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Full Length Research Paper

Comparative studies of antibacterial effect of some antibiotics and ginger (*Zingiber officinale*) on two pathogenic bacteria

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This study investigated the comparative effect of ginger (*Zingiber officinale*) and some antibiotics on two pathogenic bacteria. The plant extracts were prepared by weighing the plant leaves and root (20, 40, 60, 80 and 100 g) into 100 mls of water and ethanol (at g/100 ml) and grounded to determine the extract concentrations. Serial dilutions of the antibiotics used were prepared to determine the various antibiotic concentrations. The results obtained showed that ginger extract of both the plant and root showed the highest antibacterial activity against *Staphylococcus aureus* and *Streptococcus pyogenes* while the three antibiotics used (chloramphenicol, ampicillin and tetracycline) were also active but at less extent compared to ginger extract. The concentration of the plant extract had significant effect on the zone of inhibition on both organisms. The concentration of the three antibiotics had significant effect on the zone of inhibition for both organisms. This result showed that ethanol extracts of ginger both leaf and root can be used alongside conventional antibiotics to fight agents of infections that are so prevalent in the hospitals.

Key words: Ginger, zone of inhibition, extract, antibacterial.

INTRODUCTION

In every environment, competition for food and space is one of the major factors that determine which organisms succeed and become established as the regions microflora. Organisms that grow fastest with the available nutrients and environmental conditions will predominate. These microbes often change the environment with their metabolic by-products, securing their prevalence in that habitat. The increasing reliance on drugs from natural source gas led to the extraction and development of several drugs and chemotherapeutic agents from traditional herbs and are present in abundance in the tropic (Falodun et al., 2006). Many foods present antibiotic function that are often unknown to the eater which reduced or limited the growth of bacteria in their body. In fact, the use of medicinal plant to treat diseases of varying etiology is part of the African tradition, but in spite of thousands of years of use, none of these bioactive plants compounds have been exploited for clinical uses as antibiotics, though some alkaloid compounds like quinine and emetine have been developed as chemotherapeutic agents. Among those antibacterial foods that are becoming more common in western diet are green tea and ginger (Langner et al., 2008; White 2007; Hoffman, 2007).

The development of new antibiotics and plant based antimicrobial compounds are effective against the resistant organisms. Ginger a common substance found increasingly in the diets of the global population, have known antibacterial effects and are commonly used together in teas. Many studies have implicated *Staphylococcus aureus,* and *Streptococcus pyogene* as leading causative agents of both community and hospital acquire infections (Amita et al., 2003). Antibiotics are chemicals produced by micro-organisms. Micro-organisms that produce antibiotics are mostly bacteria,

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but a few fungi also produce them.

Ginger has been valued for its antibacterial properties for thousands of years in Asian cultures (Weil, 2005). Micro-organism prevalent in the patients' immediate hospital environment colonizes the patients' skin, mucous membrane, eye, ear and nostrils as well as the anterior urethra. Ginger *(Zingiber officinale*) is one of those plants that were seriously investigated over the years. It has been used in centuries to fight infection. In South India, ginger is used in the production of a candy called Inji-murappa meaning ginger candy in Tamil. Ginger compounds are active against a form of diarrhea which is leading cause of infant death in developing countries. Ginger has been found effective in multiple studies for tearing nausea caused by sea sickness, morning sickness and chemotherapy, though ginger was found superior over a place for post operative nausea.

The aim of this research is to investigate the effect of plant extract (ginger) and three other antibiotics on two pathogenic bacteria.

MATERIALS AND METHODS

Preparation of ginger extract and antibiotics

About 1000 g of ginger bulb and leaf were purchased from Sango General Market, Saki, Nigeria. The antibiotics used include Chloramphenicol, Tetracycline and Ampicillin. Ethanol and distilled water were used as solvents for the extraction of plant materials. The method of Silva et al. (1999) was adopted, 20, 40, 60, 80 and 100 g of ginger plants, ginger bulb and 250 mg of the three antibiotics were weighed using a clean electronic weighing balance and then poured into a sterile bottle jar containing 100 ml of distilled water and 100% ethanol. The ginger leaf were washed and cut into pieces before weighing balance. The bottle jars were labeled appropriately to avoid mixing them up during the cost of experiment, the extract were squeezed and soaked for 72 h. The extract of ginger root were prepared by washing the ginger bulb thoroughly under tap running water, aseptically cut into small pieces with a sterile knife and was blended making use of an electric blender. The extracts were then filtered using filter paper. The filtrate of the ginger plants and ginger bulb were then poured into differently labeled McCartney bottles, paper discs were made by cutting discs, (5 mm) from a sterile filter paper with a perforator and then dispensed into the extracts each sealed and stored at 5°C in a refrigerator.

