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Original Research Article

Bio-Insecticides/Repellant and Antimicrobial Activity from *Ficus polita* (DURUMI) Leaf Extract and Its Efficacy on Mosquitoes and Other Crawling Insects in Gidan Madi Town Sokoto State

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Abstract: Ethanolic leaf extracts of Ficus polita were investigated for the presence of phytochemical, physicochemical and their antimicrobial activities at various concentrations against some selected clinical microbes (*Escherichia coli* and *Salmonella typhi*) using standard methods. Qualitative phytochemical results showed that the ethanolic leaf extracts contained phytochemicals constituents such as terpenoids, glycosides and saponin were assayed except alkaloid, flavonoids, phenols and tannins were all absent in the extracts of *Ficus polita*. The physicochemical parameters of the extract revealed the pH to be 6.44 while the iodine value was 0.253 and the electric conductivity was 112.7. The results of the antibacterial activities of the ethanolic extract of *Ficus polita* leaves were effective on the tests organisms (*Escherichia coli* and *Salmonella spp*) at various concentrations and also sensitive against cefraxone at same concentration. In this study, *Ficus polita* leaves extracts exhibited varying levels of antibacterial activity against *Escherichia coli* and *Salmonella spp.* Research should be carried out using bioassay guided fractionation to identify, isolate and characterize the bioactive components of the plant extracts.

Keywords: *Bio-Insecticides/Repellent, Ficus polita (Durumi) leaf Extract,* Antimicrobial, ethanol, Ficus poilta, phytochemicals, physicochemical.

INTRODUCTION

For many viral, bacterial and protozoans' diseases mosquitoes act as vector. In term of disease transmission and public health importance mosquito are considered as very important group of insects. Population of mosquito's increases exponentially that is major problem for many countries because mosquito spread the different diseases such as filarial, Japanese encephalitis, Lyme disease, Yellow fever, encephalitis, malaria, chikungunya, dengue, and epidemic poly-arthritis. In tropical and subtropical countries mosquito borne diseases are main problem. Mosquito has approximately 3500 species and present in tropical and subtropical regions (Chandra *et al.,* 2018).

Ficus polita is an evergreen shrub or small tree usually growing up to 15 metres tall, but exceptionally to 40 metres. The dense crown can be flat or rounded, and can spread for up to 40 metres. The bole is generally short and stout. The plant often

commences life as an epiphyte, growing in the branches of another tree. It sends down aerial roots from its lower lateral branches which root when they touch the ground and become trunks The growth rate of the tree then accelerates due to the extra nutrition it receives, it sends down more aerial roots and also grows faster than the other tree eventually killing the tree it was growing in the leaves are occasionally harvested from the wild for food. The tree is sometimes grown as a boundary marker or living hedge and is also planted for ornament and to provide shade Rudrappa and Bais (2008).

The fig tree, which is also referred to as *Ficus polita* and called Durumi in Hausa, Jammeiz alazrak in Shuwa Arabic and Gbanchi bokun in Nupe, all in northern Nigeria, belongs to the family Moraceae (Keays, 1989). It grows to about 18 m high and is much branched with dense rounded crown upon which abscission can occur during wind or storms (Raghavendra, 1991). The stem of this plant is erect with a single trunk and smooth bark which secretes a milky juice that contains some waste products (Muller, 1977; Dutta, 1989). Its leaves are slender and tend to hang downwards which, close to the time of annual bud break, shed off their old ones which are soon replaced by the expanding buds hence, the plant is essentially evergreen (Raghavendra, 1991).

Statement of the Problems/Justification

Bacteria, fungi, viruses and parasites have earned a reputation placing them among the most pathogenic and most often encountered organisms in medical and clinical microbiology. Determining the repellant and bio-insecticide effectiveness of Polita leaf extract on pathogens can show which agent is most effective against a pathogen and give an estimate of proper therapeutic dose. Polita leaves have been part of human existance for ages due to its nutritional and medicinal values. But the leaves tends to fall and causes wastes that could bring about environmental pollution if not properly handled. Processing of these leaves into essential oils is a sure way of transforming these wastes with great potential for environmental pollution into a resource with great potential for economic prosperity, and also for securing the public health impacts of safer and healthier environment, likely to be obtained from the indirect waste management option so offered. This study therefore, aims to lessen the waste disposal of *Ficus polita* leaf and to propose an alternative insecticide/repellent that is less harmful than the synthetic chemical products, but conforms to the standards of the market.

