ANTIMICROBIAL ASSESSMENT *TRADESCANTIA SPATHACEA*

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DECLARATION

I hereby declare that this project has been written by me and is a record of my own research work. It has not been presented in any previous application for a higher degree of this or any other university. All citations and sources of information are clearly acknowledged by means of references.

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FAYEHUN OLUWAFERANMI DAVID

Date

CERTIFICATION

This is to certify that the content of this project entitled **"ANITMICROBIAL ASSESSMENT OF TRADESCANTIA SPATHACEA"** was prepared and submitted by **FAYEHUN OLUWAFERANMI DAVID** in partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN MICROBIOLOGY**.

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DEDICATION

I dedicate this work to GOD for his steadfast love, mercy, grace and favour he blessed me with and to my mother MRS FAYEHUN Y.O for her love and support and to my late father may he rest in peace MR. J.A FAYEHUN for his love, guidance support he gave me

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Table of Contents

ABSTRACT

T. spathacea is a perennial plant utilized internationally as ethnopharmacology to help difficulties like, colds, sore throat, whooping cough nose-bleed, anti-fertility agent, fever, bronchitis, tuberculosis, diarrhea, hypoglycaemic, snakebites and kidney disorders. The extracts and the chemicals derived from *T. spathacea* demonstrate a wide spectrum of pharmacological activity including anti-cancer, anti-tuberculosis, antiviral, antioxidant and anti-inflammatory effects. However, there is paucity of information on the antimicrobial activities of the flower. This study aims at evaluating the antibacterial activity of ethanolic extracts of the flower of *Tradescantia spathacea* against *Escherichia coli* and *Salmonella spp using* nutrient agar.The extract was tested using Nutrient Agar plate at doses of 200mg/ml, 400mg/ml, 600mg/ml/, 800mg/ml against human pathogens *Escherichia coli* and *Salmonella spp*in triplicate. However,no zone of inhibition was observed. The methanolic extract of*T. spathacea* did not show antimicrobial activities on tested pathogenic organisms.

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Tradescantia spathacea, often known to be Boat lily (Hunt, 1994),is among the Commelinaceae family of plantsidentified in 1788. In this study, the floral extract of this plant was tested to evaluate its possible antibacterial capabilities. It's been used for medical purposes since ancient times. It was discovered thata substantial percentage the total population second and third world nations rely on the plants as the major healthcare provider (Ajala *et al*, 2020).Approximately half of the global health goods are created from more than one-third of the recipes initially drawn from plants that arise in United States every year. Furthermore, 80 percent population of the world utilizes herbs to cure or prevent illnesses (Newman and Snader 2000). A significant variety of plant components have important biological, physiological and pharmacological effects. Studies have indicated that at least 12,000 physiologically active chemicals have recently been identified (Dosumu *etal*, 2019).

Herbal therapeutic agents have been demonstrated to arise owing to the advent of illnesses and the increase of scientific understanding of medicinal herbs as key alternatives or techniques to supplement various treatment for diseases (Sundram *et al*, 2011). Alkaloids, terpenoids, tannins, essential oils, lectins, polypeptides, and polyacetylenes (Pivato *et al*, 2012). These bioactive chemicals are utilized as starting points for the manufacture of antibiotics as a therapy for infectious illnesses (Anwar and Rahman, 2007). Crude extracts of *Polygonum persicaria*, *Rumex hastatus, Rumex dentatus*, *Rumex nepalensis, Polygonum plebejum* and *Rheum australe* exhibit antibacterial and antifungal properties, limiting the development of C. fruit, *Escherichia coli*, *E. aerogenes and Staphlococcus aureus* (Bato Calotropis, 2018.) Extract *Gigantean nhaxane* does not have antibacterial or antifungal action against pathogenic bacteria. However, its ethyl acetate component inhibits the activity of certain bacteria and fungi, with the exception of *T. rubrum* (Wang *et al*, 2008). A crude extract *Calotropis gigantean* exhibits potential antifungal efficacy on*Candida albicans*, *Aspergillus niger*, *Aspergillus ochraceus*, *Aspergillus ustus*, and the Asian fungal pathogen *Rizopus oryzae* (Abdul kadar *et al*., 2014). In another research, *Plumba goylanica* ethanol extract. root has high antibacterial action against *Vibrio* *cholerae*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Curvularia lunata*, *Colletotrichum corchori*, and *Fusarium equiseti* (Chua *et al*., 2014). *Euphorbia hirta* leaves aqueous extract, *Erythrophleum suaveolens* and methanol extracts of Thevetia leaves. peruviana exhibits antimicrobial properties against ESBL-producing bacteria, for example;*Escherichia coli, Pseudomonas, K. pneumonia*, methicillin-resistant *Staphylococcus aureus* (MRSA), Salmonella and Proteus (Kaushal *et al*., 2017). Rockets from various plants are being implicated in antimicrobial action against multi-resistant bacteria, including bacteria that produce MRSA and ESBL (Refaz and Motelab, 2017). In addition, some crops may exhibit multiple antimicrobial effects, possibly controlling deficits associated with multi-resistant bacteria (KennethObosi, 2017).

Similarly, It is known that chemo-synthesis and the hunt for natural products of living creatures (such as higher plants) are the major origins of the search for an active molecule. New biological products can combat human illnesses caused by harmful bacteria over 80 percent the world's population to fulfill their health-care requirements, they depend on herbal medicine (Mohd Shahnawaz, 2017); However, until recently, less than 1 percent of plants were characterized by secondary metabolites, phytochemical components, and pharmacologically active substances (Motelab, 2011). In this respect, herbs used in traditional medicine (TMPs) are the most valuable source of novel bioactive chemical compounds due to their biological variety and different chemical sources within each species (KennethObosi, 2017). Thus, *P. aethiopica*, *E. depauperata*, *C. englerianum*, *L. adoensis*, *C. pustulatus*, *D. penninervium*, and *R. abyssinicus* are TMPs utilized by the community to cure different ailments induced by their repute. Phytochemicals and antibiotic compounds as therapeutic agents against MDR bacteria and harmful fungus.

1.2 Statement of problem

Throughout the years, various bacteria species have developed antibiotic resistance to chemically made antibiotics, causing scientists to look to other alternatives i.e., herbal plants used to treat for solutions to this global problem. The worldwide problem of microbial resistance to antibiotics has led to most antibiotic failure. Researchers are therefore shifting their focus to natural products, especially medicinal plant, with effective antimicrobial properties

The issueregarding antimicrobial resistance is related to antibiotic misuse, for instance antibiotic use in the case of viral infections. It also stems from antibiotic overuse due to patients pressuring medical practitioners for antibiotic prescriptions in minor infections as well as medical practitioners prescribing ineffective antibiotics and ineffective doses of antibiotics.

The search for, and application of drugs and nutritional supplements gotten from herbs have gone up in recent times. Various scientists like microbiologists, Phyto chemists, pharmacologists and botanists are scouring the world for phytochemicals and hints that can be turned into medicines for treatment of several diseases

1.2 Aim of the study

This project aims at determining the antimicrobial activity of methanol extracts of the flower of ***Tradescantia spathacea***against *Escherichia coli* and *Salmonella* spp.

1.3 Objectives of the study

1. To find an alternative to therapeutic medicine via herbal plants

2. To find a new category of antibiotic plant derived drug

3. To provide various applications of drugs and nutritional supplements.

1.4 Significance of the study

Biomedical research has used plants as the possible sources of medicines to prevent and cure human illnesses. The WHO has acknowledged antibiotic resistance as a global health security concern that demands action across government sectors and society as a whole (Van duin and Doi, 2017).

This project is done to develop new ways of producing antibiotics from medicinal plants using phytochemical compounds from the extracts of a flower of a plant.

1.5 Definition of terms

Antimicrobial: Antimicrobials are products that kill or slow of microorganisms. These microorganisms include, bacteria, viruses, protozoans and fungi such as mildew and mold.

Flower extracts: These substances or products taken out of a flower by the use of chemical compounds. e.g., Methanol

Phytochemical: Phytochemicals are compounds that are produced by plants ("phyto" means "plant"). They are found in fruits, vegetables, grains, beans, and other plants. ... Research has shown that some phytochemicals may: help stop the formation of potential cancer-causing substances (carcinogens)

CHAPTER TWO

LITERATURE REVIEW

2.1 Medicinal plants

Medicinal herbs continue to have tremendous recognition as the number one choice when it comes to primary health care systems in diverse civilizations, since 60 percent of the globe and over 80 percent of the second world countries utilize them. Medicinal plants for medicinal purposes (Shrestha, 2003), and this is certainly connected to affordability, affordability and cheap costs (Asase, 2008). Plants have long been utilized to cure human illnesses. Various components in plant, which are, bark, leaves, roots and stems, are utilized to resist, counteract, and occasionally prevent symptoms and return anomalies to normal. Since the use of "herbal medicine" is not rigorously adhered to by facts gained via scientific techniques, traditional medicine regards "herbal medicine" as an alternative. However, treatments by doctors may be traced back to their usein traditional products, including aspirin, quinine, opiates, digitalis. In contemporary medicine, active chemicals and components discovered and separated from higher plants are employed, around 80 percent of which have a true and precise resemblance in current therapeutic uses, modern and traditional applications (Zaidi, 2015).

Lately, a significant increase in thesearch for and usage of herbal medicines and food additives. Various experts, such as microbiologists, botanists, pharmacologists, and botanists, are combing the planet for phytochemicals and hints that may be converted into medications for various ailments. Medicinal plants may also be described as plants that are frequently used to cure and prevent specific ailments and are typically considered dangerous to humans (Tyler, 2001). Spontaneously in natural populations in the wild or semi-wild environments and may live without direct human intervention or "domesticated plants". On the contrary, these species emerge through human acts such as selection or reproduction and depend on management for their existence (Calixto, 2000). Medicinal herbs have been proven to be the backbone of the traditional system of medicine and have been widely used in medical practice since ancient times, contributing to the development of the practice of using medicinal plants, both for biomedical benefits and for their place in cultural beliefs. in various parts of this world in the creation of powerful medicinal drugs. During the

1950-1970s, over 100 novel herbal medications were launched onto the US pharmaceutical market, including dessertite, rubberinamine, and vincristine, derived from higher plants. Medicinal plants have supplied humanity with numerous potent medications to lessen or eradicate infections and illnesses. Increasingly (Bhat, 1995). There is a need to create safer medications (for both humans and their environment) to treat Protozoan illnesses (malaria, yellow fever), bacterial infections, viral diseases inflammatory diseases, diabetes, liver disease and digestive problems. Thanks to current study on plants or herbal medicine, considerable improvements have been achieved in the pharmacological assessment of many plants. utilized in traditional medical systems. Thus, plants may be classified as a major supply of pharmaceuticals, not only as separated active components supplied in regular dose forms, but also as raw drugs for the population. Also among developing countriesin Africa, Asia and portions of Europe (Kassirer, 1998). Due to the varied effects of herbal plants across the world, herbal goods have arisen due to the idea that many medications known as herbal medicines do not damage health and the environment. Public dread of the usefulness of synthetic or contemporary medications is always accompanied with their single or many unfavorable health consequences or side effects (Angell, 1998).

