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GC/MS Characterization of *Cymbopogon* essential oils, Sudan

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Abstract: *Cymbopogon and it's essential oil have medicinal, pharmaceutical, industrial, and cosmetic applications. In Sudan aqueous extracts of Cymbopogon leaves and spikes are traditionally used for nutritional and medicinal purposes. This study was conducted to investigate the yield percentage and chemical composition of Cymbopogon volatile oil. Samples of Cymbopogon Leaves and spikes were obtained from Northern Darfur and Gedaref states. Steam distillation was used for extracting cymbopogon leaves and spike oil. GC/MS spectroscopy was used for the analysis of the two extracted oil samples. The oil yield was (1.5%) for spikes and (1.67%) for the leaves.Forty eight components were identified in the spikes oil, dominated by Piperitone (35.96%), Elemol (20.45%), (+) - 2- Carene (8.18%), Guaiol (6.04%), β-eudesmol (5.97%), γ-eudesmol (4.28 %), Bulnesol (3.14%), Limonene (1.44%) and α-Eudesmol (1.37%). Leaves oil showed a presence of sixteen constituents, dominated by Piperitone (84.13%), (+)-2-carene (5.75%), d–Limonene (2.67%) and α– terpineol (2.21 %). The chemical composition of the two oil samples may encourage the traditional use of Sudanese Marhabaib (Cymbopogon schoenanthus), for medicinal and nutritional, cosmetic, and flavoring purposes.*

Keywords: *C. schoenanthus*, Steam distillation, Marhabaib, Medicinal herb, GC/MS.

1. Introduction

Marhabaib (Cymbopogon) is one of the famous aromatic plants that find a wide traditional use by Sudanese for nutritional, medicinal and cosmetic purposes. The plant grows wildly in many areas of the country during the rainy season (Figs. 1 and 2).

Cymbopogon have different common names. Arabic names are, Ethkher, Tibn Makkah, Hashishat El Gamal, Halfa Bar, Sinbel Al-Arab, Askhabar, Abo Rekba. In English it is known as, Camel grass, Camel hay, Geranium grass, Camel hay grass, Lemon-scented grass, Sweet cane, Sweet rush, Spikenard oil. In French it is, Herbe des chameaux, Herbe à Chameau Citronnelle de Madagascar and in Hindi: Aghin ghās, Agiyā ghās, Atigandha, Bujina, Buraro, Gandhel, Gandh-bel Mirchiagand, Palakhari, Rohisha, Rousaghas, Rusaghas, Saundhiya, Sugani, Portuguese: Capim-cheiroso (Brazil), Capim-cidreira (Brazil), Capim-cidrilho, Capim-ciri, Capim-de-cheiro, Capim-limão; Spanish: Pasto de camellos; Swedish: Kamelgräs (Ali Esmail Al–Snafi, (2016), USDA, ARS, 2015). In Sudan it is known as Marhabaib and Maharaib (Gibla et al., 2022). In Nigeria known as (tsabre) grass (Amina R. M. et al., 2013).

(a) (b)

Figure 1: Cymbopogon schoenanthus, (a), spikes, (b), plant in the field.

The plants of the genus *Cymbopogon* (Lemongrass) contain various phyto-constituents such as, flavonoids, phenolic compounds, terpenoids and essential oils, which may be responsible from the several biological activities (Shah et al; 2011). *Cymbopogon schoenanthus* was reported to contain, tannins, saponins, saponin, glycosides, flavonoids, alkaloids, triterpens, balsams, cardiac glycosides, glycosides, steroids and volatile oils (Mohammad Ali et al., 2012, Amina RM., 2013). The oil of the two species has pale to vivid yellow color, with strong herbaceous earthy smell, and lemony flavor aroma which, makes it refreshing and lively (Flipoy et al, 1994). *Cymbopogon* oil plays an effective role against bacteria, flu, colds and it contains stimulating agents, tonics , diuretics, antispasmodisc, relaxing, soothing and balancing (Cavalcanti et al, 2004, Blanco et al, 2007). *Cymbopogon* essential oil was reported to be effective against different agricultural insect pests (Lambrano et al; 2015, Wang et al; 2016), and has no adverse effects on blood, liver function, kidney function, protein, carbohydrates and lipid metabolism on rats (Leung and Foster, 1996).

