# A COMPARATIVE STUDY ON THE PHYTOCHEMICALS AND ANTIMICROBIAL ACTIVITIES OF THE LEAVES AND ROOTS OF *Cymbopogon citratus*

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Abstract: The comparative study on the phytochemical constituents and antimicrobial activities of the methanol extracts of the roots and leaves of *Cymbopogoncitratus* were carried out. The phytochemical screening was carried out using a standard method and Agar well diffusion method was employed for the antibacterial and antifungal screening of the samples extracts. The phytochemical screening of the leaves of *Cymbopogoncitratus* revealed the presence of saponin, digital glycoside, tannins, flavonoids, resins, alkaloids, volatile oil and steroids while the roots revealed the presence of saponin, tannins and resin. The antibacterial sensitivity test at different concentration on the methanol leaves extracts of *Cymbopogoncitratus* indicated the extract was sensitive to *E. coli* and *staphylococcus aureus* with the highest zone of inhibition as 30 and 40 mm, respectively while the roots extracts showed sensitivity to *E. coli* and *S. aureus* at 20 and 15 mm zones of inhibition, respectively. For antifungal activities screening, the results revealed that the methanol extracts of the leaves of *Cymbopogoncitratus* have greater zone of inhibition at 25 mm in both *Penicillium* and *Aspergillus* than the methanol roots extracts of *Cymbopogoncitratus* in *Penicillium* (10 mm) and *Aspergillus* (0 mm). The results of the antimicrobial screening showed the extracts of the leaves of *Cymbopogoncitratus* to be more active than their roots. Also, the results support the use of both the leaves and roots of *Cymbopogoncitratus* in traditional phytomedicine for the treatment of diseases caused by the microorganisms.

**Keywords:** *Cymbopogoncitratus*, phytochemical constituents, antibacterial, antifungal

## Introduction

*Cymbopogon*, better known as lemongrass, is a genus of Asian, African, Australian, and tropical island plants in the grass family (Carbajal *et al*., 2009). Some species (particularly *Cymbopogoncitratus*) are commonly cultivated as culinary and medicinal herbs because of their scent, resembling that of lemons (*Citrus limon*). Common names include lemon grass, barbed wire grass, silky heads, citronella grass, *cha de Dartigalongue*, fever grass, *Tanglad*, *Hierba Luisa*, or *Gavatichahapati*, amongst many others.

Lemongrass is widely used as a culinary herb in Asian cuisines and also as medicinal herb in India. It has a subtle citrus flavor and can be dried and powdered, or used fresh. It is commonly used in teas, soups, and curries. It is also suitable for use with poultry, fish, beef, and seafood. It is often used as a tea in African countries such as Togo, south eastern GhanaVolta Region and the Democratic Republic of the Congo and Latin American countries such as Mexico. Lemongrass oil is used as a pesticide and a preservative. Research shows that lemongrass oil has antifungal properties (Rao and Jamir, 2012). Despite its ability to repel some insects, such as mosquitoes, its oil is commonly used as a "lure" to attract honey bees (Praditvarn, 2016).

Medicinal plants have been identified and used throughout human history. Chemical compounds in plants mediate their effects on the human body through processes identical to those chemical in conventional drugs. The use of herbs to treat disease is often more affordable than purchasing expensive modern pharmaceuticals. According to World Health Organization WHO estimate (WHO, 2003), 80% of the population of some Asian and African Countries make use of herbal medicine for some aspect of their primary health care (Yakubu *et al*., 2018) The need for more researches on the medicinal values of plants that are technically feasible, economically competitive, environmentally friendly and easily available are very necessary.

## Materials and Methods

### *Collection of plant materials*

The leaves and roots of *Cymbopogoncitratus* were collected from Agbani, NkanuWest Local Government Area, Enugu State. The plant was identified by DrEze in the Department of Applied Biology and Biotechnology, Enugu State University of Science and Technology.

### *Sample preparation*

*Cymbopogoncitratus* leaves and roots were chopped to smaller sizes, washed and air dried at room temperature for two weeks. The samples were pulverized separately using a Willey miley mill grinder and stored dry in an air tight container until needed for analysis.

### *Phytochemical screening*

Phytochemical screening was carried out separately on the methanol extracts of the leaves and roots of *Cymbopogoncitratus* to determine some chemical compositions of the samples using standard methods (Trease and Evans, 1983; Harbon, 1998).

### *Antimicrobial susceptibility test*

The pure cultures of clinical isolates of bacteria (*Escherichia coli* and *Staphylococcus aureus*) and fungi (*Penicillium* and *Aspergillus*) were obtained from Department of Microbiology Laboratory, Enugu State University of Science and Technology. The antibacterial and antifungal activities screening of the leaves and roots methanolic extracts were carried out by adopting Agar well diffusion methods (Adeniyi *et al*., 1996).

## Results and Discussion

The result of the phytochemical analysis of the methanol extracts of the leaves and roots of *Cymbopogoncitratus* is presented in Table 1.

