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**EVALUATION OF ANTIDIARRHEAL ACTIVITY OF THE ROOT BARK OF**

Tamaridus indica

**BY**

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**ABSTRACT**

**CHAPTER ONE**

**1.0 INTRODUCTION**

**1.1 Background of the study**

**1.2 Statement of the problem**

**1.3 Significance of the study**

**1.4 Justification of the study**

**1.5 Aim and Objectives**

**1.5.1 Aim of the study**

**1.5.2 Objective of the study**

**CHAPTER TWO**

**2.1 Medicinal Plants**

Medicinal plants have been identified and used throughout human history (Lichterman, 2004). The use of medicinal plants to treat diseases is almost universal amongst non-industrialized societies and is often more affordable than purchasing expensive conventional drugs (Fabricant and Farnsworth, 2001). The world Health Organization (WHO) estimates that 80% of the world population especially Asian and African countries use herbal medicine for some aspect of primary health care (<http://www.traffic.org/medicinalplants>, 30th march 2014). Over 120 active compounds currently *isolated* from the higher plants are widely used in modern medicine and 80% of these show a positive correlation between their modern day therapeutic use and the traditional use of the plants from which they are derived (Fabricant and Farnsworth, 2001).

**2.1.1 *Tamarindus indica***

**2.2 Test microorganisms**

**2.2.1 *Escherichia coli***

*Escherichia coli* are normal flora in the body of human beings and they can be non-pathogenic, commensal or pathogenic (Kaper *et al.,* 2004). When pathogenic they usually cause urinary tract infections, systematic infections and enteric infections (Mandeli *et al.,* 2005). The development of resistance by *Escherichia coli* due to increase in the use of antimicrobial agents has led to the use of medicinal plants extracts against it (Akram *et al.,* 2007). Medicinal plant extracts have shown to have antimicrobial activity against enteropathogenic *Escherichia coli* found in food material (Fullerton *et al.,* 2011). Traditional products used in food preservation (spices) have antimicrobial activity against multiple antibiotic resistant *Escherichia coli* isolated from water (Rahman *et al., 2011*). Other studies carried out on plants with a medical value such as *Allium sativum* has shown antimicrobial activity against *Escherichia coli* (Ziarlarimi *et al., 2011*).

**2.2.2 *Salmonella typhi***

*Salmonella typhi* is a Gram-negative bacterial pathogen that causes gastroenteritis in humans (Ibarra and Steele, 2009). In developing countries, it is mainly associated with causing typhoid fever (Watson and Holden, 2010). Typhoid fever is a major cause of death around the world in a limited setting and globally remains as one of the most infectious diseases (Buckle *et al.,* 2012). The disease is estimated to be responsible for about 26.9 million infections and 269,000 deaths in 2010 (Buckle *et al., 2012*). Studies carried out have shown that herbal extracts and dietary spices from medicinal plants have antimicrobial activity against *Salmonella typhi* (Shan *et al., 2007*). Other studies have shown that herbal extracts from medicinal plants not have antimicrobial activity on *Salmonella typhi* found in vegetables but also against other disease-causing pathogens such as enteropathogenic *Escherichia coli* and *Listeria monocytogenes* (Cutter, 2000).

**2.2.3 *Staphylococcus aureus***

*Staphylococcus aureus* is a Gram-positive bacteria that causes skin and soft tissues infections as well as food poisoning and toxic shocks (Perez et al., 2009). The rate of mortality associated with *Staphylococcus aureus* in developing world exceeds one of the developed countries (Nickerson *et al.,* 2009). The increasing use of antimicrobials against *Staphylococcus aureus* has led to the development of resistance hence need to develop new antimicrobial agent (Kwon *et al.,* 2007). Medicinal plant extracts have shown a wide range of antimicrobial activity against both bacterial and fungal pathogens (Manvi *et al.,* 2010). Studies carried out have shown that some edible plants extracts also have antimicrobial activity against *Staphylococcus aureus* (Alzoreky *et al.,* 2003). Other studies carried out have shown a great synergistic activity of plant extracts and spices when used against not only pathogenic, probiotic and food spoilage pathogens such as *Staphylococcus aureus*, *Escherichia coli* and other bacteria organisms, both Gram positive and Gram negative (Das *et al.,* 2012).

