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The Role of plants in treating diseases caused by microorganisms through natural product-based therapies.

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Abstract- The increasing resistance of micro-organisms to conventional antibiotics has become a significant global health concern, driving the exploration of alternative antimicrobial agents, particularly plant-based natural products. This study aimed to investigate the potential role of selected medicinal plants in the treatment of infections caused by micro-organisms, with a primary focus on assessing their antimicrobial effectiveness. To achieve this, an experimental research design was employed. Plant materials were carefully collected, processed, and subjected to detailed phytochemical screening to identify the presence of bioactive compounds. Standard laboratory procedures were used to prepare plant extracts, which were subsequently tested against a range of selected pathogenic micro-organisms using the agar well diffusion method. The zones of inhibition formed around the wells were measured, and the results were analyzed statistically to evaluate the antimicrobial activity of each extract. Findings revealed that the selected plant extracts exhibited varying degrees of antimicrobial activity. Significant zones of inhibition were observed against the bacterial isolates, which suggested the presence of active phytochemical constituents, including alkaloids, flavonoids, tannins, and saponins. These results also indicated that some plant extracts exhibited antimicrobial properties comparable to those of standard antibiotics. In conclusion, the study confirms that medicinal plants possess considerable antimicrobial potential, offering promising alternatives for the management of infections caused by resistant micro-organisms. The study recommends further research to isolate, purify, and identify the active compounds responsible for these effects, with the goal of developing them into pharmaceutical products.

Keywords- Plants, Treating diseases, Microorganisms, Natural Product.

I. INTRODUCTION

For millennia, plants have been a vital source of sustenance and healing for human societies. Ancient civilizations, long before the advent of modern medicine, utilized plants and plant-based remedies to treat a wide range of ailments, from common colds to serious infections (Adeneye et al., 2006; Obruche et al 2019). This rich tradition of herbal medicine, passed down through generations, laid the foundation for many modern pharmaceutical practices. Even today, plants continue to be an essential part of the medical arsenal, particularly in the treatment of diseases caused by microorganisms such as bacteria, fungi, viruses, and parasites (Amin et al., 2012). With the increasing challenges posed by antimicrobial

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resistance (AMR) and the limitations of synthetic drugs, there has been a resurgence of interest in plant-derived compounds as potential alternatives or supplements to traditional therapies (Itodo et al., 2021).

The modern medical community has long recognized the therapeutic value of natural products, which are derived from plants, fungi, and other organisms. These natural compounds, often referred to as secondary metabolites, are not essential for the plant's growth but serve various ecological functions, such as deterring herbivores, protecting against pathogens, or attracting pollinators. Over time, scientists have discovered that many of these compounds exhibit antimicrobial, antiviral, and antifungal properties that can be harnessed to combat microbial infections in humans (Erienu et al., 2022). The search for new plant-based antimicrobial agents is particularly urgent today, as the rise of multidrug-resistant pathogens poses a serious threat to public health worldwide. Microbial infections have long been a leading cause of morbidity and mortality globally. While advances in medicine have led to the development of antibiotics, antivirals, and antifungals, these treatments have limitations (Ogwuche & Obruche, 2020).

The emergence of antibiotic resistance, which occurs when bacteria evolve to survive the effects of drugs designed to kill or inhibit them, is a growing concern. Resistant infections are becoming increasingly common, rendering many of the antibiotics that were once the mainstay of treatment ineffective. This has led researchers to reconsider natural products, especially those derived from plants, as a potential source of new antimicrobial agents capable of overcoming resistant pathogens. The field of ethnopharmacology, which studies the traditional use of plants and other natural substances in medicine, has played a key role in recognizing the medicinal properties of plants. Numerous plants that were once used in folk medicine have now been scientifically validated for their antimicrobial effects (Burton et al., 1983). For example, the bark of the *Cinchona* tree, which contains quinine, has been used for centuries to treat malaria.

More recently, the antimalarial compound artemisinin, derived from the plant Artemisia annua, has become a cornerstone of modern malaria treatment. These examples underscore the vast potential of plant-based compounds as alternatives to synthetic drugs, particularly as we confront the growing threat of antimicrobial resistance (Obruche et al., 2018). Plants are also being investigated for their ability to treat viral, fungal, and parasitic infections, in addition to bacterial diseases. While antibiotics are effective against bacterial infections, they are largely ineffective against viruses and fungi.