2.1.1 Phytochemical constituents of medicinal plants

Bioactive chemical components in medicinal plants cause a variety of physiological effects upon the body of a human (Akinmoladun, 2007). Phenolic compounds, alkaloids, terpenoids, essential oils, saponins, tannins, flavonoids, and other physiologically active phytochemicals are the most common. Okwu (2005) defines a phytochemical is a naturally occurring bioactive molecule found in plants such as vegetables, fruits, medicinal plants, flowers, leaves, and roots that reacts with nutrients and fiber to operate as a disease defense mechanism, or more particularly, as a disease defense. They are divided in two categories:

1. primary constituents
2. 2.secondary constituents.

Major components include common sugars, amino acids, proteins, and chlorophyll, while minor components include alkaloids, terpenoids, and phenolic compounds (Bono, 2007), as well as many additional components such as flavonoids, tannins, and soon. *Justica adhatoda*, Linn *Momordica charantia*, *Nordostachys jatamansi*, and Tephrosia purpurea were chosen for research due to their abundance and accessibility, and some have been utilized in traditional medicine. The usage of these plants in traditional processing can be scientifically explained by analyzing the presence of phytochemicals in these plants (Okwu, 2005). Terpenoids, steroids, cardiac glycosides, anthrakinin glycosides, saponins, flavonoids, tannins and phenolic chemicals, anti-sterile alkaloids, uterine stimulants, hypoglycemic agents, and growth inhibitors are all found in the *Momordica charantia* fruit. Analgesic action and prostate tumor development Terpenoids, steroids, cardiac glycosides, anthraquinone glycosides, saponins, coumarin glycosides, flavonoids, tannic and phenolic compounds, alkaloids, components with antiarrhythmic, antihypertensive, anticonvulsant, and stimulant properties are found in *Nardostachys jatamansi* rhizome. Terpenoids, steroids, cardiac glycosides, anthraquinone glycosides, saponins, coumarin glycosides, flavonoids, tannins, phenolic compounds, and alkaloids are found in *Justica adhatoda* and have antibacterial, anticholinesterase, wound healing, hypoglycemia, and hypoglycemic properties. *Tephrosia purpurea* contains terpenoids, steroids, cardiac glycosides, saponins, flavonoids, tannins, phenolic compounds, and alkaloids that have anti-inflammatory, anti-infectious, hepatoprotective, antidiarrheal, anthelmintic, alexiric, and antidiarrheal, anti-inflammatory, anti-inflammatory properties**.**

2.1.2 Characteristics of Medicinal plants

In West Africa, particularly in Nigeria, medicinal plants have demonstrated special characteristics in the field of herbal treatment. In Nigeria, there are around 1000 medicinal plants, the majority of which have not yet been studied for their therapeutic properties (Grellier, 2005). Their medical actions might be critical in the treatment of current or future health issues. Some medicinal plants are known as synergic medicinal plants because they can complement, damage, or neutralize their potential negative effects in the body; others are known as official medicinal plants because they are used in the treatment of complex cases such as cancer diseases; and still others have the ability to prevent the appearance of some diseases by reducing the **s**ide effects of synthetic treatment.

2.1.3 The Role of Medicinal Plants in Traditional Healing

The pharmacological therapy of sickness began long ago with the use of plants (Hansel *et al*,2001). Methods of folk healing around the world frequently employed plants as part of their heritage. Some of these traditions are briefly discussed here, offering some instances of the diversity of major therapeutic practices across the world that employed herbs for this purpose. It is also a result of the traditionally-held notion that the synergistic combination of numerous active principles in various herbal remedies is responsible for their therapeutic effects (Joseph *et al*., 2010). Methods of folk healing around the world frequently employed plants as part of their heritage. The introduction of plant derived medicines in contemporary medicine has been connected to the usage of plant derived materials as an indigenous treatment in traditional system of medicine (Igoli *et al*, 2003).

Some of the plants have been shown to exhibit substantial antibacterial, antifungal, anticancer, antidiuretic, anti-inflammatory and anti-diabetic effects (Lamu *et al*. 2012). Other applications of herbal medicines include venom neutralization by lupeol acetate isolated from the root extract of *Hemidesmus indicus* (Gomesan and Chatterjee, 2006), treatment of hypertension and blood sugar lowering by serpentine isolated from the root of *Rauwolfia serpentine*, and treatment of Hodgkin's, choriocarcinoma, non-Hodgkin lymphomas, and childhood leukemia, testicular and neck cancer from vinblastine isolated from the *Catharanthus rosesus* (Farnsworth, 1992) treatment of acute lymphocytic leukemia in childhood advanced stages of Hodgkin’s, lymphosarcoma, cervical and breast cancer amongst others. Plant derived medicines are used to heal mental illness, skin disorders, TB, diabetes, jaundice, hypertension and cancer.

2.1.4 Medicinal plants with demonstrated anti-malarial activity

Malaria is among the world’s most significant parasite illness and a main reason of death especially in impoverished nations (Fishcer and Bialek 2002). It affects roughly 100 underdeveloped nations, resulting in an estimated 1.2 million fatalities in Africa each year (WHO, 2015), with pregnant women and children under the age of five being the most vulnerable(Tabuti, 2008). A large number ofherbal productsare utilized for malaria therapy, as majority of the individuals who are infected cannot afford the present pricey orthodox medications (Zirihi *et al*, 2005).The issue of parasite resistance over currently available pharmaceuticalproducts has required the quest in search of fresh and powerful agents, and researchers' focus is on natural products, particularly medicinal plants, because plant-derived active molecules such as quinine and artemisinin have been found to be useful lead compounds for antimalarial medication development. (Chiyaka *et al*, 2009). Severalherbal plants went through examination for their anti-malarial potential and several with shown strong in vitro action have been discussed below;

1. ***Cryptolepis sanguinolenta***

Cryptolepis sanguinolenta (Lindl.) Schlechter (Apocynaceae) is recognized by Ghanaians as 'Ghana quinine' and especially 'Nibima' and 'Kadze,' respectively (Ameyaw, 2012).Having a thin-stemmed shrub that twines and scrambles all over the place., endemic to Africa, with significant ethno-medicinal value and attention in the West of Africa sub-region (Irvine, 1996). It is used historically for malaria therapy, upper respiratory and urinary tract infections, diarrhea, hypertension and as cicatrizing of wounds (Boye and Wright, 1996). *C. sanguinolenta*ethanolic aqueous extract showed antiplasmodial effectiveness in vitro against the multidrug-resistant *Plasmodium falciparum* (K1) strain, with all extracts decreasing parasite growth by 90% at dosages less than 23 g/mL.The ethanolic extracts of the roots and leaves demonstrated strong action with IC50 of 0.895 ± 0.02 and 3.01 ± 0.02 μg/mL, respectively. The aqueous extracts of the roots and leaves showed IC50 of 2.32 ± 0.3 and 13.5 ± 0.7 μg/mL, respectively (Paulo, 2000). Evaluating the therapeutic effectiveness in individuals with uncomplicated malaria using a tea bag preparation of *C. sanguinolenta* rootindicated that within 72 h, Fifty percent (50 percent) had *falciparumparasitemia* eliminated, by Day 7, as well as all patients. By the third day, the symptoms fever, cold, nausea, and vomiting had completely disappeared. Due to two instances of recrudescence on Days 21 and 28, the overall cure rate when one tea bag of *C. sanguinolenta* was given three times a day for five days was 93.5 percent. (Bugyei *et al*, 2010).

2. ***Terminalia ivorensis***

*Terminalia ivorensis*A. Chev. is a member of the Combretaceae family widely known as ‘black afara’ and by the Asantes as ‘amire.’ It is a big deciduous forest tree of 15–46 m height, typically planted as wood plantation in several tropical nations (Burkhill, 1985). Malaria, yellow feverand other ailments are treated with different parts of the plant in traditional medicine. (Oliver-bever and Agyare, 2009). A research by Komlaga *et al*. (Komalga *et al*, 2016) demonstrated a potent *T. ivorensis* aqueous leaf extract has antiplasmodial efficacy against *P. falciparum* chloroquine-sensitive (3D7) and chloroquine-resistant (W2) strains in vitro. IC50 of 0.64 ± 0.14 and 10.52 ± 3.55 μg/mL, a piece. In vitro antimalarial effectiveness of ethanolic stem bark extract against chloroquine-resistant *P. falciparum* strains was also observed having IC50 of 6.949 μg/mL (Annan *et al*, 2012).

3. ***Elaeis guineensis***

Elaeis guineensis Jacq (Arecaceae), The coccoid group of palms includes the oil palm, which is a monocotyledonous plant. It may reach a height of 15 meters and has a lifespan of more than 100 years, and it can be found across West Africa's tropical rainforest region. (Henson, 2012). Gonorrhea, rheumatism, headaches, and wounds are all common uses for *E. guineensis* (Mshana, 2000). The ethanolic extract of *E. guineensis* leaves was shown to be anti-plasmodial in an in vitro test. had strong antimalarial activity with IC50 of 1.195 μg/mL, against chloroquine-resistant *P. falciparum* (Annan *et al*, 2012).

4. ***Phyllanthus emblica***

Phyllanthus emblica L. of the family Euphorbiaceae is a deciduous medium-sized plant (10–18 m high), native to tropical south eastern Asia and extensively spread in most subtropical and tropical nations. It's often referred to as Indian gooseberry, and it's high in vitamin C, minerals, and amino acids to make up lost energy and vigor (Calixto and Gaire, 2014). Various portions of the plant are used historically for diarrhea therapy, inflammation, diabetes, jaundice, cough, asthma, peptic ulcer, skin disorders, leprosy, intermittent fevers, headache, anemia, dizziness, snakebite and scorpion-sting (Mirunalini and Krishnaveni, 2010). In a fluorescence assay based on SYBR green I,to look into anti-plasmodial properties in*P. emblica*, leaf extract soaked with methanol demonstrated significant action*P. falciparum* CQ-sensitive (3D7) and

CQ-resistant (Dd2 and INDO) strains, having IC50 values of 3.125, 4.8, and 5 g/mL, a piece. Also, the ethyl acetate leaf extract exhibited activity with IC50 of 7.25, 15 and 9 μg/mL against 3D7, Dd2 and INDO P. falciparum strains, respectively (Bagvan *et al*, 2011).

