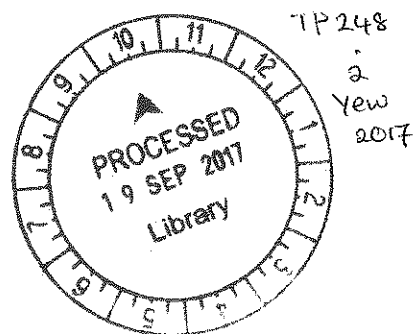


EFFICACY OF *Cymbopogon citratus* AGAINST CLINICAL IMPORTANT
PATHOGENS

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ABSTRACT

Antibiotic resistance started to develop within a few years after the use of antibiotics. Antibiotic resistance has become a major problem worldwide, and has impacted patients emotionally and financially. This is due to the existence of the resistance mechanisms in bacteria. The overuse of antibiotics, inappropriately prescribed or improper use of antibiotics have caused bacteria to develop resistance. In order to overcome antibiotic resistance, alternative therapeutic agents should be investigated. *Cymbopogon citratus* possesses various pharmacological activities including antibacterial activity, which is useful in treating multidrug resistant bacterial infections. The antibacterial property is due to the presence of resistance modifying agents that are present in the plant. In this study, multidrug resistant bacterial isolates that have been collected from healthy individuals in INTI International University were identified and confirmed. Aqueous and methanolic extracts of *C. citratus* were used in agar diffusion assays to determine the efficacy of *C. citratus* in treating multidrug resistant bacterial infections. Moreover, different parts of *C. citratus* were used to examine the difference in antimicrobial activity. The inhibition zones were measured and compared among the different extracts and *C. citratus* essential oil, which act as positive control. The extracts also compared with the antibiotics commonly used to treat multidrug resistant bacterial infections. In this experiment, *C. citratus* essential oil showed the greater antimicrobial activity than methanolic extract due to the fact that the methanolic extract was not concentrated enough while boiled extract did not exhibit any antimicrobial activity. The *C. citratus* extract also exhibited better antimicrobial activity in gram positive bacteria than in gram negative bacteria, with the exception of *P. aeruginosa* which showed a high susceptibility towards the methanolic extracts. Thus, *C. citratus* could have the potential use in the treatment of biofilm development related infections.

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LIST OF ABBREVIATIONS

<i>A. baumannii</i>	<i>Acinetobacter baumannii</i>
AIDS	acquired immunodeficiency syndrome
ANOVA	analysis of variance
A	axillae
<i>C. freundii</i>	<i>Citrobacter freundii</i>
CLSI	clinical laboratory standard institute
<i>C. citratus</i>	<i>Cymbopogon citratus</i>
°C	degrees Celsius
<i>E. cloacae</i>	<i>Enterobacter cloacae</i>
<i>E. faecalis</i>	<i>Enterococcus faecalis</i>
<i>E. coli</i>	<i>Escherichia coli</i>
HAIs	healthcare-associated infections
HPLC	high pressure liquid chromatography
HIV	human immunodeficiency virus
H ₂ O ₂	hydrogen peroxide
<i>K. pneumoniae</i>	<i>Klebsiella pneumoniae</i>
MSA	mannitol salt agar
MRSA	methicillin-resistant <i>Staphylococcus aureus</i>
MRSE	methicillin-resistant <i>Staphylococcus epidermidis</i>
MSSA	methicillin-sensitive <i>Staphylococcus aureus</i>
MSSE	methicillin-sensitive <i>Staphylococcus epidermidis</i>
MIC	microbiology
µg	microgram
µm	micrometre
mL	millilitre
mm	millimetre
N	nasal
%	percentage
<i>P. mirabilis</i>	<i>Proteus mirabilis</i>
<i>P. vulgaris</i>	<i>Proteus vulgaris</i>
rpm	revolutions per minute

S. aureus

Staphylococcus aureus

S. epidermidis

Staphylococcus epidermidis

CHAPTER 1

INTRODUCTION

Cymbopogon citratus is commonly known as lemongrass. According to Shah et al. (2011), it is a herb belonging to the family Gramineae and is widely used in tropical countries especially Southeast Asia. It is generally consumed in various forms such as in curries, soup or even tea in the various cuisines around the world including Vietnam, Thailand, and South East Asian (Nambiar, 2012).

In addition to its general use in food, extensive studies are being carried out on *C. citratus* as a potential therapeutic agent. Manvitha & Bidya (2013) discussed various pharmacological activities possessed by *C. citratus* such as anti-fungal, anti-amoebic, anti-diarrheal, anti-bacterial, anti-inflammatory, and anti-filarial properties. Other effects such as anti-malarial, anti-oxidants, anti-mycobacterial, anti-mutagenicity, neurobehavioral and hypoglycemic properties have also been studied. The use of lemongrass essential oils as potential antimicrobial agents has been studied previously. Lemongrass essential oil has been shown to effectively inhibit the growth of many different bacteria, including methicillin-resistant *Staphylococcus aureus* (MRSA), methicillin-resistant *Staphylococcus epidermidis* (MRSE), and gram negative bacteria (Sharma, Mack, & Rojzman, 2012).

It is stated that multidrug resistant bacteria are a serious problem which have rapidly spread worldwide. Health care-associated infections (HAIs) caused by MRSA, MRSE, and resistant gram negative bacteria have become global threats with high fatality rates (Ventola, 2015). Although multidrug bacterial infections are currently being treated using antibiotics, however, some first and second line antibiotics are rapidly becoming ineffective in the treatment of multidrug bacterial infections due to the emergence of antibiotic resistance (Lin et al., 2015; Ventola, 2015). The misuse and overuse of antibiotic medications has caused the efficacy of antibiotics in general, to be reduced and the lack of new drug development has led to occurrence of an escalating antibiotic resistance crisis (Ventola, 2015).

Therefore, a natural alternative treatment could be an option to help overcome multidrug resistant bacterial infections. Thus, the objective of this project is to use the extract of *C. citratus* to determine its efficacy as an antimicrobial agent. A method of boiled extraction or methanolic extraction for *C. citratus*, the comparison of using fresh and kept *C. citratus* powder and the use of leaf and root parts of *C. citratus* have been compared to essential oil of *C. citratus* due to the fact that the former method is more economical and simple to produce compared to distillation method of producing lemon grass essential oil by using HPLC which requires high technology and is very expensive. The efficacy of *C. citratus* was also compared to the commonly used antibiotics in the treatment of multidrug resistant bacterial infections.