**2.2.4**

**2.2.5**

**2.3 Phytochemicals in medicinal plants**

Secondary plant metabolites (Phytochemicals) have been extensively investigated as a source of medicinal agents (Krishnaraju, 2005). Plants can synthesize and accumulate a great variety of phytochemicals in their cells including saponins, tannins, flavonoids, cyanogenic, phenolic compounds, lignins, lignans, alkaloids and glycosides (Okwu, 2004). Plants also have a great potency of antimicrobial activity due to the presence of phenolic compounds and essential oils (Aboaba and Efuwape, 2001). Medicinal plants have been known to produce an array of phytochemicals with recognized antibacterial activity belonging to chemical structural classes: phenolics, terpenoids, alkaloids, lectins, polypeptides, and polyacetylenes but the most bioactive constituents are alkaloids, tannins, flavonoids, and phenolic compounds (Hill, 1995). The screening of plant extracts and plant products for antimicrobial activity has shown that higher plants represent a potential source of novel antibiotic prototypes (Afolayan, 2003). Numerous studies have identified compounds within herbal plants that are effective antibiotics (Afolayan, 2003). Some of the commonly used traditional remedies have already produced compounds that are effective against antibiotic-resistant strains of bacteria (Kone *et al., 2004*).

**2.3.1 Tannins**

Tannin is astringeny vegetable product found in a wide range of plants parts ranging from the barks, roots, fruits, leaves, galls and roots (Ramakrshnan, 2006). They occur naturally In plants and are water soluble phenolic compounds of the higher molecular weight of about 500 – 3000 containing phenolic

Hydroxyl groups that make them to effectively cross-link with proteins and other macromolecules (Ramkrishnan, 2006).

Tannins are generally found in plants and they are thought to function as chemical defenses against pathogens and herbivores (Gedir *et al., 2005*). They have been commercially used primarily in the preservation of leather, making glue stains and mordant (Kanth *et al., 2009*). It has also been used in the vegetable industry in different concentration in picking process to provide protection against bacteria, mold, and yeasts (Andrade *et al., 2005*). Antimicrobial activity of tannins has been tested in various fields of medicine providing positive results such as antioxidant activities, anticarcinogenic activities and antimutagenic properties (Lopes *et al., 1999*). Tannins have been used in inhibiting the growth of many fungi, yeasts, bacteria and viruses (Chung *et al.,* 1998). Studies carried out have shown that tannins such as catechin and pyrogallol found in vegetable tannins have been found to be toxic to microorganisms (Cowan, 1999). Tannins have been found not only effective against pathogenic microbes but also have a significant value as a cytotoxic and an antitumor agent (Josh *et al.,* 2013).

**2.3.2 Flavonoids**

Flavonoids or bioflavonoids are secondary metabolites of plants that chemically have a general structure of 15 carbon skeleton consisting of two phenyl rings and a heterocyclic ring (Mc Naught, 1997). There are over 500 groups of flavonoids that have been characterized from various plants according to their chemical structure (Ververidis *et al.,* 2007). They are usually subdivided into anthoxanthins, flavanones, flavanols, flavans, and anthocyanidin (Zhao *et al.,* 2012). In plants they are responsible for floral pigmentation, ultraviolet ray’s filtration in higher plants and symbiotic nitrogen fixation (Galoetti *et al.,* 2008). They are also known to have inhibitory activities against organisms that cause plant diseases for example *Fusarium oxysporum* (Galoetti *et al.,* 2008). Flavonoids have been known to posses antimicrobial activity against bacterial, fungal and viral microorganisms (Cowan, 1999). They are usually known for their antimicrobial activity of inhibiting the synthesis of the nucleic acids, tampering with the integrity of the cytoplasmic membrane function and the energy metabolism process (Cushnie and Lamb, 2005). Flavonoids from some medicinal plants have been found to inhibit the synthesis of the nucleic acids, cause permeability of the inner bacterial membrane and a dissipation of the membrane potential of Gram negative and Gram positive bacteria (Cushnie and Lamb, 2005). Some of the bioactive components have been isolated from flavonoids have been found to contain antifungal, antibacterial and insecticidal activities (Abdel *et al., 2013*). Previous studies carried out have shown that when mixed with antibiotics they have synergistic activity and suppress many pathogenic microorganisms in numerous in vitro and in vivo studies (Cushnie and Lamb, 2011; Manner et al., 2013). Additional in vivo studies have shown that flavonoids can be used as pharmaceutical drugs for bacterial infections or through the dietary intake to offer protection against infection (Zamora *et al.,* 2012).