5. ***Syzygium aromaticum***

Syzygium aromaticum (L.)*Eugenia caryophyllata*, is an ancient and valuable spice, is a part of the Myrtaceae family and is native to the Americas.Generally known as clove. It is primarily utilized for flavoring many sorts of meals and has various medical qualities like antihelmintic, anti-asthma, and anti-allergy, anti-viral, anti-inflammatory,antioxidant and anti-parasitic characteristics (Mittal *et al*, 2014). A research by Bagavan *et al*. (Bagavan *et al*, 2011), demonstrated the antimalarial efficacy of methanol extract of *S. aromaticum* flower buds with IC50 of 6.25, 9.5 and 10 μg/mL CQ-sensitive (3D7) and CQ-resistant (Dd2 and INDO) strains of *P. falciparum* were tested.

6. ***Goniothalamus marcanii***

Goniothalamus tamirensis Pierre ex Finet and Gagnep is another name and are members of Annonaceae family. It occurs natively around temperate and sub-temperate regions in Asia. About 80 percent -EtOH extracts demonstrated an in vitro antimalarial activity (IC50 = 6.3 μg/mL) against the drug resistant K1 strain of *P. falciparum* (Ichino *et al*, 2006).

7. ***Casearia sylvestris***

Casearia sylvestris var. lingua (Cambess) (Cambess.) Eichler, (Salicaceae) is an evergreen shrub or small tree with long, thin branches and a highly thick globose crown. Usually 4–6 m tall, but can grow up to 20 m high, with extensive distribution throughout South America. It has been utilized in traditional medicine for treating snake bites, wounds, inflammation, fevers, stomach ulcers and diarrhea (Sleumer, 1998). The hexane extracts of *C. sylvestris* stem wood, stem bark, root bark, leaf and root wood as well as ethanol extract of the root bark, exhibited potent Chloroquine-resistant antiplasmodial efficacy in vitro FcB1/Colombia *P. falciparum* strain with IC50 values of 0.9 ± 0.2, 1.0 ± 0.4, 1.2 ± 0.4, 1.3 ± 0.1, 2.3 ± 0.5 and 7.7 ± 1.1 μg/mL, respectively (De mesquita *et al*, 2007).

8. ***Cupania vernalis***

Cupania vernalis Cambess. (Sapindaceae) is a semi-deciduous tree with elongated and thick crown, which may grow up to 10–22 m tall. It may be found in virtually all forest forms in Brazil, South America, Argentina, Uruguay, Paraguay and Bolivia. The tree is used as a local supply of tannins and wood, as well as a diuretic, stimulant, expectorant, natural surfactant, sedative, and to cure stomach aches and dermatitis in traditional medicine. (Lorenzi, 2002). With IC50s of 0.9 0.3 and 6.6 0.2 g/mL, the hexane and ethanol leaf extracts showed active antimalarial activity against chloroquine-resistant (FcB1/Colombia) *P. falciparum*. (De mesquita *et al*, 2007).

9. ***Xylopia emarginata***

Xylopia emarginata Mart. is Annonaceae family plant species. It is endemic to Cerrado forest in Brazil. It is an evergreen tree with a very thin, nearly columnar crown which may grow up to 10–20 m tall and 30–40 cm in diameter. It generally develops in huge clusters, producing a homogenous mass. It is a species characteristic of marsh woodland, and does not grow in the driest locations. As a seasoning, it's utilizedin cuisine, a carminative and aphrodisiac in traditional medicine (Luchi, 2016). *X. emarginata* hexane root bark and stem bark extracts were able to suppress *P. falciparum* (chloroquine-resistant FcB1/Colombia strains) having IC50 values of 4.9 0.2 and 5.2 0.4 g/mL, respectively.(De mesquita *et al*, 2007).

10. ***Xylopia aromatic***

Xylopia aromatica (Lam.) Mart. Belonging to the Annonaceae family being The scientific name for this plant is *Xylopioides*. Being a tree endemic to Cerrado grassland environment, notably In the eastern Brazilian states of Goiás and Minas Gerais.It is a tree of modest sizehaving long, dangling branches that may make the crown seem like a Christmas tree. Leaves are alternating, thin, pointed, in a flat plane and placed uniformly along the branches. It is a widespread roadside and agricultural plant on the Pacific slope, not in the forest (Fern *et al*, 2014). The hexane extracts of root and woodwere shown to be antimalarial in vitro against chloroquine-resistant (FcB1/Colombia) strains of *P. falciparum*, with IC50 values of 4.7 0.9 and 6.8 0.6 g/mL, respectively. (De mesquita *et al*, 2007).

11. ***Aspidosperma macrocarpon***

Aspidosperma macrocarpon Mart.(Apocynaceae) is a tall tree with an open crown that may reach a height of 3–25 m tall and 12.5-17.5 cm radius. Being a wood tree that is indigenous to South Americans. Originally, it is utilized in fever therapy (Fern *et al*, 2014). The ethanol extract's antiplasmodial activity in vitro demonstrated an effective action against *P. falciparum* (chloroquine-resistance FcB1/ Colombia) with an IC50 of 4.9 ± 1.1 μg/mL (De mesquita *et al*, 2007).

12. ***Azadirachta indica***

Azadirachta indica A. Juss is widely known as neem tree or Indian lilac and belongs to the mahogany family Meliaceae. It is an evergreen, fast-growing tree that may reach a height of 15–20 m with few of them going up to 35–40 m, however in extreme drought it may drop most of its leaves or virtually all leaves. It is generally cultivated in tropical and semi-tropical areas. Neem is powerful against some fungi that infect people and thus used to treat skin disorders like eczema, psoriasis (Porter, 2006). The 80 percent methanol leaf extract demonstrated in vitro anti-plasmodial efficacy against chloroquine and pyrimethamine sensitive, 3D7 strain, and chloroquine resistant and Dd2 strain is pyrimethamine sensitive, having IC50 values of 5.8 and 1.7 g/mL, respectively (El Tahir *et al*, 1999).

13. ***Harrisonia abyssinica***

Harrisonia abyssinica Oliv. is a thorny, evergreen shrub of the Rutaceae family that branches from the base and may grow to be very large becoming a spreading or much-branched tree. It generally grows up to 6–13 m tall and often found in Tropical Africa, in the regions of Sierra Leone, Cameroon, Sudan, Ethiopia, Uganda, Kenya, Angola, Zambia and Mozambique (Fern et al, 2014). (Fern et al, 2014). The methanolic extract of the stem barkstopped chloroquine resistant *P. falciparum* strain Dd2, with IC50 value of 4.7 ± 0.113 whereas in chloroquine susceptible *P. falciparum* strain 3D7, the IC50 value was 10 ± 0.114 μg/mL (El Tahir *et al*, 1999)

14. ***Maytenus senegalensis***

Maytenus senegalensis Lam. Exell, A member of the Celastraceae family is an African shrubs or trees extensively spread over Central America and Southern America, Southeast Asia, Micronesia and Australasia, the Indian Ocean and Africa, growing up to 15 m high with spines up to 7 cm long. Traditionally, it is an anti-inflammatory herbal medicine and is effective in alleviating tooth pains (Da Silva *et al,* 2011). The stem bark methanol extract demonstrated anti-plasmodial action with IC50 of 3.9 and 10 µg/mL when treated in vitro on chloroquine susceptible, 3D7 and chloroquine resistant, Dd2 strains, respectively (El Tahir *et al*, 1999),

2.1.5 Medicinal plants showing actionover*Vibrio cholera*

Cholera is an acute intestinal illness caused by a facultative anaerobic, Gram negative, comma-shaped rod bacteria, known as *Vibrio cholerae*. Cholera is a life-threatening illness spread by the fecal-oral route. The organisms attach to and colonize the small bowel after a brief incubation time, where they release cholera entero-toxin resulting to severe and watery diarrhea associated by vomiting, dehydration and finally death if not treated quickly (Finkelstein, 1996). Various antibiotics have been successful for cholera therapy; however, the worldwide problem of microbial resistance to current antimicrobial treatments has led to most therapeutic failure. Researchers are consequently moving their emphasis to natural compounds, notably medicinal plant, with excellent antibacterial characteristics. Some medicinal herbs with high anti-cholera action are reviewed below;

1.*Terminalia chebula*

Terminalia chebula Retz. (Combretaceae) popularly known as black or chebulic myrobalan is a medium to a tall, broad-leaved evergreen tree growing up to 30 m tall, with a trunk of 1 m in diameter. It leaves are round, alternating to sub-opposite in arrangement and is Pharmacognosy - a native to South Asia, from India and Nepal east to southwest China, Sri Lanka, Malaysia and Vietnam. Traditionally, it has been utilized for treatment of indigestion, diarrhea and diabetes (Wu Z *et al*, 2003). The extract of the plant used to treat Cholera performed successfully against *V. cholera*strains the causal agent. The *T. chebula*fruit methanol extract with MICs ranging from 0.125 to 1.5 mg/mL, bactericidal activity was observedMBC concentrations between 0.25 to 2 mg/mL against multi-drug resistance isolates of *V. cholerae* (serotypes O1, O139, and non-O1, non-O139) (Patra *et al*, 2009).

2. *Syzygium cumini*

Syzygium cumini (L.)Skeels (Myrtaceae), sometimes known as Jam, are decidious tree endemic to the Indian Subcontinent, Southeast Asia, China, and Queensland. It may reach a height of 30 meters and may live more than 100 years, with a dense leaf which offers shade and is cultivated primarily for its beauty appeal. The leaves are pinkish while young, then turns to dark green with a yellow midrib as they develop (Govaerts and Faden, 2013). The seeds have traditionally been used to cure diarrhea, dysentery, piles, indigestion and diabetes. The seed methanol extract of*S. cumini* demonstrated a bactericidal anti-cholera efficacy against multi-drug resistance isolates with MICs and MBCs for *V. cholerae* (serotypes O1, O139, and non-O1, non-O139) ranging from 1.25–3 mg/mL (Patra *et al*, 2009). Also, Sharma *et al*. (Sharma *et al*, 2009) demonstrated against several strains of *V. cholera* with MICS ranging from 2.5 to 20 mg/mL in vitro anti-vibrio effectiveness of the ethanolic stem bark extract.

