STUDIES ON ANTIMICROBIAL EFFECTS OF METHANOLIC EXTRACT OF *CYMBOPOGON CITRATUS* AND *ZINGIBER OFFICINALE* ON SOME BACTERIAL ISOLATES

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ABSTRACT

This study investigated the individual and combined antimicrobial effects of methanolic extract of *Cymbopogon citratus* and *Zingiber officinale* on some test bacteria. This was with a view to evaluating and confirming their antimicrobial activity, determining their minimum inhibitory concentrations (MIC) and minimum bactericidal concentrations (MBC) and evaluating their combined effects.

Fresh leaves of *C. citratus* and rhizomes of *Z. officinale* were separately washed, air-dried under shade and ground into powder. The powdered plant materials were extracted with methanol; concentrated *in vacuo* using a rotary evaporator and dried using silica gel inside dessicator. The extracts were screened for their phytochemical groups. Their antimicrobial activity against Gram-positive and Gram-negative bacteria was evaluated by agar well diffusion method. The extracts were partitioned using different organic solvents in order of polarity starting from n-hexane, chloroform, ethyl acetate and n-butanol. The MIC and MBC of the extracts and their respective fractions were determined. The combined effects of the extracts were evaluated and their antimicrobial activity was compared with standard antibiotics – streptomycin and ciprofloxacin. The rate of killing of the active fractions was determined on selected Gram-positive and Gram-negative bacteria following standard procedures.

The primary methanolic extracts of both plants and subsequent chloroform and ethyl acetate fractions of *C. citratus*; chloroform and n-hexane fractions of *Z. officinale* and their combined chloroform fractions exhibited varying degree of antibacterial activity against 14 out of the 15 bacteria tested. These included both Gram-positive and Gram-negative bacteria indicating broad-spectrum antibacterial effects of the extracts. Only *Pseudomonas aeruginosa* was not susceptible to the effects of the extracts. Most of the MIC values were the same as the

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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

The war against diseases has been part of everyday life and the use of medicinal plants in the treatment of infections is as old as man. Some of the crude drugs used in the past are still being evaluated in recent phytotherapeutics (Muanzu and Kaita, 2008). In Nigeria, it is a common practice that herbal products are administered over prolonged period and by persons that have little or no knowledge of science. The constituents of these recipes elicit varied physiological activities in human (Abu and Uchendu, 2010). In Africa, up to 80% of the population use herbal medicines for primary health care and the global market for herbal medicines currently stands at over US $ 60 billion annually and growing steadily (Muanzu and Kaita, 2008). The reason is that the use of herbal medicine is less constraining and non-expensive. Despite the wide utilization of herbal medicine in Africa, information about plant metabolites and their derivatives as well as their medicinal properties is scarcely available (Schmelzer *et al*., 2010).

The use of herbal medicine originated in Egypt back in 1550 BC, yet many of their pharmacological effects remain poorly understood. Out of the estimated 800,000 known plant species on earth, about a quarter have been categorized and only a small fraction of these have been examined for pharmacological efficacy. The search continues for more drugs from plant sources, used either singly or in combination, to help treat the many diseases which still plague human society (Hussin, 2001). It is noteworthy that infectious diseases are the number one causes of death, killing almost 50,000 people every day and accounting for approximately one half of all deaths in tropical countries (Ahmad and Beg, 2001). Nearly all cultures and

civilizations from ancient times to the present day have used herbal medicines to cure infections. Given the high importance of infections with regards to health, it is not surprising that anti-infective agents are high on the list for drug development and some medicinal plants used traditionally have undergone screening (Holmstrup *et al.*, 2003).

Plant-derived drugs are widely used because they are relatively safer than the synthetic alternatives, easily available and cheaper (Perez, 2003). Many plant species have also been evaluated for their antimicrobial activities in the past. Plants therefore have several mechanisms to counter microbial attack. Some of the anti-microbial compounds in plants may be exploited for use against bacterial diseases in man (Castello *et al.*, 2002). Hence it would appear that plants have developed an arsenal of weapons to survive attacks by microbial invasions. These include both physical barriers as well as chemical ones, i.e. the presence or accumulation of anti-microbial metabolites. These are either produced in the plant (prohibitins) or induced after infection (phytoalexins). Since phytoalexins can also be induced by abiotic factors such as UV irradiation, they have been defined as 'antibiotics formed in plants via a metabolic sequence induced either biotically or in response to chemical or environmental factors' (Grayer and Harborne, 1994).

Due to the indiscriminate use of antimicrobial drugs, microorganisms have developed resistance to many antibiotics and that has created immense clinical problems in the treatment of infectious diseases (Davis *et al.*, 1994). As the use of antimicrobial drugs increased, so did the level and complexity of the resistance mechanisms exhibited by bacterial pathogens. This is due to the alteration of resistance mechanisms, acquisition of resistance genetic element from other bacteria and genetic changes in bacteria (Li *et al.*, 2003). The intractable problem of antimicrobial resistance has led to the resurgence of interest in medicinal plants as sources of

novel compounds to fight the ever increasing problems of emergence of new infections and preventing the resurgence of old ones thought to have been brought under control (El-Mahmood *et al*., 2008). In the present scenario of drug resistance by pathogenic bacteria, there is an urgent need to develop alternative antibacterial drugs for the treatment of bacterial infections. Thus there is an increasing interest in medicinal plants as a natural alternative to synthetic drugs (Doughari, 2006).