Objectives of the Study

The broad objective of this research is to produce bioinsecticides/repellent from *Ficus polita* leaf extract and determine its efficacy on mosquitoes and other microorganisms.

The specific objectives were to;

i. Extract the active ingredients from *Ficus polita* leaf
ii. Convert the leaf waste to useful product
iii. Characterized the active ingredients in the extracts
iv. Characterize the physicochemical parameters of the extracts
v. Determine the antibacterial activity of the extract against *Salmonella spp* and *Escherichia coli*.

MATERIALS AND METHODS

Collection of Plant Samples: The plant samples were collected from Gidan Madi Town, Tangaza Local Government Area, Sokoto State. The *Ficus polita* leaves were authenticated at Department of Science Laboratory Technology, Umaru Ali Shinkafi Polytechnic Sokoto

Preparation of Plant Samples: The leaves of *Ficus polita* were cut into bits with knife and oven dried at 70°C for 12 h to remove all moisture. The samples were then ground into fine powder.

Extraction of Plant Material

Ethanol Extraction: The ethanolic extract of the plant was prepared by soaking 50g of the ground sample of the leaf in 100 mL of ethanol using maceration process for 48hours for a complete maceration. The experimental set-up was left for 48 h at room temperature and thereafter filtered using Whatman filter paper No. 1. The extract was then concentrated to 50 mL of the original volume of the extract and stored in an air tight container in a refrigerator at 4°C until when needed.

Preliminary Phytochemical Screening: Qualitative phytochemical screening of the extracts was conducted to determine the presence of phytochemicals such as tannins, saponins, flavonoids, alkaloids, sterols, phenols and cyanogenic glycoside. This was done using standard procedure as described by Harborne (1973).

Physicochemical Parameters:

Iodine Test: This test was performed to check the presence of unsaturated bonds in a molecule. A few drops of the Polita extract were taken in a test tube. A few crystals of iodine was added and shaken well.

pH Test: The pH was measured using pH meter. Approximately 5 mls of the Polita extract was taken for pH analysis.

Electricity Conductivity

Kerro meter was inserted into the polita extract select the button for the parameter (Electric Conductivity) you want to detect and wait for the result to display on the screen to take your reading. Hannan instrument (Model: Hi-9828) was used to measure electrical conductivity.

Bacteria Used in the Study

The organisms (*Escherichia coli* and *Salmonella spp*) isolates used in this study were isolated from wound, nose and ear swabs and confirmed based on their cultural and biochemical characteristics.

Materials and Instruments

Ficus polita leaves, 8 meters plate, Muller Hinton Agar, 10 centimeters glass tube, What man filter paper, 5ml and 10ml syringe, mortar and pistle.

Procedures of Making the Crude Extract

Ficus polita leaves were collected and air-dried, pulverised in a wooden mortar and weighed on an electronic weighing balance. Fifty (50 g) of the powder was extracted in ethanol by Soxhlet extraction method. The extract was filtered through Whatman (No.1) filter paper and concentrated over a water bath using a rotary-vacuum evaporator to recover the solvents. The extract was then stored for antibacterial activity studies.

Preparation of Culture Media

The media used were Mueller Hinton agar and Nutrient broth. The media were prepared according to manufacturer‟s instruction. Thirty five (35 g) of medium was mixed with one litre of distilled water in a screw cap container and autoclaved at 121 °C for 15 minutes. The medium was later dispensed into 90 mm sterile agar plates and left to set. The agar plates were incubated for 24 hours at 37 °C to confirm sterility.