**2.3.3 Alkaloids**

They are a group of naturally occurring compounds that contain nitrogen and can be neutral or have weakly acidic properties (Mc Naught, 1997). They may also sometimes contain oxygen, Sulphur, more rarely other elements such as chlorine, bromine, and phosphorus (Schardl *et al.,* 2007). They are mainly secondary metabolites of plants but can also be produced by a variety of organisms including bacteria, fungi, and animals (Kittakoop *et al., 2014*). They dissolve in water poorly but readily dissolve in organic solvents (Shi *et al.,* 2014). They are divided into five major groups namely: true alkaloids (contain nitrogen in heterocyclic and originate from amino acids), proto alkaloids, polyamine alkaloids, peptide and cyclopeptides alkaloids and pseudoalkaloids (Faulkner *et al.,* 2006). They have a wide range of pharmacological activities such as antiasthma, antimalarial, anticancer, cholinomimetic, vasodilatory, antiamyhyrithic, analgesic, antibacterial and antihyperglycemic activities (Cushnie and Lamb, 2014). Some alkaloids have been known to possess psychotropic and stimulant activities and have been used as recreational drugs and entheogenic rituals (Blankenship *et al., 2005*). Alkaloids have great antimicrobial activity against bacterial pathogens such as *Escherichia coli, Klebsiella pneumonia, Staphylococcus aureus* and *Pseudomonas aureginosa* (Maatalah *et al., 2012*).

Some of the bioactive components of alkaloids such as morphine and cordine have been found to be active not only against bacterial and fungal pathogens but also trypanosomes and plasmodia (Feiburghaus *et al.,* 1996; Omulokoli *et al., 1997*). Some of the Alkaloids found in dietary food materials have also been found to contain microbiocidal and antidiarrheal effect in the small intestine where they show the ability to intercalate with the microbial genetic material (Ghoshal *et al.,* 1996; Phillipson and Niell, 1997). Other studies carried out on alkaloids extracted from a variety of medicinal plants in Nigeria showed a great antifungal activity (Garba and Okeniyi, 2012).

**2.3.4 Saponins**

They are a class of chemical compounds found in various plant species and they are amphipathic glycoside grouped structurally by having one or more hydrophilic glycosides moieties combined with liphophilic triterpene (Hostettmann and Martson, 1995). In plants, saponins are known to provide protection against microbes and fungi (Riguera, 1997). Saponins have been used by a wide range of commercial therapeutic claims for natural products whereby in organismal or human benefit are often based on preliminary biochemical and cell biology studies (Skene and Phillip, 2006). Saponins are also considered as one of the natural antimicrobial products that make up the defense system of the plants and some can be beneficial rather than harmful to animals (Rupasighe *et al.,* 2003; Hubert *et al., 2005*).

There has been evidence of the presence of saponins in traditional medicine preparations where the administration is through oral means that is expected to lead to the hydrolysis of glycosides from terponoids (Asl *et al., 2008*). Studies carried out have shown medicinal plant extracts fractions rich in saponins are effective against microorganisms such as *Escherichia coli, Salmonella typhi, Aeromonas hydrophilia* and other fungal pathogens such as *Candida albicans* (Deshpande *et al., 2013*). Saponins antimicrobial activity is attributed mainly to its capability of lysing microorganism’s membranes rather than the surface tension of the extracellular medium (Asl, 2008). Apart from antimicrobial activity, saponins have shown other biological properties with its cytotoxic activity on cancer or tumor cells being considered the most important one (Yokosuka and Mimaki, 2009). Other plants are known to produce steroidal saponins for example cholestane glycosides which are known to have a broad spectrum of biological activities such as cytotoxic activity, antifungal, antibacterial and in vivo antitumor activities (Li *et al.,* 2012).