Collection of micro-organisms

The bacteria *S. aureus and S. pyogene* were used for this analysis. Both cultured*, S. aureus* and *S. pyogene* were collected at the University College Hospital (U.C.H.) Medical Microbiology Department, Ibadan, Oyo State, Nigeria and stored in refrigerator.

Preparation of media

Fourteen gram of nutrient agar powder were weighed using a clean electronic weighing balance; 500 ml of distilled water was poured into conical flask containing 14 g of nutrient agar. The mixture was stirred with a sterilized glass rod and covered with a cotton wool, over which an aluminum foil was tightly wrapped and then autoclaved for 15 min at 121°C. The agar was then allowed to cool.

After autoclaving, the media were placed inside a water bath to maintain the media in a molten stage. 1 ml each of the three antibiotics were weighed into a test-tube containing 9 ml of sterile and serially diluted until the dilution was at the fifth test – tube (10^5). The test – tubes were covered with cotton wool and wrap with aluminum foil paper.

Antimicrobial sensitivity testing

The soaked discs from the filter paper which has been made into the extracts of both ginger leaf and ginger root for 72 h was by the means of sterile forceps dispensed into nutrient agar. The organisms were picked with the inoculating loop from sub – cultured organisms and were inoculated into each plate by striking method that is *S. aureus* and *S. pyogene*. After the agar had been solidified, 5 mm deep wells were punched in some plate containing the agar with the aid of a sterile 6 mm cork borer. The syringe was used to pipette five hundred micro liters of the three antibiotics (tetracycline, chloramphenicol and ampicillin) that were dispensed into each holes bored from the agar. After introducing the ginger extracts and the three antibiotics, each into different Petri-dishes, they were incubated in an incubator at 37°C for 18 h. Discs were also dispensed into the media for the control.

RESULTS

In this study, there was no significant difference in the effects of both water and ethanol extract of ginger on the zone of inhibition of the two bacteria *(S. aureus* and *S. pyogene)* ($P = 0.0520$), while the concentration of the plant extract (water and ethanol) had significant effect on the zone of inhibition of both organisms, (*S. aureus and S. pyogene)* ($P < 0.001$).

In Figure 1*,* ginger leaf and root had the lowest zone of inhibition of 10 mm on *S. aureus* at 20 g/100 ml concentration of the water extract and it increased significantly as the concentration increased to 100 g/100 ml concentration which recorded the highest zone of inhibition of 30 and 32 mm of both the ginger leaf and root water extract. There was no significant difference ($P = 0.055$) in the effects of both ginger leaf and root ethanol extract on the zone of inhibition of *S. aureus*.

S. pyogene had the lowest zone of inhibition diameter of 18 and 19 mm on both ginger leaf and root respectively at 20 g/100 ml of water extract concentration which increased as the concentration increased with 100 g/100 ml concentration having the highest zone of inhibition of 25 and 28 mm of ginger leaf and root, respectively (Figure 2). The ethanol extract had significant effect ($P < 0.001$) on the zone of inhibition of *S. pyogene.* At concentration of 20 g/100 ml of the ethanol extract the lowest zone of inhibition of 20 and 21 mm (ginger leaf and ginger root, respectively) was produced. Meanwhile the highest zone of inhibition value of 30 mm (ginger leaf and ginger root) was recorded at concentration of 100 g/100 ml ethanol extract (Figure 2).