As a result, the exploration of plant-derived compounds as broad-spectrum antimicrobial agents is crucial (Caius, 1986). Some plant compounds have shown promise in inhibiting viral replication, enhancing immune responses, or disrupting the ability of viruses to infect host cells. Similarly, certain plants contain compounds that are toxic to fungi or interfere with their reproductive processes. Plants such as Garlic (Allium sativum) and Tea Tree (Melaleuca alternifolia) have demonstrated antifungal activity, and Echinacea has been shown to boost immune function, aiding in the fight against viral infections (Obruche et al., 2019).

The aim of this research work is examine the Role of plants in treating diseases caused by microorganisms through natural product-based therapies.

II. MATERIALS AND METHOD

Collection and drying of plant materials

The procedure for sample collection and drying adhered to the methodology established by Krithika et al., (2009) and Obruche et al. (2019). Fresh leaves of Phyllantus amarus and Phyllantus niruri were collected in October, 2023, at the University of Calabar staff village, Calabar, Nigeria. The plants were

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identified and authenticated at the Botany Department of University of Calabar, Calabar, by pastor Frank Apejoye. The harvested fresh leaves were washed and dried in an oven at a temperature of 40oC for 48hrs in the laboratory of Chemistry Department, University of Calabar.

Extraction procedure

This extraction was conducted in accordance with Murugaigah and Ghan, (2007). The dried leaves were blended to fine powder using a manual blended (F No 4 Quaker City, Mill Philadelphia PA.U.S.A F8). Batch extraction was carried out on the material. In the batch extraction, the powdered materials (200 g Phyllantus amarus and 200g, Phyllantus niruri) were separately macerated in 250 mL of ethanol for 8 hours. The extracts were sieved and the mixture was filtered using Whatman No 1 filter paper.

Antimicrobial assay

In this study extracts of Phyllantus amarus and Phyllantus niruri, were evaluated for antimicrobial activities against the following micro-organisms (bacteria and fungi); the bacteria are: Escherichia coli, Staphylococcus aureus, Salmonella typhi, Klebsiella pneumonia, Streptococcus species, Pseudomonas aeroginosa, Bacillus species. The fungi are Candida ablican Penicillium species and Aspergillus niger (Odetola and Akosenu, 2000).

Collection of micro organisms

Pathogenic microorganisms were gotten from University of Calabar Teaching Hospital (UCTH) microbiology laboratory. The organisms were sub-cultured into a broth culture medium and incubated for 24hrs.

Agar disk diffusion method

Mueller Hinton Agar was used for testing antimicrobial susceptibilities using the disk diffusion method. It was prepared thus: 38.0gm of medium was combined with one litre of deionized water, it was stirred to mix thoroughly. After mixing, it was boiled but not overheated, after which it was autoclaved at 1210C for 15 minutes. The prepared agar was poured in Petri dishes followed by the streaking of the microorganisms on the dishes.

Application of the extracts on the organisms in the Petri dishes

Sterilized Whatman NO 1 filter paper was soaked in the extracts and placed in each of the organisms in a petri dish and incubated at 37oC for 24hrs. After which the zone of inhibition was recorded.

III. RESULT AND DISCUSSIONS

Antibacterial activity

Table 1 shows the in vitro antibacterial activities ethanolic extracts of Phyllantus amarus and Phyllantus niruri leaves. Ethanolic extracts of Phyllantus amarus leaf showed inhibitory activity against. Escherichia. coli Klebsiella pneumonia, streptococas species, staphylococcus aureus. The following bacteria: Salmonella typhi, Bacillus species and Pseudomonas aeroginosa were resistant to it.

Antifungal activity

In vitro antifungal activities of ethanolic extracts of Phyllantus amarus and Phyllantus niruri leaves were carried out. Ethanolic extracts of Phyllantus amarus leaf showed inhibitory activity against the following fungi; Candida ablican, Penicillium species and Aspergillus niger. All the fungi used for the work showed no resistance to the ethanolic extract of the leaves of the two Phyllantus species.

