetate stem bark extract, HL = hexane leaf extract, HB = hexane stem bark extract

Table 5: Minimum Inhibitory Concentration (MIC) of extract's fractions against the test microorganisms (mg/mL)

Investigated organism	HL	HB	EL	EB	ML	MB
Methicillin resist Staph aureus	-	0.63	-	-	1.50	-
Staphylococcus aureus	1.25	1.25	0.63	1.50	1.50	1.50
Vancomycin resist enterococci	-	-	-	-	-	-
Escherichia coli	1.25	1.25	1.25	0.63	1.50	1.50
Vibrio cholerea	-	-	-	-	-	-
Salmonella typhi	1.25	1.25	1.25	1.25	1.25	1.25
Helicobacter pylori	1.25	1.25	0.63	1.25	1.25	1.25
Campylobacter jejuni	-	-	-	-	-	-
Candida tropicalis	-	-	1.25	1.25	-	1.25
Candida albicans	-	-	-	-	-	-
Candida krusei	-	-	-	-	-	-

key: ML = methanol leaf extract, MB = methanol stem bark extract, EL = ethyl acetate leaf extract, EB = ethyl acetate stem bark extract, HL = hexane leaf extract, HB = hexane stem bark extract

Table 6: Minimum Bacterial/Fungal Concentration (MB/FC) of extracts against the test microorganisms (mg/mL)

Test organism	HL	HB	EL	EB	ML	MB
Methicillin resist Staph aureus	5.00	-	2.5	-	2.5	-
Staphylococcus aureus	2.50	5.00	1.50	2.50	2.50	5.00
Vancomycin resist enterococci	-	-	-	-	-	-
Escherichia coli	5.00	5.00	2.50	1.25	2.50	2.50
Vibrio cholerea	-	-	-	-	-	-
Salmonella typhi	2.50	5.00	2.50	2.50	2.50	2.50
Helicobacter pylori	5.00	2.50	2.50	2.50	2.50	2.50
Campylobacter jejuni	-	-	-	-	-	-
Candida tropicalis	-	-	2.50	2.50	5.00	5.00
Candida albicans	-	-	-	-	-	-
Candida krusei	-	-	-	-	-	-

key: ML = methanol leaf extract, MB = methanol stem bark extract, EL = ethyl acetate leaf extract, EB = ethyl acetate stem bark extract, HL = hexane leaf extract, HB = hexane stem bark extract

Table 7a: FTIR bonds' peaks for the methanol, hexane, ethylacetate extracts and powdered leaf of *P. osun*

Functional group	Methanol	Hexane	Ethylacetate	Powdered Sample
N-H stretch (Amines, amides)	3854, 3629 (w)	3853.50(w), 3695.49(w)	3854-3660	
O-H monomeric carboxylic acids H- bonded alcohols, phenols	3351.34		3369 (w,b)	
C-H stretch (alkanes)	2917, 2847 2361, 1396	2915, 2847 2360, 1378	2915,2847 (sh), 2361 , 1378	2915 2361-
nitriles, carbenes (tripple bond) C=O, C=C, C-N	1701	1734, 1708	1710, 1241	1772, 1260
C=O, C=C, C=N aromatic rings	1623.37	1653, 1559 1462,	1623, 1540	1497-
C-O, C-N, C-C (alcohols, ethers, carboxylic esters)	1052, 1052	1052, 1032, 1012	1046, 1033	1167, 1053-
C-C, C-H, (alkenes rock)	816.60	756,729, 718	840,756,718	884-

Table 7b: FTIR bonds' peaks for the methanol, hexane, ethylacetate extracts and powdered stem bark

Functional group	Methanol	Hexane	Ethylacetate	Powdered Sample
N-H stretch (Amines, amides)				3800-3546
O-H monomeric carboxylic acids H-bonded alcohols, phenols	3327 (s,b)	3275(w,b)	3278(w,b)	3360
C-H stretch (alkanes)	2943(w), 1376	2918((sh,s) 2360(sh)	2916,2848 (sh) 2343.45(w),	2360-2344
nitriles, carbenes (tripple bond)	1701(w)	1734,1708	1717(sh,s)	1869-1647
C=O, C=C,C=N	1254			
C=O, C=C, C=N aromatic rings	1610, 1521	1653, 1636	1635	1576-1497-
	1442	1457, 1378 1245	1373(sh) 1237	
C-O, C-N, C-C (alcohols, ethers, carboxylic esters)	1050	1162,1053,1032	1044(sh,s)	1133-1012
C-C, C-H, (alkenes rock)	816	883, 719		863-720

