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Short Communication

Chemical composition of volatile constituents from the leaves of *Aloe ferox*

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Volatile compounds oils play a significant role in perfumery, cosmetic, medicinal and pharmaceutical industries. In our protracted research for new useful essential oils, a volatile oil from *Aloe ferox w*as obtained by prolonged hydrodistillation. This volatile oil was subjected to GC/MS analysis to identify the major constituents of the oil. The major constituents identified were as follows: 3, 6 octatriene (23.86%), 3-cyclohexane-1-hetanol (7.31%), Bornylene (5.24%), 1, 3-cyclopentadiene (4.07) and 5-methyl-3-heptanol (3.92%). A significant number of other volatiles were also identified but in minor concentrations.

Key words: *Aloe ferox*, gas chromatography, mass spectroscopy, volatile compounds.

INTRODUCTION

Aloe species are widely distributed in the African and the Eastern European continents, and are spread almost throughout the world (Tenney, 2000; Blumenthal et al., 1998; van Wyk and Smith, 2003). Most research has been centralized on the biological activities of the Aloes, which included antibacterial and antimicrobial activities of the non-volatile constituents of the leaf gel (Coopoosamy and Magwa, 2006).

The majority of volatile oils used in Africa are imported and yet Africa is endowed with many aromatic plants. However, there is no study, to the best of our knowledge, which deals with the composition of volatile compounds which occurs in the *Aloe ferox*. In view of the wide distribution of Aloe species throughout the Southern Sahara region and their great application by both pharmaceutical companies and indigenous people of the African continent, a chemical composition of *A. ferox* volatile compounds and their possible significance is reported in this paper.

MATERIALS AND METHODS

Plant material

The plant material was collected in Alice district of Nkonkobe Municipality in the Eastern Cape Province with the authorization of the Eastern Cape Government of South Africa and in agreement with the United Nation Convention on Biodiversity. The plant was identified by Botanists at the University of Fort Hare Herbarium in Alice, South Africa. Three voucher specimens were deposited at the University of Fort Hare Herbarium in Alice, South Africa.

Essential oil extraction

Five litres of pure juice was extracted by cutting the leaves of *Aloe ferox* to obtain the crude extract. Two litres of the juice were subjected to hydrodistillation for approximately 3 h using a Clavenger-type apparatus. The essential oil yield obtained was 0.18% (v/w). It was dried over anhydrous sodium sulphate. After filtration, it was stored at approximately 4°C until tested and chemically analyzed. The essential oil was subjected to GC/MS analysis to identify the phytoconstituents.

Gas chromatograghy and mass spectroscopy analysis

The wet needle method was used to analyze the essential oil by means of a Hewlett Packard 6890 Gas Chromatograph. The temperature of the injection port was set at 220°C while the pressure at the inlet was maintained at 3.96 psi. The HP-5MS (cross linked 5% phenyl methyl siloxane) column (30 m x 0.25 mm x 0.25 µm film thickness) was temperature programmed from 60 to 150°C at 3°C per min after a 3.5-min delay. Helium was also used as a carrier gas at 0.7 ml/min. Mass spectra was recorded by a HP 5937 series Mass Selective Detector (MSD).

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Table 1. Major phytoconstituents of volatile compounds from *Aloe ferox*.

Compound	Composition (%)
2-Heptanol	7.31
Cyclopentanecarboxylic acid, ethenyl ester	1.33
1-Hexanol, 3-methyl	2.59
2-Hexene, 3, 5-dimethyl-(2, 4-dimethyl-4-hexane	1.33
2-Heptanol, 5-methyl (5-methyl-2-heptanol)	3.92
7-Methyocta-1, 3 (Z) 5 (E)-triene	1.28
1, 3, 6-Octatriene (CAS)	23.87
5-Isoprenyl-2-2methyl-2vinyltetrahydrofuran (herboxide)	1.16
δ, 3-Carene	3.44
1, 3-Cyclopentadiene, 5 (1-methyl propylidene)	4.07
1, 4-Cyclohexadiene, 1-methyl (2, 5-dihydrotoluene)	3.70
2, 4-Decadien-1-ol, (E, E)	7.45
Benzene, 1-methyl-2-(2-propenyl)-	3.78
E-3-hexenyl butanoate	1.06
3-Cyclohexene-1-acetaldehyde, α 4-dimethyl (CAS)	9.51
Syn-2-hydroxy-6-methylene-dicyclo [2, 2, 2] octane	2.28
Bornylene	5.24
Vitispirane	1.16
Theaspirane A	3.23
Theaspirane A *	2.39
2-Tridecanone (CAS)	2.52