Fig 2: Naturally growing *C.schoenanthus at Northern Darfur (Al-Kuma area)*

G. M. Hashim et al, (2016), reported that, C. schoenanthus has an antibacterial effect against S. aureus, MSA, S.saprophyticus, E. coli and K. pneu-moniae, as indicated by minimum inhibitory concentrations. Onawunmia et al, (1984) reported that, lemongrass essential oil, was active on *Bacillus subtilis, Escherichia coli, Staphylococus aureus, Salmonella paratyphi* and *Shigella flexneri*. In addition to that, α-citral and β-citral components showed antibacterial action on gram-negative and gram-positive organisms. Lemongrass oil is active against, *Trichophyton mentagrophytes, T. rubrum, Epidermophyton floccosum and Microsporum gypseum*, keratinophilic fungi, 30 ringworm fungi, food storage fungi, and is among the most active agents against human dermatophytes (Kishore N et al., 1993, Abe S Sato et al., 2003, Misrha A. K et al., 1994, Shah G, 2011). Wannissorn, (2005), reported herbicide insecticide and antimicrobial effects for lemongrass oil. The topical application of C. citratus showed high toxicity against *Sitophilus oryazae* (Franz A. R. et al, 2011). C. citratus essential oil and citral have been reported to be potential anti-*leishmania* agents (Machado M, 2012). C. schoenanthus aerial parts, solution in hot water was considered to be helpful in the treatment of gout, prostate inflammation, kidney disorders, stomach pain, fever and rheumatism (El Ghazali GEB et al, 1997, Khadri A. et al., 2008, Eltahir A. S. et al., 2010, Ali Esmail Alsanafi; 2016, Ivan pavlovic et al., 2017). *C. citratus* and *C. schoenanthus* were described as valuable sources of bioactive compounds for protecting population against malaria (Bossou et al., (2013).

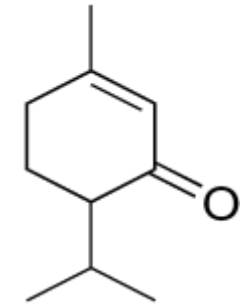
Saleem et al., (2003), and Viturro et al., (1998) reported the major components of Lemongrass as, α- Citral (40.8%), β-citral (32%), Nerol (4.18%), Geraniol (3.04%), Citronellal (2.10%), Terpinolene (1.23%), Geranyl acetate (0.83%). Shah et al; (2011) reported chemical constituents of *C. citratus* essential oil to include, terpenes, alcohols, ketones, aldehyde and esters, dominated by, geranial (45.1-54.5%), neral (30.1-36.1%), geranyl acetate (0.1-4.0%), geraniol (0.2-3.8%), (d)-limonene (0.1-3.8%), caryophyllene oxide (0-1.6%), 6-methyl-5-hepten-2-one (0.3-1.4%) and linalool (0.4-1%). According to Ketoh G., (2006), *C. schoenanthus* essential oil consist of eleven compounds which were, piperitone (61.01 %), carene-2 (32.57%), cis-pinene hydrate (1.1%), elemol (1.07%), terpineol (1.04%), caryophyllene (1.04%), trans-pinene hydrate (0.6 %), α-eudesmol (0.48 %), caryophyllene oxide (0.46 %), and β-eudesmol (0.43%) and limonene (0.2%). In a study carried by Eihab et al; (2016), the essential oil of inflorescence *C. schoenanthus* cultivated in Sudan, the identified compounds represent 98.8% of the total, characterized by high content of oxygenated monoterpenes (50.8-75.5%), where the major constituents were piperitone (47.7- 71.5%), intermedeol (6.1- 17.3%), *δ*-2-carene (4.5-10.0%) and elemol (5.2- 9%). The essential oil of *Cymbopogon schoenanthus* of Burkina Faso contain monoterpenes as (53.2 %) and sesquiterpenes as (12 %), where the principal identified monoterpenes were, piperitone (42.0%) and *δ*-2-carene (8.2%), (Andrade, 2009).

Methodology

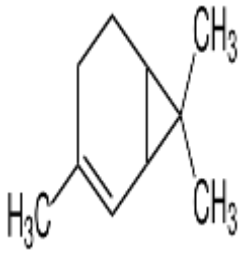
Cymbopogon schenanthus spikes samples were harvested from Northern Darfur and *Cymbopogon citratus* leaves were obtained from Al-Gedaref state. The essential oil was extracted by steam distillation. The oil yield was determined for the spikes and leaves. Each oil sample was analyzed by GC-MS.