**2.4 Current trend in Phytochemistry and Medicinal Plant**

Synthesis of secondary metabolites by plants is often with highly complex structures. Most of these important secondary metabolites are obtained from wild or cultivated plants because their chemical synthesis is not economically feasible. Various biotechnological methods have been employed in producing some of the secondary metabolites of plants through plant cell cultures. However, this has had limited success because of lack of understanding of how these metabolites are synthesized. State-of-the art genomic tools, however, can be used to enhance the production of known target metabolites or to synthesis entire novel compounds by so-called combinatory biochemistry in cultivated plant cells (Oksman-Caldenteya and Inzé 2004). Some plant cells have been used as factories to produce some secondary metabolites. Examples of these are paclitaxel, an anti-cancer drug originally extracted from the bark of 50-60-year-old Pacific yew trees (*Texus brevifolia*); shikonin, produced by cell suspension cultures of *Lithospermumerythrorhizon;* berberine, produced by cell cultures of *Coptis japonica;* rosmarinic acid, produced by cell cultures of *Coleus blumeli,* which has been achieved on a large scale, and sanguinarine, produced by cell cultures of *Papaversomniferum,* which has market potential in oral hygiene products (Oksman-Caldenteya and Inzé 2004) .

**CHAPTER THREE**

**3.0 MATERIAL AND METHODS**

**3.1.1 Equipment / instruments**

**3.1.2 Reagents and solvents**

**3.2 Sample collection**

**3.3 Methods**

**3.3.1 Collection of Plant and identification of Plant meterial**

**3.3.2 Preparation of plant extract**

**3.3.2.1 Qualitative phytochemical analysis**

The presence of saponins, tannins, flavonoids and alkaloids in the crude extract will be determined according to the method defined by Congesta *et al* (2005).

**3.3.2.2 Tannins**

Each of the extracts will be weighed to 0.5 mg and dissolved in 1 ml of distilled water. Filtration will be carried out after 2 ml of FeCl3 will be added. If there is presence of a blue or black precipitate then it indicate the presence of tannins.

**3.3.2.3 Flavonoids**

Each of the extracts will be weighed to 0.5 mg and dissolved in 1 ml of ethanol and filtered. 2 ml of 1% HCl and magnesium ribbon will be added to the filtrate. If there is formation of a pink or red colour it indicates the presence of flavonoids.

**3.3.2.4 Alkaloids**

Each of the extracts will be weighed to 0.5 mg and dissolved in 1 ml of methanol and filtered. 1 % HCl will be added to the filtrate and the solution heated. Mayor’s reagent will be added dropwise and if there is formation of any colored precipitate it indicate the presence of alkaloids.

**3.3.2.5 Saponins**

Each of the extracts will be weighed to 0.5 mg and dissolved in 1 ml of methanol and filtered. Distilled water will be added and shaking done for a few minutes. If there is persistence frothing then it indicates the presence of saponins.

**3.3.2.6 Phenols**

A fraction of the extract will be treated with aqueous 5 % ferric chloride solution. The formation of deep blue or black color indicates the presence of phenols (Solomon *et al.,* 2013).

**3.3.3 Microorganisms**

**3.3.4 Analysis of antidiarrheal activity**

**3.3.4.1 Preparation of sample extract for microbiological assay**

**3.3.4.2 Disc diffusion technique**

**3.3.4.3 Determination of Minimum Inhibitory Concentration (MIC)**

**3.3.4.4 Determination of Minimum Bactericidal Concentration (MBC)**

**CHAPTER FOUR**

**4.0 Expected Result and Conclusion**

At the end of this research work, the phytochemical screening should reveal the presence of bioactive components of the plant extract such as flavonoids, alkaloids, saponins, tannins, and the antidiarrheal activity should indicate that the plant contains medicinal and therapeutic properties and can be used as medicine for combating diseases causes by selected bacteria.

**4.1 Expected Result**

**4.2 Conclusion**

**REFERENCES**