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## Antibacterial Activity of Water, Methanol and Ethanolic Extract of Lemongrass (*Cymbopogon citratus*) on Common Bacteria Pathogen

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### Abstract

**Introduction:** Traditional medicines become main source of primary health in different part of Sudan as result of cost effectiveness and viability of antibiotic in addition of antibiotic resistance and their side effect

**Method:** water, methanol and ethanolic extracts of Lemongrass were screened for in vitro antibacterial activity against (*Escherichia coli*, *Klebsiella pneumoniae*, *Proteus vulgaris*, *Serratia marcescens* *Providencia spp*, *Salmonella spp*, *Shigella spp*, *Pseudomonas aeruginosa*, *Staphylococcus auris*, *Staphylococcus albus*) by disc diffusion method.

**Result:** extracts showed variable effect on the tested organisms. Ethanol leaves extract exhibit highest result to tested bacteria, whereas methanol extract had lowest activity. Water extract showed similar inhibition zones to the all tested bacteria with advantage to gram positive bacteria.

**Conclusion:** The results obtained in the present study indicate that extracts of lemongrass had potential antibacterial activity against tested bacteria.

**Keywords:** Lemongrass extracts, antibacterial activity, disc diffusion method

### Introduction

Scientists are now looking towards Sudan as varietal emporium of medicinal plants, verity of medicinal plants species in Sudan have medicinal value. Plant extracts in the form of infusion, decoction, and tincture are traditionally used by the population for the treatment of different diseases. <sup>(1)</sup>

In recent years, multiple drug resistance has developed due to indiscriminate use of synthetic drugs. This drives, Investigations towards the anti pathogenic potential of natural products which open new avenues for drug development in the control of antibiotic resistant pathogens. <sup>(2)</sup>

Majority of the developing countries populations consider traditional medicines back bone of several indigenous traditional systems of medicine and primary healthcare. <sup>(3)</sup>

Lemongrass (*Cymbopogon citratus*) a perennial plant with long, thin leaves one of the largely cultivated medicinal plants in Sudan, parts of tropical and subtropical areas of Asia, Africa and America.

<sup>(4)</sup> It belongs to the section of *Andropogon* called *Cymbopogon* of the family Germinae <sup>(5)</sup>. The two of the major species are *Cymbopogon citrates* and *C. flexuosus*. <sup>(6)</sup>

The lemon grass contains high percentage of Vitamin C, which is a characteristic of plants used as drug e.g., belladonna and jaborandi. Lemon grass oils show activity towards the phyto pathogenic fungi. <sup>(7)</sup> A combination of lemon grass oil is given for use on human and domestic animal pathogens. <sup>(8)</sup>

The oil has been found to possess bactericidal and anti-fungal properties, which is comparable to penicillin in its effectiveness.<sup>(9)</sup> The oil also contains male sex hormone agent.<sup>(10)</sup> It is also reported to have strong activity against two dermatophytes, namely *Trichophyton rubrum* and *Microsporum gypsum*.<sup>(11)</sup>

Similarly pharmacological investigation on the essential oil of *C. citratus* revealed that it has a depressant effect on the CNS.<sup>(12)</sup> It has analgesic and antipyretic properties.

The extract juice from the lemon grass contains inhibitor of the promotion stage of carcinogenesis induced by cotton oil. It is an oral anti-tumor drug for the cancer and in combination with cyclodextrin lengthened the survival time.<sup>(13, 14)</sup> Gallstone dissolving preparations have been made of oil.<sup>(15)</sup>

This study was set out in order to investigate the antibacterial activity of lemongrass extracts against common pathogenic bacteria in Sudan.

### Materials and Methods

**Plant Material:** The leaves of Lemongrass were collected from Khartoum state in the month of March 2013

#### Preparation of the extracts:

Ten grams of fresh leaves Lemongrass were shade dried at room temperature (32 – 35 °C) to constant weight over a period of 5 days. The dried leaves and pod were ground into powder using a mortar and pestle. 5 g of the powdered leaves and pod were separately extracted in 100ml conical flasks with 100 ml of hot distilled water (aqueous extract), and 100ml ethanol (ethanolic extraction). The conical flasks were plugged with rubber corks, then shaken at 120 rpm for 30 min and allowed to stand at room temperature for 5 days while water (aqueous extract) just 10 minutes, with occasional manual agitation of the flask using a sterile glass rod at every 24 hours. The extracts were separately filtered using sterile Whatman no. 1 filter paper, the resulting filtrate.

