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Chemical Compositions, Phytochemical Constituents and *in vitro* Biological Activity of Various Extracts of *Cymbopogon citratus*

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Abstract: *Cymbopogon citratus* was analyzed for its chemical constituents. Proximate analysis revealed that the sample contained moisture content: 5.76%; crude protein 4.56%, ash content: 20.00%, crude fat 5.10%, Carbohydrate 55.00% and crude fibre: 9:28. The food energy of the sample was 360.55 cal/100g. The phytochemical analysis of the ethanolic extracts of *cymbopogon citratus* indicates that it has alkaloids, saponins tannins, anthraquinones, steroids, phenols and flavonoids. Test for antibacterial activity using agar diffusion technique shows that antibacterial activity was active on *S. typhi* with Minimum Inhibitory Concentration (MIC) of 50 mg/ml but inactive on *E. coli*, *L. monocytogenes* and *S. aureus*.

Key words: *Cymbopogon citratus*, phytochemicals, agar diffusion

INTRODUCTION

Cymbopogon citratus of the Poaceae family is a tall aromatic coarse grass of 1.5 m high. It is a monocotyledonous hypogeal perennial plant with slender sharp edged green leaves that has a pointed apex. The stem is reddish brown in colour and it is attached to the bulb by stalk. The entire plant is attached to the soil by fibrous root (Burkill, 1996).

Many biologically active substances have been isolated and elucidated in *cymbopogon citratus*. The most important being citral, which aids digestion as well as relieve spasms, muscle cramps, rheumatism and headache (Russo, 1992). A tea made from the leave of *cymbopogon citratus* has been used to treat fever, cold, cough and stomach upset. The tea also has diuretic properties and can help in urinating difficulties and water retention (Stehmann and Brandaw, 1995). Ramirez *et al.* (1988) have also reported that extracts of both the leaves and stalks of *cymbopogon citratus* are used as an herbal medicine to treat nervous condition and inflammation.

Cymbopogon citratus is a plant of considerable economic importance which forms the bedrock farming systems in United States of America and some part of Asia where they are cultivated for commercial purpose as industrial raw materials to cosmetic and insecticide factories. It is used as scent in many product including soap, perfume candle mosquito and other insect repellent (Praditvarn and Samhandharaksa, 1990).

Since the functions of *cymbopogon citratus* cannot be overemphasized most especially its use for the treatment of various diseases, it becomes very important to know its chemical composition and biological activity. This study therefore sought to investigate the chemical and phytochemical constituents as well as its *in vitro* biological activity against *Enterobacteriocеae*.

MATERIALS AND METHODS

Collection of plant materials: *Cymbopogon citratus* were collected fresh from University of Ado-Ekiti, Ekiti State, Nigeria while the authentication was done at the Department of Plant Science, University of Ado-Ekiti. The Bacteria used were collected from the Department of Microbiology, University of Ado-Ekiti.

Preparation of extracts from plant material: 300 g of powdered leaves of *Cymbopogon citratus* were soaked in 500 ml of 95% ethanol and water for four days respectively. The extracts were filtered and the filtrates were concentrated by rotary evaporation to form ethanolic and water (aqueous) extract respectively.

Chemical analysis of extracts

Proximate analysis: Proximate analysis of the samples were performed according to AOAC (1990) procedures for ash, crude fibre, fat, moisture and protein using nitrogen to protein conversion factor of 6.25. Carbohydrate was determined by difference.

Mineral analysis: The mineral analysis were carried out using Atomic Absorption Spectrophotometer (AAS).

Phytochemical analysis: The phytochemical constituents of the leaves of *Cymbopogon citratus* were determined using the methods of Sofowora *et al.* (1982).

Antimicrobial activity: Antimicrobial activity of the extract of *Cymbopogon citratus* on *Escherichia coli*, *Stahylococcus aureus*, *Salmonella typhi* and *Listeria monocytogenes* were determined by agar diffusion bioassay as describe by Sadha (1992).