3.*Saraca indica*

Saraca indica auct. L. The Detarioideae subfamily of the Fabaceae family includes the plant known as Asoka-tree or Ashok. The asoka tree has a spreading crown and is evergreen which may grow up to 24 m tall and 17 cm in radius. The plant originated from Java. Some traditional applications of the plant include treatment of dyspepsia, fever, burning feeling, colic, ulcers, menorrhagia, leucorrhea, acne (Bagchi *et al*, 1998). *S. indica* generated significant bactericidal action against various strains of multi-drug resistant showing MBCs range between 1 and 4 mg/mL in *V. cholera*. (Patra et al, 2009). A research by Sharma et al. (Sharma et al, 2009) also revealed the anti-vibrio efficacy of ethanolic stem bark extract against 13 strains of *Vibrio cholera*, with MICs ranging from 2.5 to 10 mg/mL.

4. *Butea monosperma*

Butea monosperma (Lam.) Taub. (Papilionaceae) is a native to tropical and subtropical portions of the Indian Subcontinent and Southeast Asia, extending throughout India, Bangladesh, Nepal, Sri Lanka, Myanmar, Thailand, Laos, Cambodia, Vietnam, Malaysia and western Indonesia. Flame-of-the-forest and bastard teak are two common names for this species. It is a medium-sized dry-season deciduous tree that may grow to be 15 meters tall. The leaves are pinnate, with a petiole of 8–16 cm and three leafletsof 10–20 cm long. Its flowers are used in herbal therapy for ulcer, inflammation, hepatic problem and eye disorders (Muthuswamy and Senthamarai, 2014). The methanol floral extract demonstrated anticholera efficacy havingMIC and MBC values ranged from 1.75 to 5 mg/mL against various strains of multi-drug resistant *V. cholera* (Patra *et al*, 2009).

5. Euphorbia serpens

Euphorbia serpens Kunth from the Euphorbiaceae family. Endemic to South America although it may be found on most continents as an invasive plant and commonly a weed. This is an annual plant producing a mat of prostrate stems (Hyde *et al*, 2011). Purified bioactive fraction of *E. serpens*aqueous extract demonstrated an anti-Vibrio activity at 3.92 mg/mL MIC (Payne *et al*, 2015).

6. *Acacia farnesiana*

Vachellia farnesiana(L.) Willd, Sweet acacia, sometimes known as needle bush, is a shrub or small tree in the Fabaceae family of legumes. The species grows to a height of 4.6–9.1 m and develops numerous trunks. *V. farnesiana* has been used in Colombia to cure malaria, in the Philippines the leaves are historically massaged on the skin to treat skin problems in cattle. In Malaysia, an infusion of the plant's blossoms and leaves is combined with turmeric for post-partum therapy (US department of Agriculture, 2012). With MBCs of 0.5 0.1 and 0.9 0.1, respectively, the bark methanolic extract demonstrated high bactericidal action against two strains of V. cholera, O139 (AI-1837) and O1 (569-B)(Sanchez *et al*, 2010).

7. *Artemisia ludoviciana*

Artemisia ludoviciana (Nutt.) The Asteraceae family's white sagebrush is unique to North America, where it may be found over most of the United States, Canada, and Mexico. It is a rhizomatous perennial plant that grows to a height of 0.33–1 m. Medicinally, it is utilized for dermatological reasons and for curing cold (Turner, 2007). Methanol whole plant extract's anti-cholera activity was efficient and bactericidal over *V. cholera* strains O139 (AI-1837) and O1 (569-B). The lowest bactericidal doses against the two strains were 0.7 ± 0.2 and 1 ± 0.3, respectively (Sanchez *et al*, 2010).

8.*Ocimum basilicum*

Ocimum basilicum (L.) Basil (Lamiaceae) may be found throughout Tropical Asia. It is a perennial reaching up to 0.5 m tall and by 0.3 m in circumference. Medicinally it is useful on fever therapy, colds, influenza, poor digestion, nausea, stomach cramps, gastro-enteritis, migraine, insomnia, depression and tiredness (Chevallier, 1996). The plant methanolic extract demonstrated a bactericidal activity with MBCs of 2 0.6 and 3 0.5, respectively, over*V. cholera* O139 (AI-1837) and O1 (569-B) strains.(Sanchez *et al*, 2010).

9.*Opuntia ficus*

Opuntia ficus (L.) is a long-domesticated cactus plant from the Cactaceae family. It is often known as prickly pear or Nopal cactus. It originates from Mexico and farmed in various areas of the world including Mediterranean Basin, Middle East and northern Africa (Wiersema, 1994). A research by Sánchez *et al*. (Sanchez *et al*, 2010), demonstrated the lowest bactericidal concentrations of the methanol cladode extract of O. ficus against O139 (AI-1837) and O1 (569-B) *V. cholera* strains were 3 0.05 and 3 0.1, respectively.

10.*Lawsonia inermis*

Lawsonia inermis Linn. (Apocynaceae) widely known in India as Henna is a plant that blooms and the genus Lawsonia. It is a tall shrub or small tree, growing 1.8–7.6 m tall, glabrous and multi-branched, with spine-tipped branchlets. The plant is indigenous to northern Africa, western and southern Asia, and northern Australia, and it thrives in semi-arid and tropical climatesIt is useful in the treatment of burning sensations, leprosy, and skin problems, amenorrhea, and dysmenorrhea as abortifacient (Warrier and Nambiar, 1993). In vitro anti-vibrio activity of the ethanolic leaf extract was observed against 13 strains of *V. cholera* with MICs ranging from 2.5 to 10 mg/mL.(Patel *et al*, 2009).

2.1.6 Medicinal plants with demonstrated anti-tuberculosis activity

Tuberculosis (TB)

Tuberculosis is an airborne infectious illness which does not only affect the lungs but also other areas of the body like brain and spine (WHO, 2015). The major cause of TB is *Mycobacterium tuberculosis*. Other M. tuberculosis complex that causes TB include *M. bovis*, *M. africanum*, *M. canetti* and *M. microti* The primary signs of TB are; fever, nocturnal sweat, weight loss and persistent cough with blood contained sputum. However, most TB infections are latent which may develop into active illness if left untreated (WHO, 2015). Treatment of TB is highly laborious and needs a long course with many medicines involved. However, these fastidious bacteria have developed resistant to most antibiotics, and thus researchers are striving diligently to come up with new and efficient solutions notably from natural goods such as medicinal plant. Some medicinal plants that have been studied to contain active anti-tuberculosis action are reviewed below;

1.***Anogeissus leiocarpa***

Anogeissus leiocarpa (Combretaceae), sometimes known as African birch, is a tall deciduous tree native to tropical Africa's savannas.The stem and root barks of this plant have traditionally been used to cure gonorrhea, worm infestations, cough, and asthma also TB. (Mann *et al*, 2007). The sensitivity of clinical isolates of *M. tuberculosis* to the methanolic extract of *A. leiocarpa* was examined by utilizing broth dilution technique. The results revealed anti-mycobacterial property (MIC 78 μg/mL). *A. leiocarpa* fraction exhibited an enhanced anti-mycobacterial activity (MIC 7.8 μg/mL) (Mann *et al*, 2008).

2.***Terminalia avicennioides***

Terminalia avicennioides (Combretaceae) is a tree widely seen West of Africa. Its root bark, fruit and mistletoes are used historically to cure diarrhea, hemoptysis, sore throat, TB, asthma and cough (Mann *et al*, 2007). The in vitro antibacterial tests employing broth dilution technique of methanolic extract of *T. avicennioides* revealed a strong antimycobacterial activity (MIC 78 μg/mL) against clinical isolates of *M. tuberculosis*. The n-hexane and ethyl acetate fractions derived from the crude methanol extract of *T. avicennioides* demonstrated inhibitory efficacy (MIC 200 and 625 μg/mL, respectively) against attenuated strains of *M. bovis*. A subsequent investigation of *T. avicennioides* fraction obtained revealed anti-mycobacterial activity (MIC 4.7 μg/mL) (Mann *et al*, 2008).

3.***Capparis brassii***

Capparis brassii (Capparidaceae), the narrow-leaf caper bush is widespread in the coastal forest and mixed woodland from tropical West Africa to South-East Africa.

The root bark is used to cure TB in traditional medicine (Mann *et al*, 2007). The methanol extract of C. brassii has showed some amount of anti-mycobacterial activity (MIC 1.25 mg/mL) against clinically isolated strains of M. tuberculosis (Mann *et al*, 2008).

4.***Combretum spp.***

Combretum (Combretaceae) popularly called the bush willows includes around 370 species of shrubs and trees, prominent in southern and tropical Africa, Madagascar, Asia and tropical America. Traditionally, its root and stem barks isutilized to cure cough, bronchitis and TB (Mann *et al*, 2007). (Mann *et al*, 2007). The methanol extract demonstrated antimycobacterial activity (MIC 1.25 mg/mL) against *M. tuberculosis* clinical isolates when tested in vitro using the broth micro dilution technique (Mann *etal*, 2008).

5.***Solanum torvum***

Solanum torvum (Solanaceae) is an upright bushy and spiny perennial plant which is endemic to the Caribbean, southern Mexico, tropical and central America. It has also become natural and warmer along coastal areas of New South Wales, northern and eastern Australia, tropical Africa, Asia, and the southeast United Statesand on many pacific islands. The juice from this plant is useful for fever therapy, sore throat, dropsy, rheumatism, gonorrhea, stomach pain, chest illness, and asthma, while leaves and fruits can also be utilized to manage a lot of microbial activity (Manandhar, 2002). The crude leaf extract of *S. torvum* has showed a high inhibitory effect against two stains of *M. tuberculosis* (H37Ra and H37Rv) with MIC of 156.3 and 1250 μg/mL, respectively (Nguta *et al*, 2016).

6.***Galenia africana***

Galenia africana (Aizoaceae) is an upright green to yellow-green fragrant woody perennial shrublet often found on the western and southern margins of Karoo (Burkill, 1998). *G. africana*ethanol extract exhibited anti-mycobacterial action (MIC 1.2 mg/mL) against *M. tuberculosis*. A further investigation of flavone, 5,7,2′-trihydroxyflavone which was obtained from *G. africana* revealed an enhanced activity (MIC 0.1 mg/mL) against M. TB (Meyer *et al*, 2008).

7.***Allium sativum***

Allium sativum (Amaryllidaceae) generally termed garlic is a bulbous plant, native to northern and eastern Iran and Central Asia (Block, 2010), but garlic may thrive in the wild and in locations where it has been naturalized. During the 2 world wars, To to prevent gangrene garlicserved as antiseptic (Tattelman, 2007). Aside from claimed nutrition content, garlic shows antimicrobialeffect at high temperatures 120c.*A. sativum*aqueous ethanol extract has showed anti-tuberculosis efficacy (MIC 0.05 and 0.1 mg/mL, respectively) against M. tuberculosis, H37Ra utilizing Microplate Alamar Blue Assay (MABA) (Sivakumar and Jayaraman, 2011). A research by Gupta *et al.* (Gupta *et al*, 2010) also revealed the inhibitory efficacy of *A. sativum*over isolates that have multi drug resistance DKU-156 and JAL-1236, and also specific*M. tuberculosis* H37Ra having 72, 72 and 63 inhibition percentages respectively.