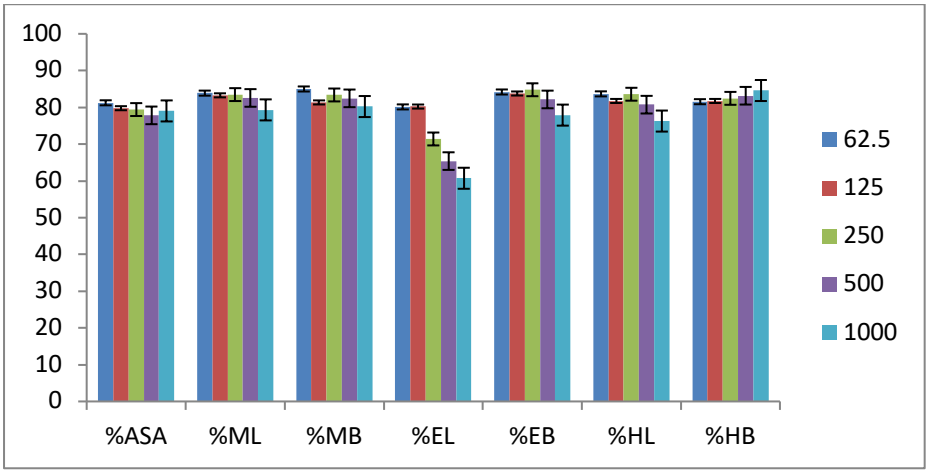

Figure 1: Comparison of the %antioxidant capacities of the crude extracts' fractions and ascorbic acid at measured concentrations (µg/mL)

Key: ASA - ascorbic acid, ML- methanol leaf extract, MB- methanol stem bark extract, EL- ethyl acetate leaf extract, EB- ethyl acetate stem bark extract, HL- hexane leaf extract, HB- hexane stem bark extract.

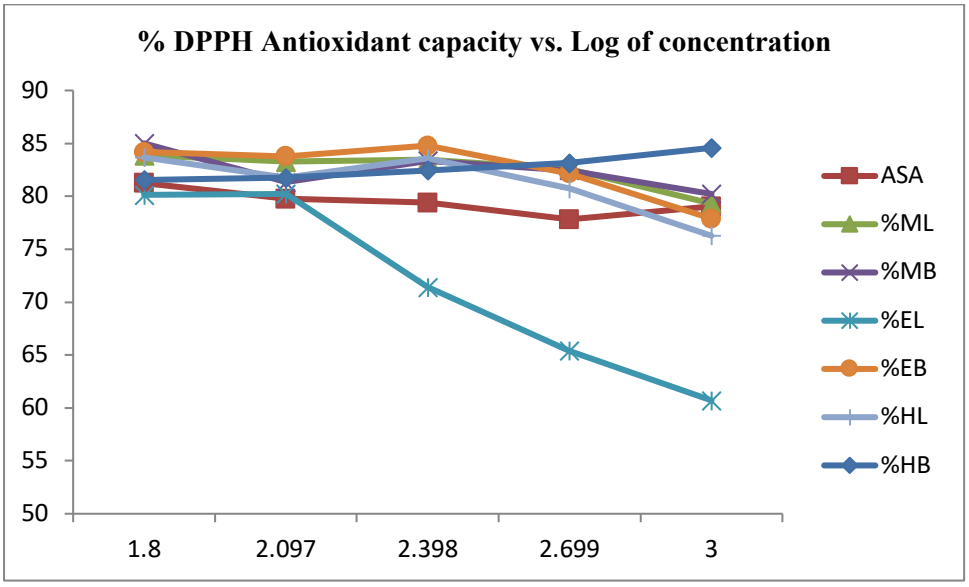

Figure 2: Graph of % Antioxidant activities against log concentration of extracts and ascorbic acid

Key: ASA - ascorbic acid, ML- methanol leaf extract, MB- methanol stem bark extract, EL- ethyl acetate leaf extract, E B- ethyl acetate stem bark extract, HL- hexane leaf extract, HB- hexane stem bark extract.