**Test organisms:** Tested bacteria were isolated from different clinical specimens, samples were isolated and identified according to standard laboratory methods.<sup>(16)</sup> Isolated bacteria include: (*Escherichia coli*, *Klebsiella pneumoniae*, *Proteus vulgaris*, *Serratia marcescens*, *Providencia spp*, *Salmonella spp*, *Shigella spp*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Staphylococcus albus*)

#### Antibacterial sensitivity testing

Antibacterial susceptibility testing of antibiotics was performed by the diffusion method.<sup>(16)</sup> For susceptibility testing, a suspension from one day-old bacterial cells of each isolate was prepared in agar broth (2 ml equivalent to the McFarland turbidity standard; the suspensions were spread on to the surface of the Mueller Hinton agar with sterile cotton

swabs. The plates were briefly dried and then the antibiotic disks of Lemongrass were added to each plate and incubated overnight at 37 °C. The inhibition zone diameters were measured in millimeters, with a ruler. Resistance was determined by a zone of growth inhibition diameters. Greater zones of complete growth inhibition indicated the presence of susceptible strains. The procedure was repeated for cultures that were defined as resistant.

### Result and Discussion

The results obtained from this study showed antibacterial properties of ethanol, methanol and water extract of lemon grass against common bacterial pathogens in Sudan.

In general, herbal products leading to granular cytoplasm, cytoplasmic membrane rupture<sup>(17)</sup>, inactivation or inhibition of intracellular and extracellular enzyme activity and being disintegrated into cell wall.<sup>(18)</sup>

There were a number of studies carried out to prove antimicrobial activities of Lemongrass (*Cymbopogon Citratus*) against different human pathogens.<sup>(19, 20)</sup> The presented results are consistent with most of these studies.

All extracts demonstrated antimicrobial activity against our tested bacteria with the ethanol extracts demonstrating the highest activity while results obtained of lack of growth inhibition zone showed that growth inhibitory effect of methanol extract on tested bacteria was very low.

*Serratia marcescens* and *Salmonella spp* had the highest microbial sensitivity at ethanol extract with (13, 12 mm) respectively. The rest of the tested bacteria had converged results ranging between (9-11 mm). (figure.1)

Among tested bacteria, methanol extracts were active against only three bacteria (*Escherichia coli*, *Providencia spp* and *Pseudomonas aeruginosa*). Other tested bacteria observed that no inhibition zones were detected. Our results showed that methanol extract effect against Gram negative bacteria was much stronger than the Gram positive ones. (figure.2)

The present study was supported by Gopinath *et al.* (2013)<sup>(21)</sup>, investigated the antibacterial activity in the leaf methanol extracts of lemon grass against *S aureus*, *E coli* and Coagulase-negative staphylococcus and reported Methanol extracts show considerable antimicrobial activity to the tested bacteria. Similarly to Thompson *et al.*, (2013)<sup>(22)</sup> result, lemon grass having more moderate

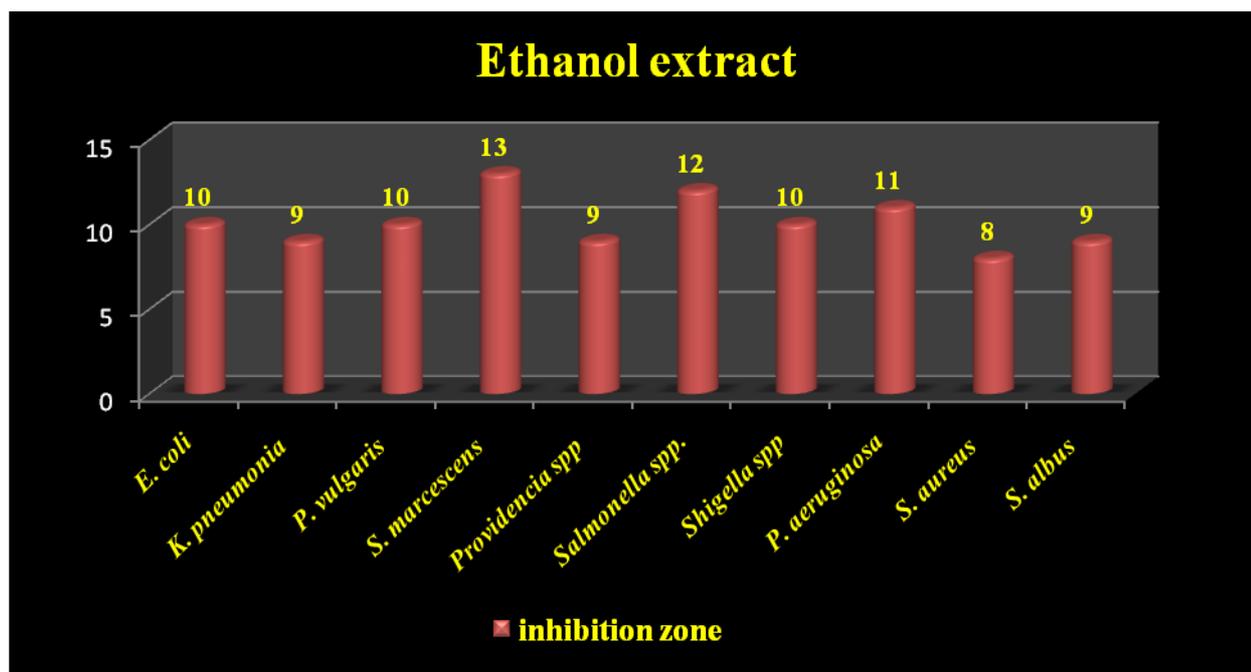
weak inhibitory effect against *Escherichia coli* and none inhibition effect on *Pseudomonas aeruginosa*.