8.***Allium cepa***

Allium cepa popularly called onions belongs to family Liliaceae. Onions contain many pharmacological properties such as anti-diabetic, antioxidant, anticancer, cardiovascular, antibacterial and others (Kuete, 2017). The concentration at which ethanolic and aqueous extracts of *A. cepa* tissue stopped *M. tuberculosis* H37Ra development was observed to be 0.1 mg/mL for both extract (Sivakumar and Jayaraman, 2011). Another in vitro investigation demonstrated a 79 percent proportion of inhibition of *A. cepa* bulb aqueous extract against MDR isolate JAL-1236 (Gupta et al, 2010).

9.***Cinnamomum verum***

Cinnamomum verum of the family Lauraceae, generally known as cinnamon is a green tiny tropical plant native to Sri Lanka, it is also cultivated in Madagascar and Seychelles on commercial scale (Fern *et al,* 2014). Its anti-tuberculosis efficacy studied by (Sivakumar and Jayaraman, 2011) The anti-mycobacterial activity of *C. verum* aqueous extracts bark over*M. tuberculosis* H37Ra was determined (MIC 0.1 and 0.2 mg/mL, respectively).

10.***Acalypha indica***

*Acalypha indica*referred to as Indian nettle is a member of family Euphorbiaceae. Throughout Africa, It is found in Nigeria, stretching from the eastern part of Sudan to Somalia, and south through the Democratic Republic of the Congo and East Africa to Southern Africa. It's also found in Southeast Asia, India, Oceania, and the Indian

Ocean islands in large numbers. Traditionally, it is utilized as an antifungal and antibacterial agent for both human and plant diseases. It is also used as an expectorant to treat pneumonia and asthma (Fern *etal*, 2014). The in-vitro investigation of the *A. indica*aqueous leaf extract against MDR isolate DKU-156, JAL-1236 and sensitive *M. tuberculosis* H37Rv, revealed inhibition percentages of 95 and 68 a piece, respectively (Gupta *et al*, 2010).

2.1.7 Medicinal plants showing action against pneumonia

Pneumonia is an infection of the lungsknown as the swelling of one or both lungs becauseof pus accumulation in the alveoli Pneumonia is a respiratory infection caused by bacteria, viruses, or fungi and these can be mild, moderate and fatal (Opal, 2009). *Streptococcus pneumonia* which is the commonest cause of bacteria pneumonia, *Staphylococcus aureus*, *Moraxella catarrhalis, Klebsiella pneumoniae, Haemophilus influenza*, *Chlamydophila pneumonia* and *Legionella pneumophila* (Van der poll, 2009). *Pneumocystis jirovecii pneumonia* (PCP) is a fungal pneumonia often encountered in immunocompromised people. Viral pneumonia can also be caused by adenovirus, *Varicella zoster*, Influenza virus and respiratory syncytial virus (File, 2001). Traditionally, Plants with therapeutic properties have been used for treating pneumonia and therefore the necessity to verify, scientifically, their traditional benefits. Researchers have examined such plant, and here is a summary on some of the reported plants with shown action;

1. ***Echinops adenocaulos***

In Ethiopiamedicinalproducts, Echinops genus members from the Asteraceae family are used to cure diarrhea, intestinal worm infestation, hemorrhoids, and migraine and other types of infections (Hymete *et al*, 2005)With a minimum inhibitory concentration (MIC) of 0.781 mg/mL, a zamzam water extract of *E. adenocaulos* demonstrated antimicrobial action against multidrug resistant *S. pneumoniae*(Saleh Fares *et al*, 2013).

2.***Verbascum fruticulosum***

Because of its antibacterial action against *Klebsiellapneumonia* and *Staphylococcus aureus*many species of Verbascum (family Scrophulariaceae) have been utilized to treat pulmonary ailments in herbal medicine (Turker and Camper, 2002). The antibacterial activity of *V. fruticulosum* aqueous extract in vitro against a multidrug resistant clinical isolate of *S. pneumoniae* exhibited a significant antibacterial activity with a MIC value of 0.195 mg/mL. (Saleh Fares *et al*, 2013).

3. ***Parietaria judaica***

Parietaria judaica widely known as pellitory of wall from family Urticaceae has been appreciated for its use as a diuretic, balm for wounds and burns and also as a soother for chronic cough in herbal medicine (Giachetti *et al*, 1986). The micro-broth dilution technique was employed to evaluate the inhibitory action extract aqueous of*P. Judaica*. The extract was able to suppress multidrug resistant *S. pneumonia* with a MIC value of 3.125 mg/mL (Saleh Fares *et al*, 2013).

4. ***Urtica urens***

Urtica urens popularlyreferred to as tiny nettle or yearly nettle from family Urticaceae is used medicinally for lung disease therapy (Ozkarsli *et al*, 2008). A research by Saleh Fares *et al*. (Saleh Fares *et al*, 2013) on the inhibitory efficacy of the aqueous extract of this plant over*S. pneumoniae* clinical isolates that are multidrug resistant, utilizing micro-broth dilution technique, gave a MIC of 6.25 mg/mL. This demonstrates its potential to be utilized as medication in the treatment pneumonia induced by multidrug resistant *S. pneumoniae*.

5. ***Beta vulgaris***

Beta vulgaris widely known as sugar beet from family Amaranthaceae is a sugar producing plant. Sugar-producing plants include bioactive chemicals, which are active against microorganisms and therefore are able to preserve the sugar from fermenting or from experiencing any change (Srivastava and Kulshrestha, 1989). The antimicrobial action of crude ethanolic leaves was investigated.(lamina and midrib) extracts as well as fractions (n-hexane and chloroform)At various dosages, *K. pneumonia* showed zones of suppression of growth. examined. At 1 mg/12 μL, the lamina and midrib crude extracts revealed 19- and 9-mm inhibitory zone. The chloroform lamina and midrib fractions yielded 12 and 14 mm at concentration 1 mg/6 μL, whereas at concentration 1 mg/12 μL, They had 15 and 20mm inhibitory zones, respectively. Also, the fractions of n-hexane lamina and midrib showed 20-

and 16-mm inhibition zones (1 mg/6 μL), whereas 36- and 32-mm zones of inhibition (1 mg/12 μL) were observed, respectively (Hussain *et al*, 2011).

2.1.8 Medicinal plants exhibiting anti-asthmatic activity

Asthma is a complicated inflammatory illness and congestive respiratory condition brought about by airway constriction. It symptoms may include episodic wheeze, cough and chest tightness causing in airflow obstruction (Masoli *et al*, 2004). It results to alterations in the numbers of eosinophils, mast cells, lymphocytes, cytokines and other inflammatory cell products. There is growing incidence worldwide notably in industrialized nations and among youngsters with higher morbidity and death rate (Braman, 2006). Medicinal herbs have been tested for characteristics that improve their performance as anti-asthmatic medicines, since existing drugs have undesirable side effects. Few of such plants with proven action are reviewed below;

1. ***Curcuma longa***

Curcuma longa L. Zingiberaceae is a rhizomatous herbaceous perennial flowering plant in the ginger family. It is endemic in the subcontinent of India and Southeast Asia, and requires temperatures between 20 to 30°C and a substantial quantity of yearly rainfall to grow. Curcumin-II methanol extracts at 200 mg/kg and curcumin-I at 100 mg/kg) of *C. longa's* rhizomes decreased substantially ($P < 0.01$) In both long and short term ovalbumin (OVA) sensitized Wistar rat models, the number of white blood cells was estimated. At a greater dose, curcumin-II (200 mg/kg) appears to protect intact mast cells against degranulation (Sarkar *et al*, 2015). This shows that curcumin can be utilized as supplementary medication for Asthma therapy.

2. ***Aerva lanata***

Aerva lanata (L.) A. L. Juss. ex Schult (Amaranthaceae) is a perennial plant, frequently growing more or less woody at the base. The stems can be upright to prostrate, occasionally scrambling or creeping into neighboring plants for support. It is ubiquitous in the tropics and subtropics of Africa through Asia to the Philippines and New Guinea (Umaramani, 2015). It is used historically for treating cough, sore throat, indigestion, wounds, and diabetes and as a vermifuge for children (Sivakanesan, 2015). (Sivakanesan, 2015). The ethanol extract of aerial portions of A. lanata at 100 μg/mL substantially (***$p < 0.01$) demonstrated % reduced contraction in the production paradigm tracheal chain of a goat that has been separated . Also, in clonidine induced mast cell degranulation, the extract at 30 and 60 mg/kg given orally, exhibited percentage protection of 64.2 and 68.9 percent, respectively (Kumar *et al*, 2009).

3. ***Cynodon dactylon***

Cynodon dactylon (L.) Pers, of the family Poaceae is a short-lived, prostrate, perennial grass. It has spread over Europe, Africa, Asia, the Pacific, and the Americas, where it may be found in moderate to tropical climates. It lives along the edges of roadways and in exposed rocky or sandy places. It uses herbal productsin halting bleeding in small injuries, for poor eyesight and eye problems, pile, asthma, and cancers are just a few examples. (Nandkarni, 1992). The findings of Savali *et al*. (Savali *et al*, 2010), revealed that isolated *C. dactylon* compound was strong and had substantial ($p < 0.001$) inhibitory impact on compound 48/80 caused allergic response and mast cell activation. Also, compound 48/80 caused an increase in the amount of nitric oxide in rat blood and rat peritoneal mast cells were considerably suppressed.

4. ***Piper betle***

Piper betle L. (Piperaceae) usually referred to as Betel pepper, is an evergreen climbing shrub growing woody stems, 5–20 m long, and widespread throughout Southeast Asia—probably originated from Malaysia. It is historically used to treat cough, cold, pruritis, asthma and rheumatism (Pradham *et al*, 2013). Ethanol and aqueous extract of leaves at dosages 100 and 200 mg/kg exhibits anti-asthmatic effect on histamine induced bronchoconstriction in guinea pig and histamine induced dose dependent contraction of guinea pig tracheal chain (Jawale *et al*, 2009).