The effect of antibiotics (Tetracycline, Chloramphenicol and Ampicillin) on *S. aureus* is presented in Figure 3. Antibiotic concentration (tetracycline, cloramphenicol

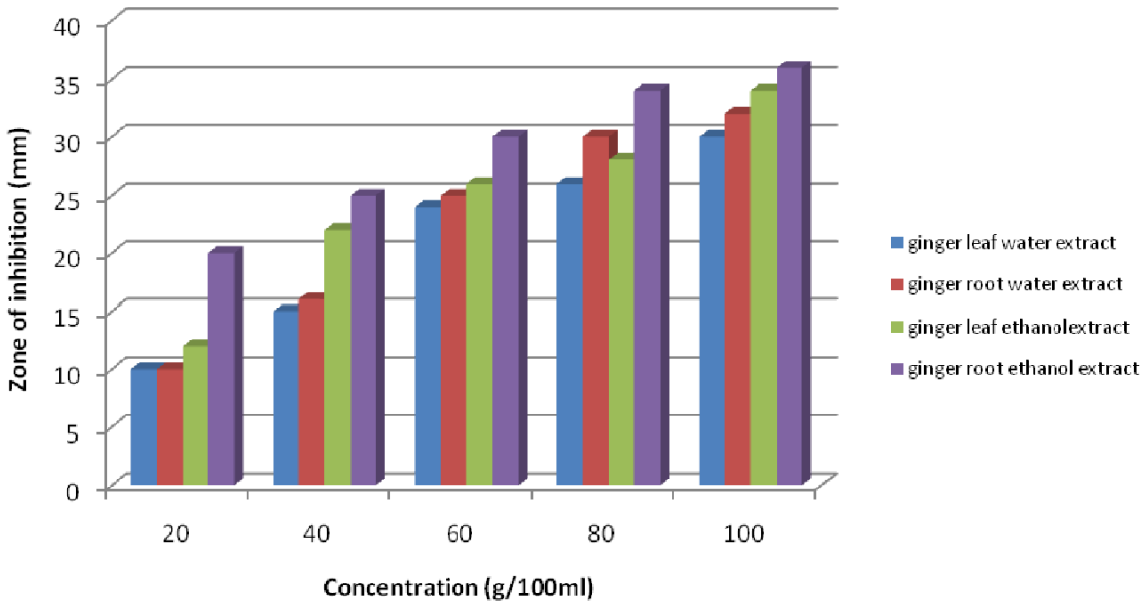

Figure 1. Effects of ginger on *Staphylococcus aureus.*

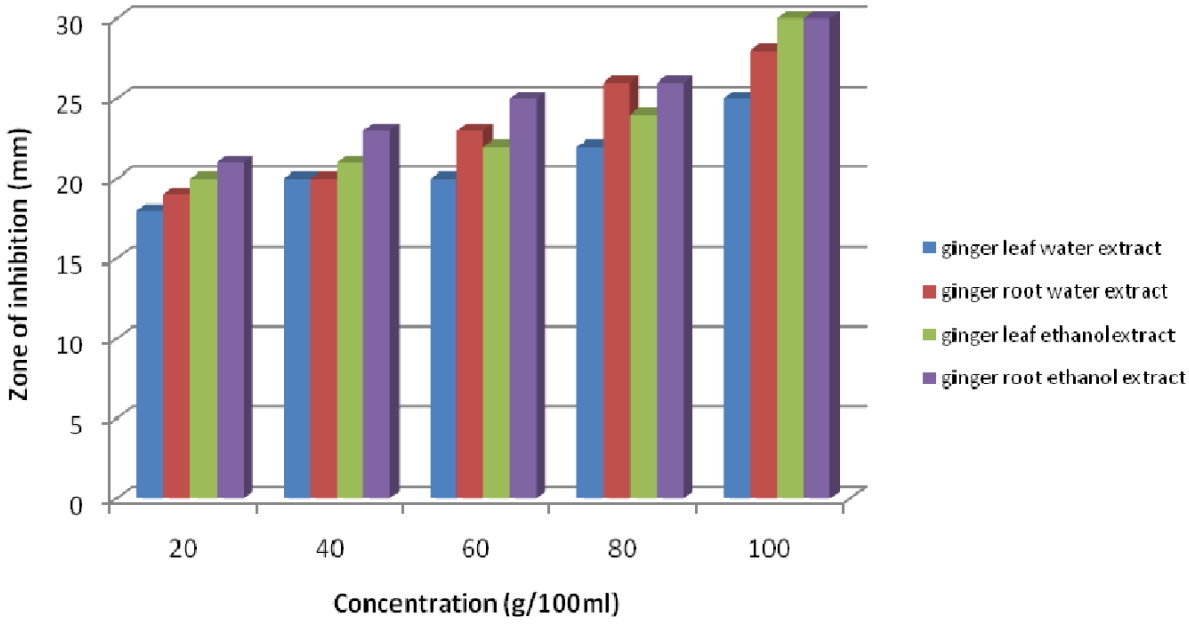

Figure 2. Effects of ginger on *Streptococcus pyogene.*

and ampicillin) had significant effect (P<.001) on the zone of inhibition of both *S. aureus* and *S. pyogene.* As the concentrations of the antibiotics used in this study decreased the zones of inhibition also decreased concomitantly. However, Chloramphenicol had the greatest effect on *S. aureus* producing a zone of inhibition of 30 mm at concentration of 10^{-1}. Meanwhile there was no effect at antibiotic concentrations of 10^{-5} for all the antibiotics when tested on *S. aureus* while Ampicillin showed no effect at concentrations of 10^{-4} and 10^{-5}. Figure 4 shows the effect of antibiotics on *S. pyogene.* Ampicillin had the greatest effect on *S. pyogenes* at concentration of 10^{-1} producing a zone of inhibition of 30 mm while both Tetracycline and Chloramphenicol had no effect on *S. pyogene* at concentrations of 10^{-4} and 10^{-5}.