(Ewansiha *et al.*, 2012)<sup>(24)</sup> (Akiyama *et al.*, 2001)<sup>(25)</sup>, assessed the antibacterial properties of lemon grass leaf methanol extract and founded that, Methanol extracts shows no antimicrobial activity which is partial in conformity with our result.

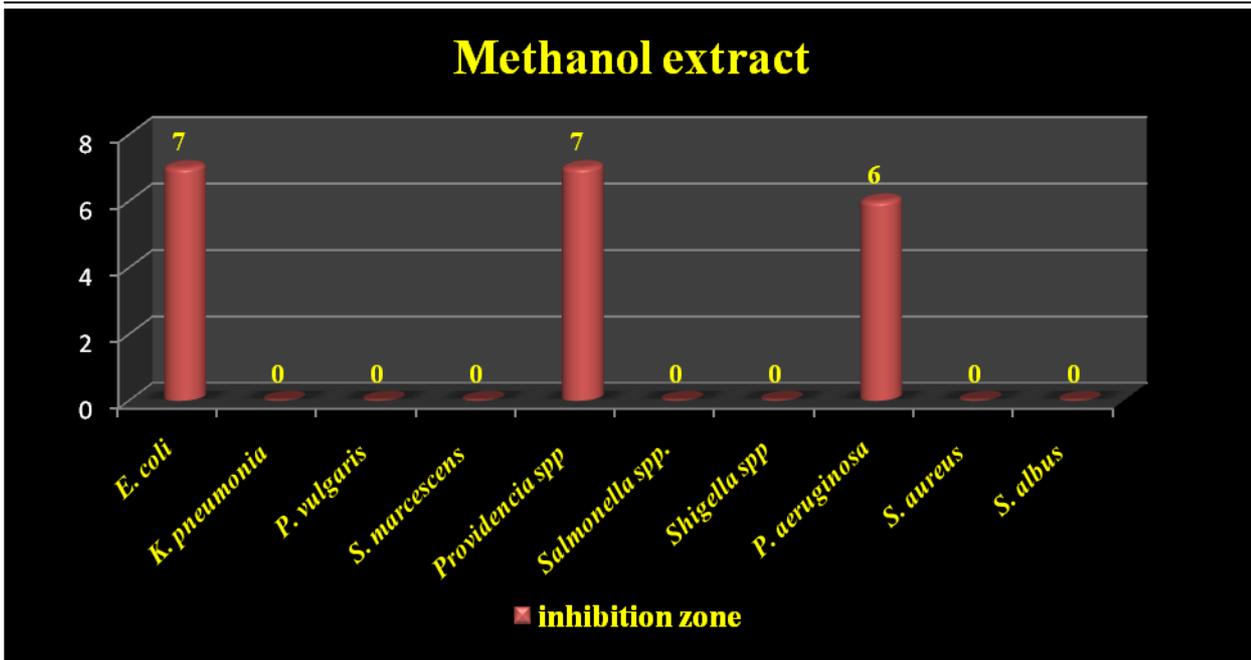
It seems that generally antimicrobial properties of methanol extracts can be attributed to the presence of secondary metabolites especially flavonoids in first degree, in the second degree terpenes and in the third degree saponins.<sup>(26)</sup>

Water extract was strongly inhibited tested Gram-positive bacteria *Staphylococcus auras* and *Staphylococcus albus* (10 mm) which