5. ***Lepidium sativum***

Lepidium sativum L. (Brassicaceae) often referred to as Garden cress is a densely branched, upright, annual plant reaching up to 80 cm tall (Facciola, 1990). It frequently grows in various locations in Saudi Arabia and the Eastern Province. The seeds are used to heal bronchitis, asthma, cough, and helpful as abortifacient, antibacterial, aphrodisiac, diuretic, expectorant, gastrointestinal stimulant, gastroprotective, laxative and stomachic (Duke, 2002)In guinea pigs, the bronchodilatory activity of ethanolic seed extract, ethyl acetate, n-butanol, and methanol fractions against histamine and acetylcholine caused acute bronchospasm was shownsignificant inhibition of bronchospasm, with n-butanol fraction showing a significant ($p < 0.001$) protection comparable to the reference standards used in the study (Mali *et al*, 2008). (Mali *et al*, 2008). Rehman et al. (Rehman *et al*, 2012) further verified the broncho dilatory impact of L. sativum crude extract by studying the numerous routes for its action in airway diseases. It was discovered that, the extract's action was mediated by a mixture of anticholinergic, Ca++ antagonist and phosphodiesterase inhibitory pathways.

6. ***Curculigo orchioides***

Curculigo orchioides Gaertn(Hypoxidaceae) is a stemless perennial evergreen plant that grows in clumps and forms a cluster of leaves from the roots. It may reach a height of 50 cm. It runs from East Asia to the West Pacific, passing via South China, Japan, the Indian subcontinent.*C. orchioides* alcoholic extractrhizomes at dosages (100–400 mg/kg) demonstrates on Compound 48/80-induced mast cell degranulation and systemic anaphylaxis, it displays mast cell stabilizing and antihistaminic effect. (Venkatesh *et al*, 2009). Also, The effectiveness of the ethanol extract in treating asthma was demonstrated by Pandit *et al*. (Pandit *et al*, 2008), who found that it had a substantial relaxant effect (p 0.01) at doses of 100 and 25 g/mL in isolated goat tracheal chain and isolated guinea pig ileum preparations, respectively.. In an in vivo investigation employing histamine produced bronchoconstriction in guinea pigs, egg albumin caused passive paw anaphylaxis in rats and haloperidol-induced catalepsy in mice, there was substantial ($p < 0.01$) protection at lower dosages. Again, maximal increase in leucocytes and lymphocytes (99 percent) and maximum reduction in eosinophils up to 0 percent at dose 375 mg/kg p.o. was recorded in milk-induced total leukocytes and differential leukocyte counts.

7. ***Casuarina equisetifolia***

Casuarina equisetifolia L. (Casuarinaceae) more popularly known as Common Ru, is a tree that is always greenhaving delicately branching, feathery crown generally growing from 6 to 35 m and 20–100 cm in diameter. The tree is widely planted across the tropics, and spans from East Asia through Bangladesh, Myanmar, Thailand, Australia and the Pacific (Jensen, 1995). The wood and bark methanolic extract (10–80 mcg/mL) demonstrated a substantial dosage dependent ($p < 0.05$)

antihistaminic effect by reducing the histamine induced contraction of trachea. The wood extract (100 mg/kg, i.e.) significantly decreased clonidine induced catalepsy ($p < 0.05$) also degranulation of mast cell ($p < 0.001$) (Aher *et al*, 2009)

2.1.9 Medicinal Plants in Nigeria with Anti-microbial properties

Medicinal plant includes chemical components that determine their medicinal efficacy. Researchers have discovered that various plants contain different bioactive components at varying quantities. The larger the amount of the essential phytochemical in medicinal plants, the greater therapeutic efficacy or medicinal value of the plants. There are more than 300 recognized medicinal plants in Nigeria; however, the uses differ from plants to plants, culture and people think, weather and other variables, many of these plants are not widely spread; some growing well in rain forest while others in Savannah regions. In certain area of Nigeria, most particularly, pawpaw (Carica papaya) is in treatment of ulcer; other part utilized it for treatment of constipation, catarrh, abortion and cough. The following analyze the common significance of various therapeutic plants and the phytochemicals of some chosen plants in Nigeria:

1. *Alternanthera nodiflora*

Botanical name: *Alternanthera nodiflora*

Local name: Dagunro (Yoruba)

Common name: Joy weeds or Joseph's coat

Phytochemical constituents: Alkaloids, carotenoids, flavonoids, terpenoids, phlobatannins, phenols, saponins(Ogu, 2012 and Feka, 2013).

Medicinal application: They are primarily used as pain reliever. The leaves are crushed to fine powder and subsequently coated with white palm oil and this was then placed on the afflicted portion of the body.

2. Kalanchoe genata

Botanical name: Kalanchoe genata

Local name: Odundun (Yoruba), onwa (Ibo),

Common name: Miracle plant, Hand-life plant

Phytochemical constituents: Alkaloids, flavonoids, phenolic compounds, tannins (Makinde, 2007 and Oladeji 2016).

Medicinal application: They are useful for treating boil. Fresh leaves soften by boiling and then pressed to get liquid content. This was then combined with palm oil and consumed orally or rubbed on the afflicted area of the body

3. *Cassia alata/Senna alata*

Botanical name: *Cassia alata or (Senna alata) (Senna alata)*

Local name: Asunwon (Yoruba), ogala (Ibo).

Common name: Candle bush, acapulo

Phytochemical constituents: Flavonoids; anthraquinones; tannins; steroids; saponins; phenolic compounds, glycosides (Owoyale *et al*., 2005).

Medicinal application: Used as a therapy to alleviate sour throat. The dried leaves are crushed and fine powdered potassium aluminum sulphate was added and supplied orally.

4. *Strophanthus hispidus*

Botanical name: *Strophanthus hispidus*

Local name: Isa (Yoruba), kwankwani (Hausa), Sagere, isagere.

Common name: Arrow poison

Phytochemical constituents: Flavonoids, tannins; steroids; saponins, glycosides, phlobatannins, carbohydrate (Ojiako *et al*, 2009).

Medicinal application: It is commonly used as therapy for cough. The leaves sample was crushed and tiny quantity of sodium chloride was combined together. This is taken orally with palm-wine every day.

5. *Pupalia lappacea*

Botanical name: *Pupalia lappacea*

Local name: Emi-agbo (Yoruba), ose (Ibo), marin-kusu (Haua).

Phytochemical constituents: Flavonoids; anthraquinones; saponins; phenols, glycosides (Rajpant *et al*, 1998).

Medicinal application: It is commonly used as therapy for sterility in women. The sample was crushed and combined with fruits, dried squirrel and corn grains. About three tea spoons full are taken orally with liquid meals.

6. Nicotiana tabacum

Botanical name: *Nicotiana tabacum*

Local name: Ewe taba (Yoruba), a were (Ibo), taba (Hausa)

Common name: Tobacco

Phytochemical constituents: Alkaloids; flavonoids; anthraquinones; tannins; steroids; saponins; glycosides; terpenes (Akindele et al., 2007).

Medicinal application: As a therapy for convulsion. The leaves are crushed to extract the juice and this is put to water for bathing.

8. Carica papaya

Botanical name: *Carica papaya*

Local name: Ibepe (Yoruba), ojo (Ibo), gwanda (Hausa)

Common name: Pawpaw

Phytochemical constituents: Flavonoids; anthraquinones; tannins; steroids; saponins; phenolic compounds, glycosides (Elekwa *et al*, 2005).

Medicinal application: They are commonly used as a medication therapyfor constipation, catarrh, abortion and cough. The leaves are cooked with honey in water for 5 h and left to cool; this is given orally as therapy for catarrh and cough.

9. Byrsocarpus coccineus

Botanical name: *Byrsocarpus coccineus*

Local name: (Yoruba), (Ibo), (Hausa) (Hausa)

Common name: Schellent

Phytochemical constituents: Flavonoids; anthraquinones; tannins; steroids; saponins, glycosides (Okwu, 2005 and Okihde, 2002).

Medicinal application: They are commonly used as a therapy of sore throat and tooth-ache. The juice is collected from the leaves and placed on the afflicted portion with the assistance of cotton wool on the affected part of the tooth.

2.2 Antimicrobial Resistance

The term antimicrobial resistance has been defined asa microorganism's capability to survive at a givenantibacterial concentrationagent at which its species in the population would be killed. It is also defined as the ability of a microorganism to evade/resist treatment with a clinical concentration of an antimicrobial agent in the body.

2.2.1 The Origins of Resistance Genes

Novel antimicrobial resistance variables might possibly arise anywhere, at any moment. The amazing number of bacterial cells on Earth, estimated at about 1030 – a thousand billion (Kallmeyer *et al*, 2012), present an extraordinary genetic diversity, and chances for mutations, rearrangements and horizontal gene transfer. Thus, new resistance factors presumably arise constantly, but we never notice the great majority of these occurrences. As will be explained below, there are nonetheless numerous reasons to why infections are not swamped by new resistance genes. To begin, resistance considerations aretypically connected Considering the expense of some fitness.The expense might be significant for genes offering novel resistance capabilities for a bacterium, because their representationmight not be fine-tuned enough, and their products could affect other cellular processes. Thus, new resistance genes will be chosen against unless there is a reasonably significant selection pressure to preserve them. Furthermore, even if such a resistance component would have a low or insignificant fitness cost, it would still be unusual, and may therefore not become permanently entrenched in the bacterial population unless there is a positive selection pressure for it (Martinez, 2011). This selection pressure may be modest, but without it is present the only way by which a novel resistance component would be preserved is through genetic drift (Baquero *et al*, 1998).

2.2.2 Mechanism of Resistance

There are various ways by which microorganisms develops antimicrobial resistance, which are mentioned below:

2.2.2.1 Mobilization of Resistance Factors

Mobilization of resistance factors Similar to the formation of novel resistance factors, resistance genes might be deployed everywhere their fitness costs are low, a selection pressure to be retained on a genetic fragment that can move around until they have evolved to lowerthe price of fitness host. The second issue then becomes: where are selection forces strong enough to favor mobility of chromosomal resistance genes and/or maintenance of existing mobile resistance genes? Resistance factors that have recently been mobilized onto a mobile genetic element are likely to be linked with higher fitness costs, as a result of the burden of maintaining numerous copies of the same gene and the difficulties of maintaining gene expression regulation on a mobile element. (Kallmeyer *et al*, 2012). This indicates that conditions permitting extended life of a resistance gene regardless of its cost would be of particular relevance in order to mobilize opposition determinants. It is thus fair to anticipate that if a mobile resistance gene has acquired a foothold in a bacterial population, it can subsequently evolve towards decreased fitness cost (Martinez, 2011).