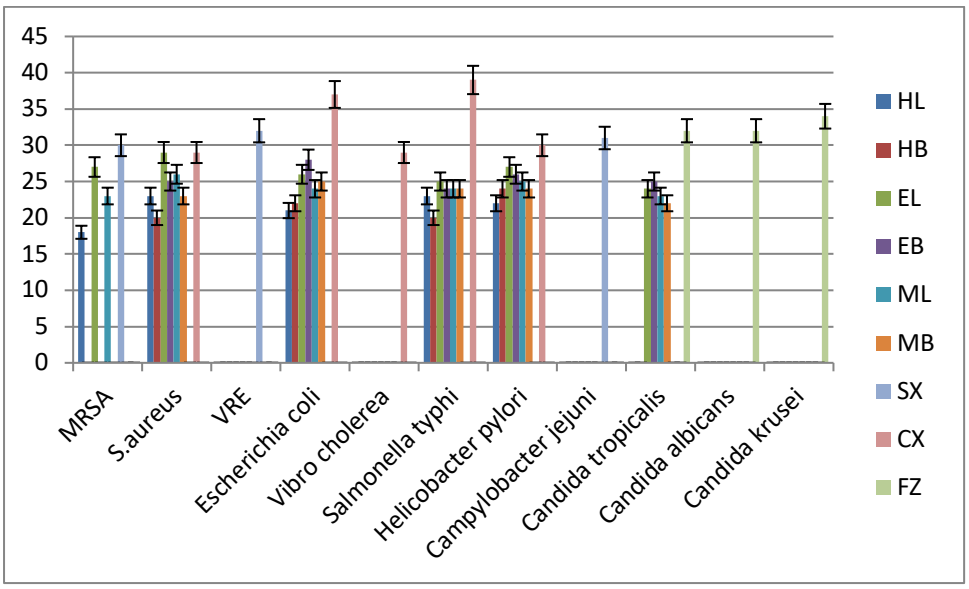

Figure 3: Zones of inhibition of crude extracts' fractions and the control drugs on test organisms

Key: ML = methanol leaf extract, MB = methanol stem bark extract, EL = ethyl acetate leaf extract, EB = ethyl acetate stem bark extract, HL = hexane leaf extract, HB = hexane stem bark extract, SX = Sparfloxacin; CX = Ciprofloxacin; FZ =Fluconazole

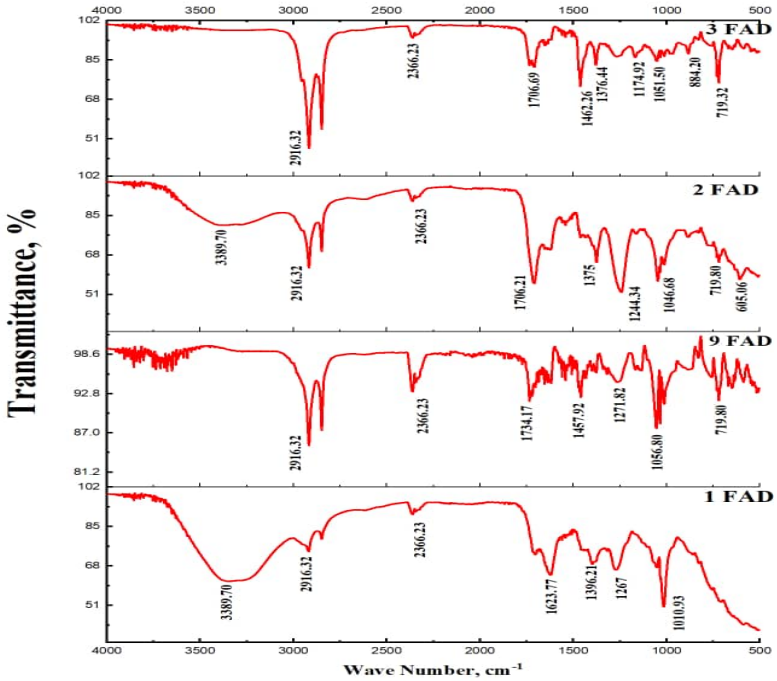

Figure 4a: FTIR plots of the leaf extracts and powdered leaf sample.