Antibacterial Activity of the Plant Extracts

Susceptibility Test: The susceptibility test of the extract was carried out using the agar well diffusion method (Irobi *et al.*, 1994). *Escherichia coli* and *Salmonella spp* were inoculated separately on the surface of Mueller Hinton agar plates by surface spreading using a sterile cotton swab and each bacterium evenly spread over the entire surface of agar plate to obtain a uniform inoculums (Irobi *et al.*, 1994). Five wells of 6 mm diameter and 5 mm depth were made on the solid agar on each plate using a sterile glass borer and numbered for the concentrations of extracts. 1g of the extract was dissolved in 10 ml of distilled water to obtain 2, 4, 6 and 8 mg/ml concentration. The set up was incubated for 24 hours at 37^{o}C. All the tests were run in triplicates. After incubation, the zones of inhibition were measured in millimeters (mm) using a transparent ruler. Oxoid (1985) standard susceptibility range was used to classify zones of inhibition as either sensitive.

RESULTS

The results of the study are presented in Table 1-3 and Fig 1. Qualitative phytochemical screening of leaf extracts of *Ficus polita* ethanolic solvents is presented in Table 1. It was observed from the result that phytochemical such as terpenoids, glycosides and saponin were assayed except alkaloid, flavonoids, phenols and tannins were all absent in the extracts of *Ficus polita* (Table 1). The physicochemical parameters of the extract revealed the pH to be 6.44 while the iodine value was 0.253 and the electric conductivity was 112.7 as presented in Table 2. The results of the antibacterial activities of the ethanolic extract of *Ficus polita* leaves were effective on the tests organisms (*Escherichia coli* and *Salmonella spp*) at various concentrations and also sensitive against cefraxone at same concentration. The results are presented in Table 3.

Fig. 1: *Ficus polita* species (Source: Self collection from study site)

Table 1: Qualitative Phytochemical Screening of Ethanolic extract of *Ficus polita* leaf extract

Solvent	**Phytochemicals**						
Ethanol	Alkaloid	Flavonoid	Terpenoid	Glycoside	Phenol	Tannins	saponnins
	-	-	++	++	-	-	+++

Note + represents the presents of the constituents
- represents the absent of the constituents

Table 2: Physicochemical Parameters of the Ethanolic Extract of *Ficus polita* leaf extract

Solvent	**Physicochemical Parameters**		
Ethanol	Iodine value	pH	Conductivity
	0.253	6.44	112.7

Table 3: Antibacterial activity of *Ficus polita* ethanolic leaves extracts against the tests organisms

Test organisms	**Concentration (mg/ml)**				**Control (Cefriaxone)**			
	2	4	6	8	2	4	6	8
	Zone of inhibition in (mm)				**Zone of inhibition in mm**			
Escherichia coli	0.63	1.28	2.02	2.63	0.48	1.92	2.88	3.84
Salmonella spp	0.00	0.25	1.50	2.08	1.63	6.50	9.72	13.00

DISCUSSION

Phytochemicals are secondary plant metabolites that occur in various parts of plants, they have diverse roles in plants which include provision of vigour to plant; attraction of insect for pollination and feeding defense against predators, provision of colour while some are simply waste products (Igwe *et al.,* 2007). However this phytochemicals elicit varied biochemical and pharmacological actions when ingested by animals (Trease and Evans, 1989). This study revealed the presence of various medically important phytochemicals in Ficus polita extracts. The results revealed the presence of saponins, glycosides and terpenes while phenols, alkaloids, flavonoids and tannins were absent. Saponin has also been identified during the determination due the presence of honey comb froth in the solutions of *Ficus polita* leaves extract and this revealed the present of saponin. Therefore, according Trease and Evans, (1985) *F. polita* leaves can be use as anti-inflamatory, cardiac depressant and hyper-cholesterolemic. Saponin & Steroid also have relationships with sex hormones like oxytocin which regulate the onset of labour in pregnant women and subsequent release of milk (Okwu and Okwu 2004). The presence of this phytochemicals in the extract is an indication that this leaves can be given to expectant ruminant animals and those that deliver without the expulsion of their placenta. Terpenes was also present in the leaf, this indicate that *Ficus polita* leaves can be used for certain inflammatory conditions such as system vas colitis (inflammation of blood vessels) and myositis (inflammation of muscle) they may also be used selectively to treat inflammatory condition such as rheumatoid arthritis. The results of the study is in agreement with the findings of Solomon Wisdom *et al.,* (2011), who detected glycoside, saponnins, terpenoids, steroids and tannins but no alkaloids, triterpenoids and glycosides. However, the results of the study is in contrast with the research conducted by Magali and Agber, (2021) in Mubi, Adamawa State Nigeria which showed that considerable amount of phytochemicals (saponins, glycosides, flavonoids, alkaloids and terpenoids) were found in both the leaves and stem bark of Ficus polita extract. However, the variation in the results may be due to geographical location of the plants, climatic and environmental conditions which may have impact on the plants.