2.2.2.2 Horizontal Transfer of Resistance Factors

Horizontal gene transfer is important for the dissemination of resistance components, since it permits resistance to proliferate above exact clones. This approach, gene transfer makes resistance genes available to a much broader section of the bacterial community in a specific environment, frequently outside species boundaries (Martinez, 2011). Mobilization of resistance components, theoretically transfer of genes across bacteria occurs everywhere. However, in order for resistance genes to be passed horizontally from environmental bacterial to pathogenic bacteria, they must first be transmitted vertically, inhabit the same environment(Matte-Tailliez et al, 2002) (Wiedenbeck and Cohan 2011). Horizontal gene transfer is considerably more likely to occur amongst phylogenetically closely related bacteria (Philippot et al, 2010) (Smillie et al, 2011)Genetic material is transferred across bacterial cellsis promoted by stresses such as antibiotics (Beaber and Waldor 2004) (Hastings and Slack 2004) (Maiques *et al,* 2006) (Jutkina *et al,* 2016), and perhaps also metals and biocides (Seier-Petersen *et al*, 2014), (Zhang *et al*, 2017). Antibiotic selection aids the development of transplanted resistance genes in their new host as a result. As a result, resistance switch to pathogens is likely to be common among human-associated bacteria (Gupta and Wang 2004) (Porse *et al*, 2017), especially during antibiotic therapy. In contrast, switch of resistance genes to pathogens from environmental bacteria, which occupy different habitats and are frequently much less phylogenetically related, might probably be much less common, despite the fact that environmental stressors may also result in horizontal gene switch to and from (opportunistic) human pathogens in environmental settings.

2.2.2.3 Dissemination of Resistant Microorganisms

The major method of exposure for humans to resistant infections is through other individuals, either in clinics or through the community environment. Typical distribution methods here include through bodily contact or indirect contact transmission, aerosols, and food produced by people harboring the virus (Livermore 2000). These are also the typical transmission routes for infectious bacteria in general, and interventions preventing circulation of resistant pathogens among humans are essentially the same as those applied to prevent the spread of any bacterial pathogen (Rao, 1998) (Livermore, 2000) (Lipsitch *et al*, 2000) (Levin *et al*, 2014). Importantly, appropriate hygiene practices form the primary dispersion barrier for resistant infections, and the relevance of sanitation for avoiding spread of resistant germs between people cannot be emphasized (Mattner *et al*. 2012). Apart from transmission between people, environmental dispersion pathways for resistant bacteria have also been singled out as possibly significant for the spread of antimicrobial resistance (Allen *et al*., 2010), (Pruden *et al*., 2013), (Finley *et al*., 2013), (Levin *et al*, 2014) and (Huijbers *et al*., 2015)

2.3*Tradescantia spathacea*

Tradescantia spathacea, the boat lily (Hunt, 1994) or Moses-in-the-cradle, is a plant in the Commelinaceae family first described in 1788. It is native to Belize, Guatemala, and southern Mexico (Chiapas, Tabasco, and the Yucatán Peninsula) but commonly grown as an ornamental and naturalized in portions of Florida, Texas, Hawaii, and numerous oceanic islands. *T. Spathacea* or boat-lily of the genus Tradescantia belongs to the Commelinaceae family. It occurs natively in the West Indies, Mexico, and Central America, where it generally grows in woods and urban areas. It's an herb native to Mexico with meaty rhizomes. It features rosettes of waxy lance-shaped leaves. Leaves are dark to metallic green above, with glossy purple beneath. (Prakash and Rajesh, 2014) In China, blossoms of this species are employed in herbal therapies to alleviate dysentery, as well as aesthetic treatments in the Yucatan, Guatemala, and Belize.

The plant has been extensively disseminated to tropical and sub-tropical regions, gradually grown and has turn out to be an invasive species. (Bercu, 2013) In the traditional medicine plant of *T. Spathacea* were used for the treatment of mycosal infections, venereal illnesses, urinary tract infections, hemorrhoids, TB and cough. Other traditional applications of anti-inflammatory, antitoxic supplement and promote blood circulation, anti-diarrheal, expectorant, hypoglycaemic agent and against snakebites were also recorded. Pharmacological activity of distinct extracts of several Tradescantia species had been experimentally demonstrated antibacterial, anti-hyperuricemia, analgesic and anti-inflammatory properties. The cytotoxic and hepatoprotective properties of *T. spathacea* were reported. (Mohamed, 2013)

A picture showing the plant*Tradescantia spathacea*

2.3.1 Nomenclature, Classification, and Taxonomy

Tradescantia spathascea discovered in 1788 is a medicinal plant and its scientific classification is as follows;

Kingdom: Plantae

Phylum: Tracheophytes

Clade: Angiosperms

Clade: Monocots

Class: Commenilids

Order: Commenilales

Family: Commenilaceae

Genus: *Tradescantia*

Species: *T. spathacea*

2.3.2 Antimicrobial activity of *Tradescantia spathacea*

1. Treatment of AIDS: Baez and Jose worked on *T. spathacea,* which needs prescription pharmaceutical formulations to treat Acquired Immune Deficiency Syndrome (AIDS), as well as the technique of obtaining it. Treatment requires the combination of several anti-retroviral medicines to prevent immune depression and halt the multiplication of viruses. Anti-retroviral treatment complicated and expensive since it needs repeated daily administration of at least three medicines (triple therapy) and high dosages that do not exhibit the desired effects interact with other drugs that should be taken with or without meals. Nevertheless, it is known that all Tradescantia species are extensively poisonous, and it is not feasible to expressly introduce them in people without generating a very severe and toxic response. Since the early 1990s, this plant has undergone numerous researches and it has been able to state that this plant includes specific compounds such as flavonics and coumaric substances with anti-inflammatory effects. (Baez, 2008)

2. Anti-cancer Activity: *T. spathacea* medicinal plant's anti-cancer or cytotoxic capabilities showed cell lineage in human breast adenocarcinoma. Anticancer activity therapy of *T. spathacea* in the MCF-7 cell line was evaluated at 229.7µg/ml as 50 percent MCF-7 cell line inhibition, or at 229.7 as final CTC50. Furthermore, overexpression and mutation in a variety of malignancies caused by β-catenin. Overe xpression of β-catenin has been found in breast cancer. The cytotoxic\activity of the *T. spathacea*, at increasing concentration. β-catenin expression in the human breast adenocarcinoma cell line also indicates *T. spathacea* medicinal as vine. βcatenin dysregulation of signaling significantly regulated breast cancer in a female. Medicinal plant extract of the *T. spathacea* leaves is suppressed by the production of β-catenin protein. Also, this plant medicine was inhibited or stopped by the β-catenin Overexpression shown by increasing concentration. Finally, expression CTC50 is 229.7 and β-catenin inhibited by *T. spathacea* leaf extracts. (Prakash, 2014)

3. Lymphocyte Proliferative Activity: The dried extracts yield obtained from Gynura procumbens Lour. and *T. spathacea* were respectively 4.19 and 3.42 percent w/w. Houttuynia cordata fresh aerial part (580 grams) was combined with water and its filtrate was lyophilized to create residue (produce: 2.91, percent w/w). Attempts were undertaken to validate 8 kinds of Thai medicinal herbs that promote human lymphocyte growth in vitro. Several lines of evidence have indicated non-specific immunostimulating or immunomodulating behavior in laboratory animals involving a wide variety of medicinal plants. For first assessment of its activity some in vivo investigations are cumbersome. In this research it is demonstrated that the extracts of *Gynostemma pentaphyllum*, *Houttuynia cordata* and Phytolacca american exhibit immune-stimulating properties using human cells. The increase in activation of lymphocyte stimulation, as measured by the activation index, was also seen in cultures that generate *T. spathacea* extracts. Important dosage dependant change induced by some extracts. This may be likely because of variation in the chemical components that are responsible for plant functions. (Sriwanthana *et al*, 2007)

4. Anti-Tuberculosis Activity: Radji in 2015 examined the aqueous extracts of *T. spathacea* leaves, produced by maceration. The dried extracts are utilized for the Standard strain of *Mycobacterium tuberculosis* H37Rv and isolated multidrug-resistant (MDR) strain. Dimethyl sulfoxide was used to dissolve 2.5 g of dry extract. The percentage of inhibition against *Mycobacterium tuberculosis*in aqueous extract H37Rv strain was 100 percent, 82.1 percent, 78.5 percent, 100 percent, and 100 percent respectively, whereas against MDR strain while 93.7 percent, 50.0 percent, 50.0 percent, 100 percent, and 100 percent respectively. An aqueous extract of leaves showed strong anti-mycobacterial action. The percentage of inhibition of aqueous extract (2.5 mg/ml) was *T. spathacea* 100 percent against *M. tuberculosis* H37Rv and MDR strain. (Raji *et al*, 2015)

5. Anti-Bacterial activity: World Health Organization (WHO) defined this plant as a plant having one or more organs that contain chemicals that may be utilized for therapeutic reasons or which are precursors for the manufacture of effective medicines. *T. Spathacea* Sw. member of the Commelinaceae family. It is widely cultivated in gardens and is usually known to as Tradescantia. The extract was tested against the following three Gram-positive bacteria: *Staphylococcus aureus*, *Staphylococcus citrus*, *Bacillus subtilis*. Five Gram-negative bacteria were also investigated, including *Salmonella typhi*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, *Serratia sp*. and *Proteus vulgaris*, were also analyzed. Rhoeo discolors has demonstrated highest antibacterial activity present test, and thus this plant may be utilized to find bioactive natural compounds that may serve as leads for the creation of novel medicines that meet either unmet clinical need (Parivuguna, 2008).

6. Antiviral Activity: Chanin 2016,A research of *T. spathacea*, a Malaysian medicinal plant for anti-chikungunya virus activity, discovered that ethanol, methanol, and chloroforms leaf extracts of *T. Spathacea* had the most significant cytopathic inhibitory impact on Vero cells, with cell viability of 92.6 percent., 91.5 percent and 88.8 percent, respectively. As a wide polarity range of solvents were employed in the extraction, hexane and chloroform extracts may be classified as nonpolar extracts, ethyl acetate extract as an intermediate polar extract, and ethanol, methanol and water extract as polar extracts. Nonpolar and intermediate polar extracts were typically more hazardous to the Vero cells for the cytotoxicity test than polar extracts, which hindered assessment of their potential antiviral activities at greater doses. Non-toxic doses (cell viability about 90 percent) of an extract were then tested for cytopathic effect inhibitory actions (Chan *et al*, 2016).

7. Antioxidant and Anti-inflammatory Activity: Russo studied antioxidant and anti-inflammatory activity for the root and leaves of ethanol/ hexane extracts in 2017. The action of the antioxidant was assessed by three particular assays: ferric reducing antioxidant power assay (FRAP), DPPH, free radical scavenging (FRS) method in vitro antioxidant activity and is represented as ascorbic acid (AA) antioxidant capacity equivalent (mg AA/100g). The total phenolic content (TPC) was determined using the Folin Ciocalteau reagent and represented as mg/g gallic acid equivalents (GAE) (GAE). 2mL of methanolic extract solutions are coupled blended with 2.5mL of 7.5 percent sodium bicarbonate (NaHCO3), and 2.5 mL of 10 percent Folin-Ciocalteu reagent. The test tubes were placed in an incubator shaker for 45 min at 45°C before the absorbance values were measured at 765 nm using a spectrophotometer. The total phenolic content test (TPC) revealed that the roots and leaves of ethanolic/hexane solvent mixes exhibit extremely high values expressed in mg of gallic acid equivalent per gram of vegetal material (Russo *et al*, 2012).