RESULTS AND DISCUSSION

The results of the proximate and mineral compositions (Table 1) of *Cymbopogon citratus* are shown in Table 1. The results showed the average ash content of *Cymbopogon citratus* to be 20.30% which is reasonably high. This is an indication that *Cymbopogon citratus*

Table 1: Proximate (%dry matter) and mineral (ppm) compositions of *Cymbopogon citratus*

Moisture content	Crude Protein	Total ash	Energy value (cal/100g)	Crude fibre	Fat	Carbohydrate	Na	K	Ca
5.76	4.56	20.30	5.10	55.00	360.55	9.28	323	298	242

Fe	Cu	Zn	Pb	Mg	Mn	Co	P	Se	Cd	As
43	ND	16	ND	226	25	ND	1245	2.00	ND	ND

Table 2: Phytochemical composition and physical properties of ethanolic and aqueous extract of *Cymbopogon citratus*

Phytochemical composition		Physicochemical properties: Ethanolic extracts				Aqueous extract			
Phytochemicals	Concentration	Colour	Taste	Odour	Texture	Colour	Taste	Odour	Texture
Alkaloids	0.520	Dark green	Bitter	Lemon like	Crystalline	Dark brown	Bitter	Lemon smell	Crystalline
Saponins	0.645								
Tannins	0.600								
Anthraquinones	0.005								
(cadenolides)	ND								
Phlobatannins	ND								
Steroids	0.058								
Cyanate	ND								
Phenols	0.400								
Flavonoids	0.532								

Table 3: Antimicrobial activities of ethanolic and aqueous extracts of *Cymbopogon citratus*

Ethanolic Extract				Aquoeous Extract			
Conc. Mg/ml	*E. coli S. aureus*	*S. typhi*	*L. monocytogenis*	*E. coli*	*S. aureus*	*S. typhi*	*L. monocytogenis*
20	-	15.0	-	-	-	-	-
30	-	17.0	-	-	-	-	-
40	-	25.0	-	-	-	-	-
50	-	30.0	-	-	-	-	-

contains reasonable amount of inorganic nutrients. The low moisture content (5.7%) of *cymbopogon citratus* is desirable, as it will prevent microbial attacks and allows for high storage capacity. The carbohydrate content is high (55.00%). This shows that *cymbopogon citratus* is a very good source of energy. The protein content is (4.56%) low, which compare favourably with those obtained by Asaolu (2003) for *Garcinial kola*. The crude fibre content (9.28%) of *cymbopogon citratus* on the other hand is higher than that reported for other leaves (Tindall, 1986). This makes *Cymbopogon citratus* to be a good source of crude fibre than other conventional leaves. The food energy of the sample (360.55 cal/100 g) is moderate compared with those of other plants (Tindall, 1986).

The results of mineral analysis showed that phosphorus is the highest followed by sodium potassium, magnesium and calcium, Iron, Manganese and Zinc in descending order. These values are comparable to values reported for *Gacinial kola* (Asaolu, 2003). The absence of some heavy metals in *cymbopogon citratus* makes it desirable for consumption.

The results of phytochemical composition of the ethanolic extract of *Cymbopogon citratus* (Table 2) shows that it contains alkaloids, saponins, tannins, anthraquinones, steroids, phenols and flavonoids. Each or these phytochemicals is known for various protective and therapeutic effects. For instance, phenol was known to be an erythrocyte membrane modifier (Adesanya and Sofowora, 1983).

The results of antibacterial activity of the extracts against *E.coli L.monocytogenes*, *S. typhi* and *S. aureus* showed the ethanolic extract to inhibit only the growth of *S. typhi* at 50mg/ml of the extracts while the growth of *E. coli, L. Monocytogenes* and *S. aureus* were not inhibited (Table 3). The aqueous extract of *Cymbopogon citratus* has no inhibitory effect on the growth of tested bacterial. This non-inhibitory effects produced by the aqueous extract suggest that the active constituents that gave antiabacterial activity could not be extracted by distilled water. The mechanism of action of the ethanolic extract seems to be dose-dependent, similar result has been reported by Oboh (2001).

From the present study, it could be seen that ethanolic extract of *Cymbopogon citratus* exhibits antibacterial activity against *S. typhi* while the growth of this microbe (*S.typhi*) was affected by the extract. *Cymbopogon citratus* is a good source of carbohydrate, crude fibre, and nutritive elements.

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