1FAD = methanol leaf extract, 2FAD = ethyl acetate leaf extract, 3FAD =hexane leaf extract, 9FAD = powdered leaf sample

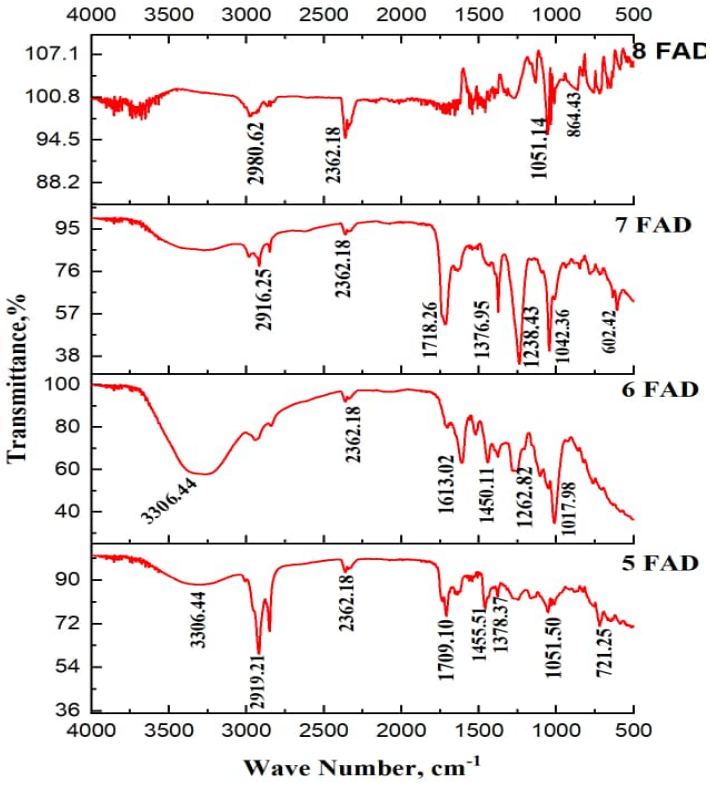

Figure 4b: FTIR plots of the stem bark extracts and powdered leaf.

5FAD = hexane stem bark extract, 6FAD = methanol stem bark extract,
7FAD = ethyl acetate stem bark extract, 8FAD = powdered stem bark sample