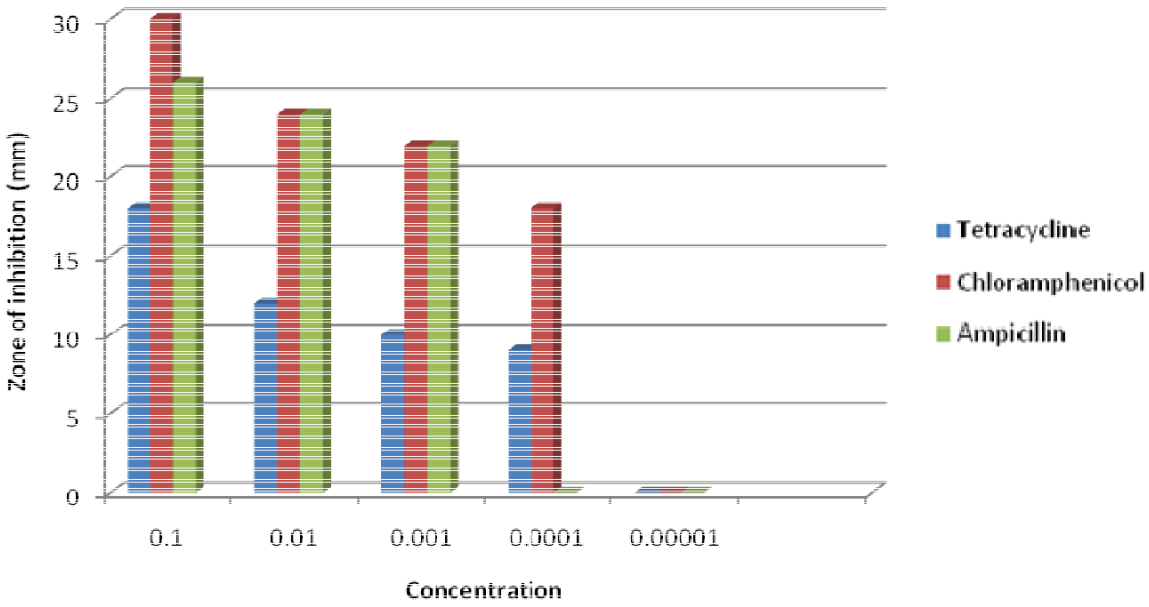

Figure 3. Effect of antibiotics on *Staphylococcus aureus.*

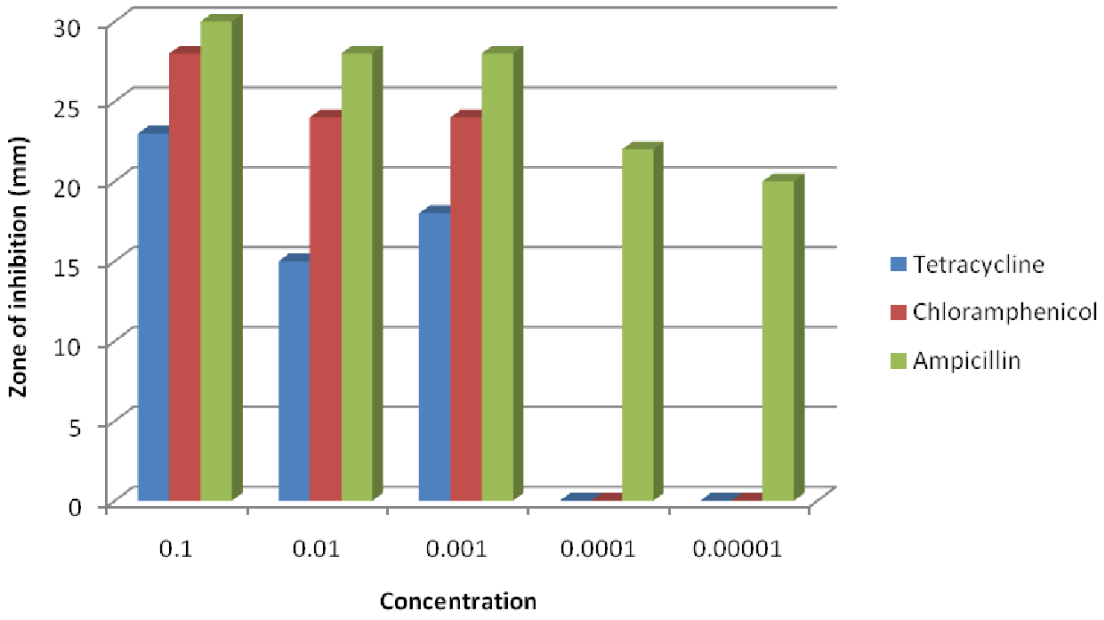

Figure 4. Effect of antibiotics on *Streptococcus pyogene.*

DISCUSSION

The large sizes of zones growth inhibition produced by ginger extracts and the three antibiotics (Chloraphenicol, Tetracycline and Ampicillin) against the two bacterial *S. aureus* and *S. pyogene* indicated the potency of the active constituents in ginger and those antibiotics. The ginger root ethanol extract showed the greatest effect on both *S. aureus* and *S. pyogene* compared to the leaf and root water extract and the leaf ethanol extract. This is an indication that ginger is effective against *S. aureus* and *S. pyogene* infections. The phytoconstitutuents of ginger have longed been known as its antibacterial properties have been widely reported (Roy et al., 2006). However, most reports on the activity of ginger have focused mainly on the commensal micro flora and community acquired

infections, while information's on its activity against hospital based pathogens is scanty.

The data from this study showed that ethanol extract were more effective than the water extract. This may be attributed to the fact that the three antibiotics as a conventional antibiotic, is prepared by a reproducible manufacturing processes and procedures. Extract of herbal medicines are subject to degradation and decomposition on storage (El – Mahmood and Amey, 2007). Roy et al. (2006) had reported the decrease in potency of ginger extract upon storage and attributed this to the volatile nature of the active principles in ginger. The preparation of plant materials like other pharmaceuticals also requires special conditions of storage. Both crude extract and pure compounds of some plants have been reported to potentiate the activity of antibiotics, hence the need to use both side by side to fight recalcitrant infections, especially in the hospital environment. In some parts of the African Continent, herbal medicines are sometimes administered con-comitantly with antibiotics (Estimone et al., 2006) and this can lead to either beneficial or deleterious effects.

Ginger is a promising plant material with numerous biological activities. Various solvents were used for extraction of bioactive compound from ginger and the extract yields were measured. Highest percentage yield obtained with ethanol followed by water. Antimicrobial activity of these extract was tested with two different pathogenic bacteria by disc method. The results of this testing sheds light into the antimicrobial abilities of test substance, potentially providing ground for natural alternatives to pharmaceutical antibiotics medication. This study has consistently demonstrated the effectiveness of ginger as an antibacterial agent against *S. aureus* and *S. pyogene*, whereas the three antibiotics tested also showed the ability to inhibit the growth of *S. aureus* and *S. pyogene*. Ginger can be used for the development of broad spectrum antibiotics.

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