A picture showing the flower of the plant T. spathacea

2.4 Review of method

2.4.1 Minimum Inhibitory concentration

The growth of the colonies of bacteria is generally impeded when they are under antibiotic action. However, several bacteria would have evolved a resistance to few of the antibiotics. Therefore, to determine the antibiotic to be used to effectively treat a patient, a laboratory test termed as the Kirby-Bauer test is conducted (Hudzicki, 2005). The Kirby-Bauer test or the disc diffusion antibiotic sensitivity test is used to identify whether an antibiotic is effective to treat a specific bacterium. The test sample is generally taken from any patient who is known to have been affected. A tiny fraction of the obtained material is put evenly on a petri-dish. A sheet of filter paper impregnated with a few different antibiotics applied at different spots, is then placed on the plate. This configuration is eventually installed in agar. The antibiotic diffuses into agar after which it's concentration radially declines from the location at where the antibiotic was administered outwards. If the antibiotic is reported to be effective against the bacteria at a specific concentration, the bacteria will not proliferate when the concentration of the agar at that moment is greater than the effective concentration. This zone of no bacterial growth is termed as the Zone of Inhibition. The zone lacking bacterial colonies that is the Zone of Inhibition will be in a distinct hue as opposed to other regions of bacterial growth. There is a noticeable difference and clearly evident to the naked eye. The measurement of the diameter of this Zone of Inhibition will indicate if the antibiotic is beneficial in treating the patient or not. Larger the diameter more will be the efficacy of the antibiotic. The exact range of the dimensions is extensively recorded, defined and maintained by the Clinical & Laboratory Standards Institute (Wikler, 2006).

Minimum inhibitory concentrations (MICs) are regarded the best benchmark for measuring the susceptibility of organisms to antimicrobials and are thus used to measure the performances of all other techniques of susceptibility testing. MICs are employed in diagnostic labs to confirm extraordinary resistance, to provide a conclusive response when other techniques of testing provide a borderline result, or when disc diffusion methods are ineffective, such as when assessing the susceptibility of bacteria coagulase-negative staphylococci to teicoplanin.

The range of antibiotic concentrations used for calculating MICs is widely agreed to be doubling dilution steps up and down from 1mg/l as necessary. The MIC is the lowest dose of a medication that would suppress the observable Following an overnight incubation, an organism's growth (this duration is extended for organisms such as anaerobes, which require prolonged incubation period) (Winstanly *et al*, 1994).

CHAPTER THREE

METHODOLOGY

3.1 Materials

The following materials were used for the experiment: Petri dishes, conical flask, inoculating loop, aluminum foil, measuring cylinder, cotton wool, cork borer, test tubes, test tube racks, sensitivity discs, filter paper, beakers, perforator.

3.2 Equipment

The following equipment was used for the experiment: Autoclave, incubator, water bath, Bunsen burner, weighing balance, vortex, hot air oven, weighing balance micro pipettes, pipette tips.

3.3 Media

Nutrient Agar, (BHI) Brain and Heart Infused broth

3.4 Reagents

MacFarland standard

3.5 Plant preparation and extraction

The plant's roots were air-dried at temperatures below 40 °C and crushed into fine powder with a laboratory milling machine, after which 500 g of the ground powder was extracted in the following order: n-hexane, ethyl acetate, chloroform, and methanol. In the maceration, 5 L of each solvent (volume per volume [v/v]) were utilized. The extract was condensed using a rotary evaporator (Buchi type R210, Switzerland), and then dried in a vacuum desiccator. The dried extract was ground into powder using a laboratory mill and sieved using a 250-mesh sieve.

3.6 Test organisms

The antimicrobial activity of the extracts was determined using agar well diffusion. The test organisms were gotten from the Department of Biotechnology, Mountain Top University, Ibafo, Ogun state, Nigeria. All the isolates were checked for purity and maintained in nutrient agar. The bacteria isolates used includes *Salmonella* (SH1351), *Escherichia coli* (SH70E1)

3.7 Antimicrobial assessment

100 microlitres of the test organism were distributed into test tubes containing BHI and cultured at 37 degrees Celsius for 24 hours. This was done to get the test organisms to work. 10mg of the plant extract was diluted in 800 micro litres of sterile distilled water, 10mg in 600 micro litres of sterile distilled water, 10mg in 400 micro litres of sterile distilled water, and 10mg in 200 micro litres of sterile distilled water. This was carried out in Eppendorf tubes. The tubes were appropriately labeled and kept. The set plate was appropriately labeled with the right concentration for each strain of the test organisms.

The antibacterial activity of the extracts against the chosen strains was determined using the agar well diffusion technique. Each sterile Petri plate was filled with 20 mL of sterilized nutritional agar medium and allowed to solidify. The test bacteria cultures were standardized to 0.5 percent McFarland standard (NCCLS 1993) and evenly dispersed on the appropriate substrate using a swab stick. The medium was then drilled into with a sterile cork borer to create 2 mm wells (Bhargav et al. 2016). Sample solutions were concentrated, and then dilutions to the appropriate concentration (20 mg/mL) were done.

These concentrations (20 microlitres) were transferred to separate wells and incubated for 24 hours at 35 °C. After the incubation period, the zones of growth inhibition (ZI) were seen and measured with a clear ruler (Mbata et al, 2008), and each test was repeated three times to verify repeatability. The diameter of the zone of inhibition was measured as the standard error of the mean (SEM) of the triplicate experiments. Standard sensitivity discs of chosen antibiotics, such as ciprofloxacin, were used as a positive control.

CHAPTER FOUR

4.0 RESULTS

The flower of the plant ***Tradescantia spathacea*** extract/dilute concentration of 800mg/ml, 600mg/ml, 400mg/ml, 200mg/ml using Nutrient Agar plates were tested against *Escherichia coli* and *Salmonella spp*, over three trials. However, there was no zone of inhibition observed.

Table showing a summary of the results of the experiment done

Test Organism	Extract/Dilute concentration (mg/ml)	Minimum Inhibition Concentration	Minimum Inhibition Concentration	Minimum Inhibition Concentration
Escherichia coli	800	No zone of inhibition observed	No zone of inhibition observed	No zone of inhibition observed
	600	No zone of inhibition observed	No zone of inhibition observed	No zone of inhibition observed
	400	No zone of inhibition observed	No zone of inhibition observed	No zone of inhibition observed
	200	No zone of inhibition observed	No zone of inhibition observed	No zone of inhibition observed
Salmonella spp.	800	No zone of inhibition observed	No zone of inhibition observed	No zone of inhibition observed
	400	No zone of inhibition	No zone of inhibition	No zone of inhibition

		observed	observed	observed
	600	No zone of inhibition observed	No zone of inhibition observed	No zone of inhibition observed
	200	No zone of inhibition observed	No zone of inhibition observed	No zone of inhibition observed

4.1 DISCUSSION

Biomedical research has used plants as the possible sources of medicines to prevent and cure human illnesses. The World Health Organization has acknowledged antibiotic resistance as a global health security concern that demands action across government sectors and society as a whole (Van duin and Doi, 2017). It is evident that the growing occurrences of MDR microorganisms alleviate socioeconomic difficulties and diminish public health condition worldwide. These MDR microorganisms threaten the success of several currently available and inexpensive antimicrobials on the shelf, especially in impoverished nations. It is for these reasons that the hunt for novel antimicrobials from medicinal plants to tackle the rising danger from those pathogenic microorganisms, MDR bacteria, and fungus. These findings support earlier research showing the medicinal compounds derived from plants are employed as a significant surrogate, alternative, or supplemental therapy of infectious illnesses (Damni *et al*, 2013)

According to (Prakash *et al*, 2014) ***Tradescantia spathacea*** medicinal plant's cytotoxic characteristics exhibited activities in the human breast towards anti-cancer activity. (Baez *et al*, 1992) discovered throughout his study work during the 1990s that *T. spathacea* plant includes specific compounds such as flavonics and coumaric substances with anti-inflammatory effects. According to (Radiji *et al*, 2015) after examining the aqueous extracts of *T. spathacea* leaves against TB, it demonstrated significant anti-mycobacterial activity.

(Chanin, 2016), performed a research of T. spathacea leaves for anti-viral activity and was observed that the most considerable cytopathic inhibitory impact was detected on vero cells. (Russo *et al*, 2017) researched on anti-toxidant and anti-inflammatory activities for the root and leaf extracts.

However during my research, after following all aseptic techniques and appropriate methods no zone of inhibition was observed when the extract of the flower of *T. spathacea*was cultured on Nutrient Agar against *E.coli* and *Salmonella spp.*

Why was there no zone of inhibition?

There are various factors that affect zone of inhibition. Which are;

1. **Drug/Extract solubility :** The amount of drug that passes into solution when an equilibrium is established between the drug solute in solution and any excess, un-dissolved drug to produce a saturated solution at a specified temperature (Savjani, 2012).

2. **Rate of diffusion through the agar:** The rate of diffusion is 0.5 cm/10 minutes = 0.05 cm/ minute. This is the rate at which agar media diffuses or spread evenly on the innoclating plate (Malgidi *et al*, 2004)

3. **The thickness of the agar medium:** Recommended solid medium used for diffusion testing is standard or cation-adjusted Mueller–Hinton agar at a depth of 4 mm (Wayne, 2013 and Coyle, 2005)

4. The drug/extract concentration impregnated into the disk: This is the concentration of the extract either by agar well or disk diffusion method impregnated into the disk

CHAPTER FIVE

CONCLUSION

Tradescantia spathacea plant has been found to offer high potential for therapeutic applications. These plants have diverse Phyto-components that can be employed in medicine for their substantial pharmacological and therapeutic significance. *T. spathacea* is recognized for its wide spectrum of biological activity; colds, sore throats, whooping cough nose-blood, anti-fertility agent, fever, bronchitis, TB, diarrhea, hypoglycaedemia, snakebites and kidney disorders.

However, in my investigation of the floral extracts of *T. spathacea* plant cultured on Nutrient Agar plate in doses of 800mg/ml, 600mg/ml, 400mg/ml/, 200mg/ml against human pathogens *Escherichia coli* and *Salmonella spp* done three times, no zone of inhibition was found.

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