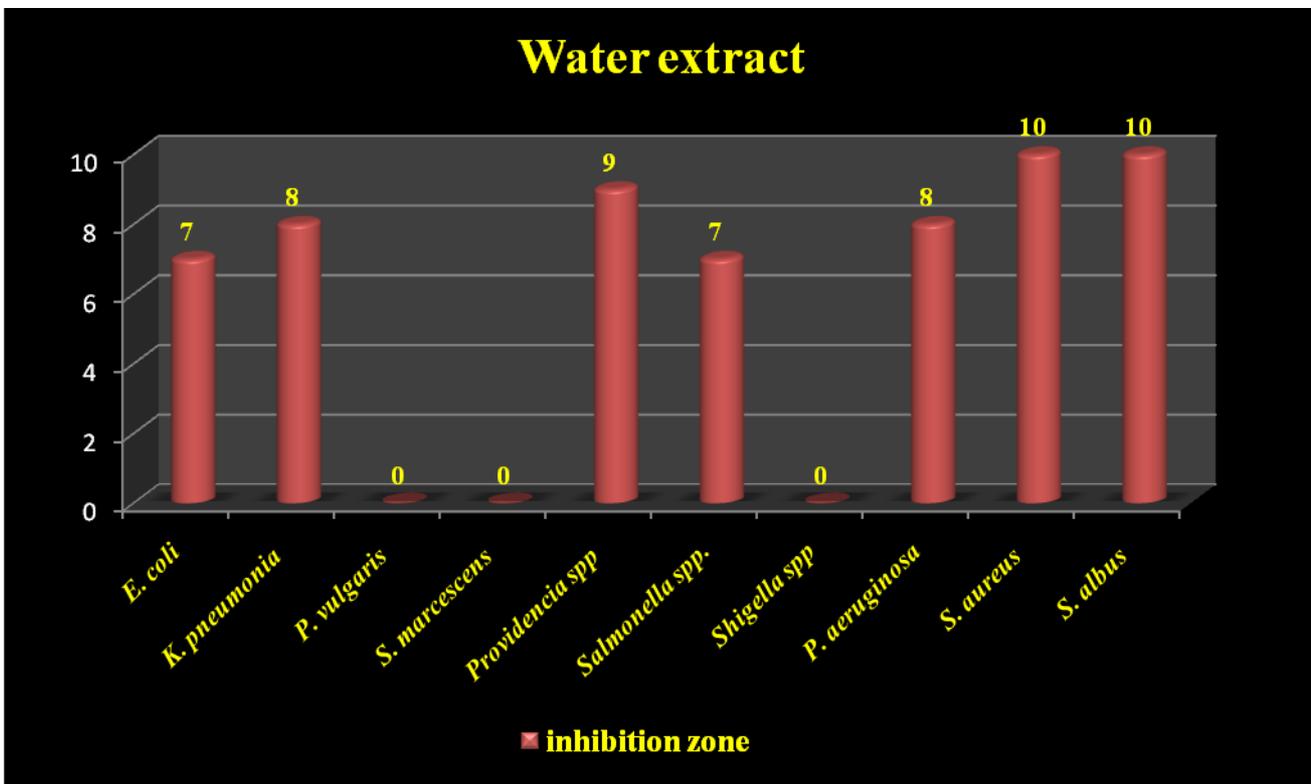
presented a higher activity as compared to gram negative. Among tested gram negative bacteria presented that, *Proteus vulgaris*, *Serratia marcescens* and *Salmonella spp* were resistance to water extract. (figure.3) our result also supported by Gopinath *et al.* (2013), they reported that water extract exhibited strong antibacterial activity against *E. coli*. On the other hand Isam and his colleagues disagree us, they reported water extracts did not demonstrate any reasonable activity against all their tested organisms.<sup>(27)</sup>



(figure.1) Antimicrobial activity of Lemongrass leaves ethanol extract against tested bacteria



(figure.2) Antimicrobial activity of Lemongrass leaves methanol extract against tested bacteria



(figure.3) Antimicrobial activity of Lemongrass leaves water extract against tested bacteria

**Conclusion**

Extracts of *Lemon grass* in this study demonstrated a broad-spectrum of activity against both gram-positive and gram-negative bacteria. Extracts showed varying degrees of antimicrobial activity on the tested bacteria. Further work is needed to carry out more pharmacological from the extracts in order to support antimicrobial activity of the *Lemon grass*. Our study demonstrated

that folk medicine can be as effective as modern medicine to combat pathogenic microorganisms.

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