DISCUSSION

Alkaloids, flavonoids, cardiac glycosides, and terpenoids were found in all six fractions tested in the phytochemical screening of *P. osun* stem bark and leaves (Table 1). Saponins were found in all of the extracts except the hexane extracts. Table 2 shows that the existence of these secondary metabolites supports the antioxidant capacity result. Flavonoids have been used to treat diarrhea (Dweck and Mitchell, 2002; Schuier, et al., 2005), fever, and pain, as well as to reduce free radical damage in the body. Flavonoids are also known as anti-cancer agents and spasm-inhibitors. Phenols and flavonoids have antioxidants, antimicrobials, antiallergy, anti-inflammatory, and anticancer properties. They play an important role in the reproduction and growth of organisms. Phenolic chemicals provide defense against pathogenic bacteria and predators (González-Paramás et al., 2018; Enechi et al, 2016). Tannins are renowned for their ability to promote wound healing and scavenge free radicals (Zheng et al., 2022). Alkaloids are nitrogen-containing natural substances that serve as sedatives and analgesics. Alkaloids are used to treat hypertension. It is also used as stimulants, pain relievers, malaria, cancer, diabetics, cardiac dysfunction and tranquilizers. Alkaloids have been demonstrated to be effective in lowering the symptoms of stress and depression. Due to their stimulatory effects, alkaloids substances are hazardous in excessive doses, resulting in excitement linked with cell and nerve problems (Ain Q-U et al, 2016; Obochi, 2006). Saponins are terpenoids or steroidal glycosides found in plants that have antiallergic, antitumor, antiviral, immunomodulating, antihepatotoxic, and antifungal properties (Musa et al., 2011). Saponins are found to be very useful in veterinary vaccines due to their adjuvant activity, which helps to improve immune response. Many saponins can be used in intracellular histochemistry to allow antibodies to reach intracellular protein molecules. Table 2 shows the antioxidant capacity of the plant's parts measured using the DPPH radical scavenging method. All of the extract fractions produced high activity levels that compared favourably with the ascorbic acid used as a control as shown in Figure 1. Methanol stem bark extract has the maximum inhibitory activity (85 percent), whereas ethyl acetate leaf extract has the lowest activity (60.71 percent). The crude fractions' non-linear regression graph was plotted and compared to the ascorbic acid graph (Figure 2). The IC50 of the crude fractions' DPPH scavenging capabilities was determined and reported in Table 2. The ethyl acetate leaf fraction, EL, which has the lowest IC50, has the most activity, followed by the fraction hexane leaf fraction, HL. Comparatively, the radical scavenging activities of the leaves fractions are higher than those of the stem bark. The presence of phenolic compounds, polyphenols, flavonoids, and tannins in the plant extracts, make *P.osun* a good source of antioxidant. This is in line with the findings of Nahak and Sahu's, (2010). In-vitro antimicrobial studies revealed that *Staphylococcus aureus, Salmonella typhi, Helicobacter pylori, and Escherichia coli* are sensitive to all six crude fractions of the leaf and stem bark extracts, whereas *Vancomycin resistant enterococci, Campylobacter jejuni, Candida albica, Vibrio cholerae*, and *Candida krusei* are resistant to all extract fractionsas reported in Table 3. The antibacterial activity was found to be lowest in hexane fractions with zones of inhibition range 18–24mm, followed by 23–26mm for methanol fractions, and it is highest in ethyl acetate fractions (24–29mm) as reported in Table 4 and Figure 3. This suggests that ethyl

acetate is a better solvent in the extraction of bioactive components of *P. osun.* One could draw the conclusion that ethyl acetate is the optimum solvent to extract therapeutically valuable bioactive components from *P. osun* because it produced strong antioxidant activity and strong inhibitory effect. In addition to being able to extract phenolic compounds with antioxidant capabilities, this solvent displayed some degree of hydrophobic prowess to extract low polar molecules with inhibitory effects. This finding is consistent with the discussion of (Arioua et al, 2022). Noticeably, the activities in the leaf fractions are slightly higher than those in the stem-bark fractions, when compared. This is in agreement with the IC_{50} of the extracts' DPPH scavenging capabilities. The antibacterial activity of the crude extract fractions are comparable to those of the conventional antibiotics Sparfloxacin, Ciprofloxacin, and Fluconazole (29-37mm), which were utilized as controls (Figure 3). There is prospect of higher biological activities when the pure bioactive compounds are isolated from the extracts of this plant. The FTIR spectrum was used to identify the functional groups of the active components present in extract based on the peaks values in the mid IR region of IR radiation. When the extract was passed into the FTIR spectrophotometer, the functional groups of the components were separated based on its peaks ratio. FTIR spectra of the powdered samples and crude extracts are presented in Figures 4a and 4b. The functional groups of the FTIR spectra confirmed the presence of C-H stretch (alkanes) at 2917- 2847cm^{-1}, C=O, C=C, C-N stretch (carboxylic acid, amide) at 1734 – 1710,1690 – 1630 cm^{-1}, N-H stretch (Amines, amides) at between 3800 - 3600 C-H stretch (alkyne) at 3300 cm^{-1} (Tables 7a and 7b). FTIR spectroscopy is proved to be a reliable and sensitive method for detection of bioactive molecules.

CONCLUSION

The findings of this study on *P. osun* phytochemical screening, antioxidant capacity measurement, and antimicrobial activities lend some support to the indigenous medicinal claims about the plant and also suggest that once the plant is fully investigated; new antibiotics drugs could be developed from it that could be used against drug-resistant pathogens like *E.coli* and *S. aureus.*

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CONFLICTS OF INTEREST: The authors state that they have no competing interests.

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