Results and Discussion

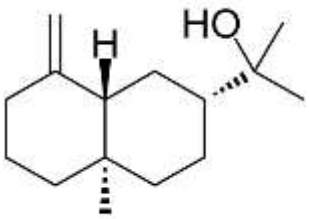
The oil yield of *C. schoenanthus* spikes was (1.5%) and *C.citratus* leaves was (1.67%). Eihab O. et al., (2016), reported spikes oil yield as (1.9%) and Shah et al., (2011), reported *Cynbopogon citratus* Leaves oil yield as (0.2-0.5%). Bossou A. D et al., (2013), reported oil yields of C. citratus and C. schoenanthus plant material as (1.7%) and (2.6%) respectively. Ivan Pavlovic, (2017) reported oil yield of C. schoenanthus aerial part samples in the seasons, 2013 and 2015 as (1.9%) and (2%) respectively. The variations in yield percentage may be attributed to climatic conditions, soil characteristics, topographical location, and methods of cultivation and/or harvesting period. The GC-MS characterization of spikes oil showed a presence of forty eight components, dominated by, Piperitone (35.96%), Elemol (20.45%), (+)-2–carene (8.18%), guaiol (6.04 %) , β-eudesmol (5.97%), γ-eudesmol (4.28 %), Bulnesol (3.14%), Limonene (1.44%), 2,4 diisopropenyl-1-methyl-1-vinyl (1.41%), α-Eudesmol (1.37%), and α-Terpineol (0.94%), (Fig.1). High Piperitone content of *C. schoenanthus* spikes oil was reported by Eihab et al., (2016) and Yantema et al; (2007) as (47.7%) and (42.0%) respectively. Relatively low Piperitone content (14.6%), was reported by Hashim et al., (2016). This study showed high Elemol content (20.45%) when compared with some other studies (Eihab et al., 2016, Yantema et al; 2007 and Hashim et al., 2016). The spikes oil content of 2- Carene in this study was almost similar to that, shown by Yantema et al; (2007) and Eihab et al., (2016). β- Eudesmol and α-Eudesmol in C. *schoenanthus* spikes oil were low than that of Saudi Arabia (Hashim et al., 2016). Guaiol (6.04%) and Bulnesol (3.14%), in the spikes oil, showed trace levels or not detected in some previous studies. Limonene content (1.44%) was almost similar to that reported by Yantema et al; (2007). Bossou et al, (2013) reported, the major constituents of C. schoenanthus as, piperitone (58.9%) and α-2-carene (15.5%), which agree with, Ketoh et al., findings (2004, 2005 and 2006).



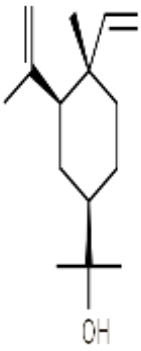
Piperitone



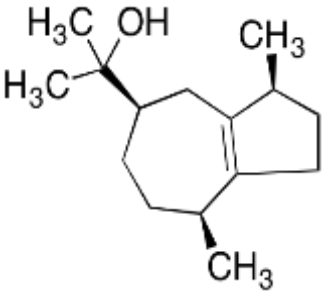
(+) – 2- Carene



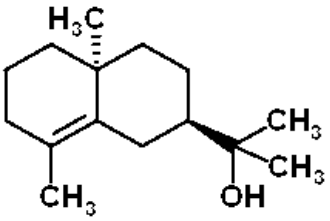
β-Eudesmol



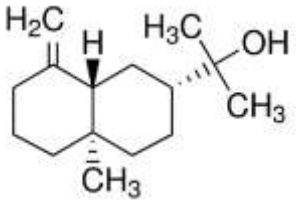
Elemol



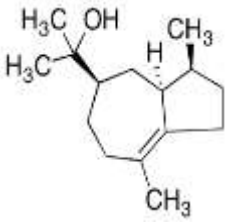
Guaiol



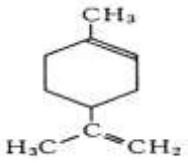
γ-Eudesmol



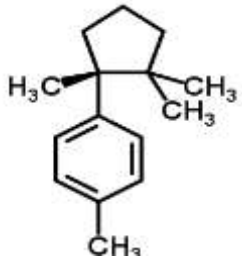
β-Eudesmol



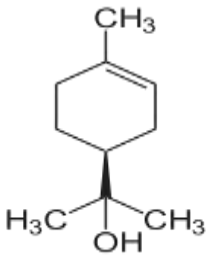
Bulnesol



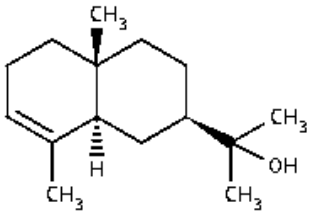
Limonine



Cuparene



Terpineol



α-Eudesmol

Figure 3: Structures of the major constituents of Marhabaib oil samples

Ivan Pavlovic et al, (2017) suggested that, the high essential oil content of *C. schoenanthus* makes the wildly growing plant of Sudan a valuable source of piperitone as commercially important monoterpine.

The *C. citratus* leaves oil showed a presence of sixteen (16) constituents, dominated by Piperitone (84.13%), (+)-2-carene (5.75%), terpineol (2.67%), d–Limonene (2.21 %) α–Eudesmol (0.76%) and α–Eudesm-7(11)-en-4-ol (0.68%). Bossou et al., (2013), reported different major components of *C. citratus* plant essential oil where, geranial was (44.3%), Neral (33.1%) and Myrecene (12.4%). These constituents either showed very low availability or not detected in some studies carried in Brazil (Andrade et al., 2009), India (Shah et al., 2011) and Portugal (Gago et al., 2020). The significant variations may reflect mainly, the environmental differences between the four countries.

Conclusion

The spikes and leaves essential oils of Sudan *Cymbopogon* species (Marhabaib), were rich with Pipretone, (+)-2-Carene, Limonene, α– Eudesmol and (+)-Cuperene. Marhabaib may be valuable source for piperitone and many other terpenes. From nutritional value sight of view, *Cymbopogon* (Marhabaib) spikes and leaves may be safe for human consumption, hot drink, medicinal herb, or food additive to enhance taste and flavor.

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