The photochemical screening of the crude methanol extracts of *Cymbopogoncitratus* showed the presence of saponin, tannin, carbohydrate, protein and resin. The leave extracts of *Cymbopogoncitratus* were found to contain saponins, steroids, alkaloids, tannin, flavonoids, digital glycosides, volatile oil, carbohydrate, protein and resins. Anthracene was absent. Phytochemicals like tannins and saponins have potentially

significant applications against bacteria (El-Mahmood *et al*., 2008).The secondary metabolites have been found to posses pharmacological activities, responsible for the use of plants in traditional phytomedicine to treat diseases caused by pathogenic microorganisms. All the secondary metabolites present proved the high efficiency of the plant in herbal medicine. Different phytochemicals have been found to posses varied medicinal properties for example; saponins, terpenoids, tannins and steroids have been reported to have anti-inflammatory effects (Liu, 2003). Some glycosides and tannins have been reported to have had hypoglycemic activities (Udeozo *et al*., 2015).

**Table 1: Phytochemical screening of *Cymbopogoncitratus* leaves and roots extract**

| Class of phtochemical compounds | Plant leaves | Plant roots |
|---|---|---|
| Alkaloids | + | – |
| Flavonoids | + | – |
| Resin | + | + |
| Tannin | + | + |
| Saponin | + | + |
| Steroids | + | – |
| Digital glycosides | + | – |
| Carbohydrate | + | + |
| Protein | + | + |
| Anthracene | – | – |
| Volatile oil | + | – |

+ = Present; – = Absent

Flavonoids indicated that the plant is a good source of antioxidants which mops up free radicals in the system and helps the immune system to function properly. The concentration of tannin in the tested sample proved the authentic ability to act as an antidote to poisoning by an alkaloid and its ability to heal fresh injury. Tannin is used as parasite expeller from the body due to its antiseptic properties. Also the concentration of Saponins possess a unique property to effect hydrolysis of red-blood cells (RBC) even in high dilutions, therefore, have been used in the treatment of a number of cardiovascular disorders, facilitate and ease the process of digestion (Ashutosh, 2010).

The results of the antibacterial and antifungal susceptibility test of the extracts of *Cymbopogoncitratus* leaves and roots are given in Tables 2 and 3, respectively. The results revealed that both the leaves and roots methanol extracts have inhibitory activity on the tested bacteria (*Escherichia coli* and *Staphylococcus aureus*) at almost all concentrations based on observation of zone of inhibition. At high concentration (200 mg/ml), the leave extract depicted the highest activity against *E. coli* which produced almost the same zone of inhibition as chloramphenicol while the highest activity against *S. aureus* was observed at low concentration (50mg/ml) which showed greater antibacterial activity than chloramphenicol. For the root methanol extract, the highest zone of inhibition was observed at the same concentration (200 mg/ml) as 20 and 15 mm for *E. coli* and *S. aureus.* Based on the tested organisms results, the leave extract of *Cymbopogoncitratus* showed better antibacterial activity than the root extract. This could be due to the presence of more phytochemical constituents present in the leaves than the roots.

**Table 2: The antibacterial and antifungal susceptibility test for methanol extract of *Cymbopogoncitratus* leaves**

| Test organism | Zones of Inhibition (mm) | | | | | |
|---|---|---|---|---|---|---|
| | 200 mg/ml extract | 100 mg/ml extract | 50 mg/ml extract | 10 mg/ml chloramphenicol | 30 mg/ml nystatin | DMSO |
| *Escherichia coli* | 33.00 | 18.00 | 10.00 | 32.00 | --- | NA |
| *Staphylococcus aureus* | 10.00 | 10.00 | 50.00 | 35.00 | --- | NA |
| *Penicillium* | 15.00 | 25.00 | 25.00 | --- | 18.00 | NA |
| *Aspergillus* | 18.00 | 25.00 | 25.00 | --- | 18.00 | NA |

NA = No Activity; DMSO = Dimethyl sulfoxide

**Table 3: The antibacterial and antifungal susceptibility test for methanol extract of *Cymbopogoncitratus* roots**

| Test organism | Zones of Inhibition (mm) | | | | | |
|---|---|---|---|---|---|---|
| | 200 mg/ml extract | 100 mg/ml extract | 50 mg/ml extract | 10 mg/ml chloramphenicol | 30 mg/ml nystatin | DMSO |
| *Escherichia coli* | 20.00 | 18.00 | 15.00 | 32.00 | --- | NA |
| *Staphylococcus aureus* | 15.00 | 10.00 | 0.00 | 35.00 | --- | NA |
| *Penicillium* | 10.00 | 0.00 | 0.00 | --- | 18.00 | NA |
| *Aspergillus* | 0.00 | 0.00 | 0.00 | --- | 18.00 | NA |

NA = No Activity; DMSO = Dimethyl sulfoxide

The roots extract exhibited antifungal activity only on *Penicillium* at 200 mg/ml concentration only while the leaves extract exhibited antifungal activity on *Penicillium* and *Aspergillus* at all the tested concentrations (Table 3). As a result, the leaves extract showed more antifungal activity than the root extract especially at lower concentrations (100mg/ml and 50mg/ml). The observed zone of inhibition is greater than that of Nystatin. This could be due to the presence of tannins, saponins and steroids which have been found to possess antimicrobial activities (El-Mahmood *et al*., 2008; Liu, 2003).

**Conclusion**

The methanolic leaves and roots extracts of *Cymbopogoncitratus* can serve as a potential source of antibacterial and antifungal. The extracts can also be used in ethno medicine.

**Conflict of Interest**

Authors have declared that there is no conflict of interest reported in this work.

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