The results obtained from this study shows clearly the various physicochemical parameters of extract examined. The pH ranged obtained from this study was 6.44 for the sample. This falls within the Standard Organization of Nigeria (SON) and by World Health Organization (WHO) limits (SON, 2007; WHO, 2011). It should be noted that high pH increases the toxicity of ammonia in water while low pH enhances the toxicity of H_2S and cyanide (Ibiebele *et al.,* 1983). Since the pH values of this extract is basic, they sample may pose no serious health risk to consumers who use the extract for treatment of ailments and other traditional purposes. The conductivity value was 112.7. Although these values fell within the acceptable limits. The overall chemical richness of any extracts is a reflection of its conductivity values. The relatively low conductivity values may be attributed to low concentrations of chloridet. The conductivity of the plant extracts is a useful and accessible indicator of its salinity or total salt content (Oluyemi *et al.,* 2010).

The results for the antibacterial screening have revealed that though at varying concentrations, *Ficus polita* leaves extracts have antibacterial activity on the *Escherichia coli* and *Salmonella spp*. However, the results generated from the study indicates that the aqueous extract of *Ficus polita* leaves has

antibacterial activity with variable degree of sensitivity on *Escherichia coli* with inhibition zone of 0.63, 1.28, 2.02 and 2.63mm at concentration of 2, 4, 6 and 8g respectively. Similarly, *Salmonella* spp also shows sensitivity to the extract with inhibition zone of 0.00, 0.25, 1.50 and 2.08mm at concentration of 2, 4 6 and 8g respectively. The control was all sensitive to the test organisms at various concentrations.

The result of this study is in agreement with the result reported by Solomon *et al.,* (2011) in Abuja Nigeria who showed that the leaf extract of *Ficus polita* had activity on the micro organisms but at 1.0mg/ml. Saponins, saponin glycosides, tannins, phenols and volatile oils were the important phytochemical components found in the plant parts which may be responsible for the biological properties of this plant. The biological screening result is indicative of the potential of Ficus sur as antimicrobial substance. This research is also in agreement with the research reported by Naser *et al*., (2012) in Saudi Arabia who reported the effects of crude extracts of herbs on bacteria isolates showing higher inhibition of 8.00 and 16.0mm on *Staphylococcus aureus* and *Streptococcus* spp respectively. Antibacterial studies indicated that the ethanol leaf and stem extracts of *Ficus polita* inhibited the growth of the microbes but at varied levels and the inhibition was extracts concentration dependent (Table 3). The leaf extracts of *Ficus polita* showed inhibition against test microbes indicating that the plant possesses antimicrobial properties. This could be attributed to the presence of chemical compounds in the extracts. These phytochemicals are known to have medicinal properties. The inhibition of bacterial strains suggests that the plant possesses broad spectrum of antibacterial properties which could be used in the treatment of skin diseases and food poisoning of which the microbes are commonly implicated.

CONCLUSION

In this study, *Ficus polita* leaves extracts exhibited varying levels of antibacterial activity against *Escherichia coli* and *Salmonella spp.* The antimicrobial activity of *Ficus polita* leaves extract varies widely, depending on the type of herb on the test medium, and microorganism. For these reasons, *Ficus polita* leaves herb may be considered as excellent antimicrobials and bioinsecticidal agents.

RECOMMENDATIONS

From the results obtained in this study, it is recommended that:

1. Experiments should be carried out at higher concentrations of the aqueous and methanolic extracts to assess their activity on multidrugs resistant organisms (MRSA and PRSA)
2. Research should be carried out using bioassay guided fractionation to identify, isolate and characterize the bioactive components of the plant extracts.
3. The ministry of health should make it mandatory that all herbal products be subjected to scientific verifications before being sold as remedy.

Conflict of Interest

The author declares that there is no conflict of interest.

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