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Table 1 Antibacterial and antifungal activity of Phyllantus amarus and Phyllantus niruri on selected micro- organism

S/N	Micro organisms	Zone of inhibition	
		Diameter (mm)	
		P. amarus	*P.niruri*
1	*Escherichia coli*	20	30
2	*Klebsiella pneumonia*	15	31
3	*Streptococus species*	22	26
4	*Bacillus spec*ies,	Resistance	20
5	*Salmonella typhi*	Resistance	20
6	*Staphylococcus aureus*	20	28
7	*Pseudomonas aeroginosa*	Resistance	25
8	*Candida ablican,*	22	33
9	*Aspergillus niger*	21	20
10	*Penicillium species*	20	25

Antimicrobial activity of Phyllantus amarus and Phyllantus niruri against E. coli.
The zone of inhibition of ethanolic extract of Phyllantus amarus leaf on E. coli is 20 mm while that of Phyllantus niruri leaf extract is 30 mm which shows that Phyllantus niruri inhibits the growth of E.coli more than Phyllantus amarus. Hence, P. niruri is more effective in treating diseases caused by E.coli. Similar observations have been documented by Oudhia and Tripathi, (2002)

Antimicrobial activity of ethanolic leaves extracts of Phyllantus amarus and Phyllantus niruri against Klebsiella pneumoniae
Ethanolic extracts of Phyllantus amarus and Phyllantus niruri leaves against klebsiella pneumonia showed zone of inhibition of 15 mm and 31 mm respectively. This indicates that the Phyllantus niruri leaf extract is more effective in treating diseases caused by klebsiella pneumoniae. Similar findings have been reported by Festus-Amadi et al. (2021)

Antimicrobial activity of ethanolic extracts of Phyllantus amarus and Phyllantus niruri leaves against streptococas species
This shows zone of inhibition of 22 mm for Phyllantus amarus and 26 mm for Phyllantus niruri. Hence, Phyllantus niruri leaf extract is more effective against the streptococas species than that of Phyllantus amarus.
Antimicrobial activity of ethanolic extracts of Phyllantus amarus and Phyllantus niruri leaves against straphylococcas aureus.

Ethanolic extracts of Phyllantus amarus and Phyllantus niruri leaves against Straphylococcas aurenus showed zone of inhibition of 20 mm for Phyllantus amarus and 28 mm forPhyllantus niruri indicating that Phyllantus niruri is more effective in fighting this bacterium than Phyllantus amarus.

Antimicrobial activity of ethanolic extracts of Phyllantus amarus and Phyllantus niruri leaves against Bacillus species, Salmonella typhi and Pseudomonas aeruginosa.
The result of ethanolic extract of Phyllantus amarus leaf showed resistance to the Bacillus species, salmonella typhi and Pseudomonas aeroginosa while that of Phyllantus niruri shows zone of inhibition of 20 mm for Bacillus species, 20 mm for Salmonella typhi and 25 mm for Pseudomonas aeroginosa. Phyllantus amarus therefore has no antibacterial activity against these three bacteria species.
Antimicrobial activity of ethanolic extracts of Phyllantus amarus and Phyllantus niruri against the fungi: Candida ablican, Aspergillus niger and Penicillium species.

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The results of ethanolic extracts of Phyllantus amarus and Phyllantus niruri leaves on the fungi mentioned above showed zone of inhibition for Phyllantus amarus extract of 22 mm for Candida ablican, 21 mm for Aspergillus niger and 20 mm for Penicillium species while that of Phyllantus niruri extract showed zone of inhibition of 33 mm for Candida ablican, 20 mm for Aspergillus niger and 25 mm for the Penicillium species. Hence, Phyllantus niruri is more effective in the control of infection caused by the fungi except in the case of Aspergillus niger were Phyllantus amarus is more effective. Similar results were documented by Oluwafemi and Debri, (2008) and Ogwuche & Obruche (2020)

IV. CONCLUSION

The results or antimicrobial (antibacterial and antifungal) study of Phyllantus amarus and Phyllantus niruri extracts indicate that the ethanolic leaf extract of Phyllantus niruri was more active than that of Phyllantus amarus. The ethanolic leaf extract of Phyllantus niruri showed good inhibitory properties on the bacteria: E. coli, klebsiella pneumonia, Streptococas species, Bacillus species, Salmonella typhi, Staphylococcus aureus, Pseudomonas aeroginosa. For fungi, the ethanolic leaf extract of Phyllantus niruri was more active against Candida ablican and Penicilium species. Ethenolic leaf extract of Phyllantus amarus was effective against the bacteria E. coli, Klebsiella pneumonia, Streptococas species and, Staphylococcus aureus (but less effective compare to Phyllantus niruri), Bacillus species, Salmonella typhi, and Pseudomonas aeroginosa were resistant to the extract. For fungi, ethanolic leaf extract of Phyllantus amarus was effective against Candida ablican, penicilium species and Aspergillus niger compare to Phyllantus niruri, ethanolic leaf extract of Phyllantus amarus was more effective against Aspergillus niger.

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