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ORIGINAL ARTICLE

Biological activity of *Cymbopogon schoenanthus* essential oil

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KEYWORDS

Cymbopogon schoenanthus;
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Abstract *Introduction:* A number of plant species, including *Cymbopogon schoenanthus*, are traditionally used for the treatment of various diseases. *C. schoenanthus* is currently, traded in the Saudi markets, and thought to have medicinal value. This study aimed at investigating the biological activities of *C. schoenanthus* against both Gram-positive and Gram-negative bacteria and to identify its chemical ingredients.

Materials and methods: The inhibitory effects of water extracts of *C. schoenanthus* essential oils were evaluated against ten isolates of both Gram-positive and Gram-negative bacteria using the agar well diffusion and dilution methods. The minimum inhibitory concentration (MIC) was assayed using the Broth microdilution test on five of the ten isolates. The death rates were determined by the time kill assay, done according to the Clinical Laboratory Standards Institute (CLSI) guidelines. The chemical composition of the essential oils of the plant was performed using GC/MS.

Results: The *C. schoenanthus* essential oil was effective against *Escherichia coli*, *Staphylococcus aureus*, methicillin-sensitive (MSSA) *S. aureus* (MRSA) and *Klebsiella pneumoniae*. The essential oil was not effective against *Staphylococcus saprophyticus* at the highest concentration applied of > 150 µg/ml. The MIC values were as follows: 9.37 µg/ml for *E. coli* 4.69 µg/ml for *S. aureus* (MRSA), 2.34 mg/ml for MSSA and 2.34 µg/ml for *K. pneumoniae*. The time-kill assay indicated that there was a sharp time dependent decline in *K. pneumoniae* counts in the presence of the oil. This is in contrast to a gradual decline in the case of *S. aureus* under the same conditions. The eight

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major components of the essential oil were: piperitone (14.6%), cyclohexanemethanol (11.6%), β-elemene (11.6%), α-eudesmol (11.5%), elemol (10.8%), β-eudesmol (8.5%), 2-naphthalenemethanol (7.1%) and γ-eudesmol (4.2%).

Conclusion: The results of the present study provide a scientific validation for the traditional use of *C. schoenanthus* as an antibacterial agent. Future work is needed to investigate and explore its application in the environmental and medical fields. In addition, to evaluating the efficacy of the individual ingredients separately to better understand the underlying mechanism.

1. Introduction

Medicinal plants have been widely used in traditional medicine for several centuries for the treatment of many health-related ailments. According to the World Health Organization (WHO), the majority of the world's population depends on traditional medicine for primary healthcare. There has been an increasing interest in medicinal plants and their active ingredients because of their potency and negligible adverse side effects. In Saudi Arabia, medicinal plants account for more than over 50% of all plants spices (1200 out of 2250) (Mossa et al., 1987). Despite the indigenous knowledge of the healing ability of certain plants in Saudi Arabia, few plant extracts and essential oils have been assessed *in vitro* or *in vivo* for their therapeutic potentials (Al Yahya et al., 1983). Recent published data on medicinal plants worldwide revealed that some exhibited: antioxidant (Narendran et al., 2016; Noorudheen and Chandrasekharan, 2016; Puthur, 2016; Santhosh et al., 2016), anti-diabetic and attenuation of insulin resistance (Kannan and Agastian, 2015; Balamurugan, 2015), anti-diarrheal activities (Antonisamy et al., 2015), cardio and hepatic protective ability (Nandhini and Bai, 2015; Rathi et al., 2015).

One important medicinal plant, *Cymbopogon schoenanthus*, locally known as Sakhbar, Izkhir or Athkhar traditionally named as camel grass, is a desert species that grows in dry stony places (Al-Ghamdi et al., 2007; Farooqi, 1998). It was mentioned in Alhadith for its potential applications (Marwat et al., 2009). Its oil has a strong aromatic odor and has great medicinal value. The plant is well known traditionally and is widely used as: antispasmodic, a protection against fever, anti-intestinal ailment problems, anti-malarial, and anti-helminthic (especially against Guinea worms) (Yentéma et al., 2007; Marwat et al., 2009). It is an effective renal antispasmodic and diuretic agent (El-Askary et al., 2003; Elhardallou, 2011; Sabry et al., 2014), and it was shown to possess sedative, digestive and anti-parasitic properties (Sousa et al., 2005). Norbert et al. (2014) demonstrated that it is an antifungal and anti-inflammatory agent used for the prevention and treatment of acute inflammatory skin conditions. The vapor phase is more effective as an antifungal agent as compared to the liquid phase and may be used for the decontamination of air in hospitals. It has also been used as an anti-abortive, anti-convulsive or laxative agent, aroma and anti-rheumatic, asthmatic, and antipyretic agent (Ketoh et al., 2006). Furthermore, *C. schoenanthus* is used in the treatment of colds, epilepsy, abdominal cramps and pains, as well as in culinary and perfume products (Takaisi-Kikuni et al., 2000). In Saudi traditional medicine, it is mainly used as a diuretic to inhibit kidney stone formation and as an anti-infectious agent in urinary tract infections (Al-Ghamdi et al., 2007).

The aim of this study is to evaluate the antimicrobial activity of the essential oil of *C. schoenanthus* against susceptible and resistant pathogenic bacteria in order to validate some of its traditionally claimed therapeutic properties.

2. Materials and methods

2.1. Plant collection and extraction

C. schoenanthus was collected from Asfan area, north-east of Jeddah, Saudi Arabia. The plants were washed, dried in the shade, crushed into small pieces, then were subjected to distillation using conventional methods. Water was added to completely cover clean dried crushed plants that had been compressed into a boiling chamber. The mixture was then allowed to simmer and gently brought to boil. Ice cold water was continuously circulated to the condenser to facilitate the condensation process of the generated steam. The process lasted for 48 h. The concentration of the stock solution was determined by dividing the weight of the plant parts used over the volume of the resulting distill. Stock solutions were suspended in Tween 80 to preserve the activity of the oil, divided into small aliquots and stored at −80 °C till the day of the experiment. One aliquot was thawed on ice and used on the day of the experiment and was discarded soon after the completion of the experiment. Tween 80 was added to the control at the same concentration as that in the stock containing the extract to rule out the effect of Tween 80 (Lahlou, 2004).

2.2. Antimicrobial susceptibility testing

The antimicrobial activity of *C. schoenanthus* essential oil was evaluated using three tests: (i) Agar well-diffusion test, (ii) Broth microdilution test, and (iii) time-kill assay test.

2.2.1. Agar well-diffusion test

2.2.1.1. Preparing the agar plates. Mueller–Hinton agar was used (Oxoid Limited Wade Road Basingstoke Hants, England), and prepared according to the manufacturer's instructions. Post autoclaving, the agar was allowed to cool down (45–50 °C) in a water bath. Then, the agar was dispensed into Petri dishes, stored in the refrigerator and used within five days.

2.2.1.2. Bacterial cultures. Ten bacterial pathogens were used and purchased from the American Type Culture Collection, ATCC, Virginia, USA. The pathogens included