RESULTS AND DISCUSSION

Historical records have found evidence of Aloe use for several diseases by many people including Egyptians, Greeks, Romans, Hebrews, Chinese Indians, Algerians Moroccans, Tunisians and Arabians, as well as the other indigenous communities in Africa for several centuries (Tenney, 2000; Blumenthal, et al., 1998; van Wyk and Smith, 2003). Egyptians, Assyrians, and Mediterranean people used the dried latex for several purposes more than the gel. In the first century C. E., the Greek physian, Dioscorides used aloe for mouth infec-tions, sores, wounds and as a purgative. In the 10th century, aloe found its application in England and during the 17th century, records showed that the East India Company purchased Aloe from the King of Socotra. In India, the whole leaves, exudates, and fresh gel aloe are used as a cathartic, stomachic, emmenagogue and anthelmintic. In China, Mexico and West Indies, the use of Aloe has been documented as a common household remedy for a variety of applications.

Modern research has shown that these products are able to restore skin tissue due to their moisturizing effect as well as to relieve pains associated with burns and wounds. The aloe juices have been use in herbal and western therapies to treat stomach disorders such as ulcers, colitis, constipation and other colon related problems. The parenchymatous pith contains, in turn, very helpful enzymes, saponins, hormones and amino acids which can be absorbed into the human skin. One of the constituents of the Aloe pith is acemannan, a complex carbohydrate, with immune stimulating and antiviral properties. Certain lecithins which, are found in the Aloe pith, are assumed to help in the stimulation of immunue response by increasing the production of lymphocytes that are known to kill bacteria and some tumor cells. These aloe product, in addition, have uronic acids that are natural detoxicants and take part in the healing process by stripping toxic materials of their harmful effects.

Aloe ferox commonly known as Cape aloe is widely distributed along the eastern parts of South Africa (van Wyk and Smith, 1996). The morphology of this species is characterized by persistent dry leaves on the lower portion of the single stem. The broad, fleshy leaves are dull green in summer or reddish-green in winter, with dark brown spines along the edges. They constitute a rather compact rosette arrangement around a stout stem (Palgrave, 1981) and aloe is well-known and famous for its medicinal qualities. The bitter yellow juices which exudes from the leaves which results to a dark brown resinous solid known as aloe lump or Cape aloe is used by the traditional indigenous people and pharmaceutical companies in many remedies. The aloe gel together with the aloe juice constitute the palisade mesophyll tissue has been researched for its biological activities (Coopoosamy and Magwa, 2006). The modern research has shown that the *A. ferox* contains a chromone type natural ingredient, aloeresin, which is able to inhibit tyrosine at the cellular level without deterring cell viability. It is also shown to be a superior potent anti-oxidant with the Oxygen Radical Absorbance Capacity of 33 and 299 higher than green tea and grape seed extracts, respectively. It is also well documented that aloeresin promotes not only anti-aging by restoring the immune function in UV-damaged cells but also light sensitivity and naturally darker skin pigmentation without harmful chemicals or side effects (Jones et al., 2002).

Many of the twenty one volatile compounds identified in this study are known to be in-cooperated in many herbal medical remedies currently marketed throughout the world. Twenty one compounds, representing more that 99.99% of the essential oil were identified as indicated in Table 1. 1, 3, 6-octatriene (23.87%), 3-cyclohexene-1-acetaldehyde, α-4-dimethyl (9.51%), 2, 4-decadien-1-ol, (E, E) (7.45%) and 2-heptanol (7.31%) were the most abundant components of the volatile compounds. The other chemical components were 1,3-cyclopentadiene, 1-

methyl propylidene (4.07%), 2-heptanol, 5-methyl (5-methyl-2-heptanol) (3.92%), benzene, 1-methyl-2-(2-propenyl)- (3.78%), 1,4-cyclohexadiene, 1-methyl (2,5-dihydrotoluene) (3.70%), δ,3-carene (3.44%) and theaspirane A (3.23%).

The following chemical components occurred in small amounts: α-terpinene (4.84%), α-terpinolene (4.00%), camphene (3.27%), (-)-bornylacetate (2.43%), tridecane (1.95%) and α-humulene (1.74%). It is important to note that the monoterpene fraction was present in relatively high amounts (> 85.57%). They were composed of the following hydrocarbons: O-cymene, 2-β-pinene, α-pinene, 1,8-cineole, limonene, α-terpinene, α-terpinolene and camphene.

The aloes have been extensively researched owing to its vast medicinal values. Research has indicated that the biological activity of this genus is of utmost importance. This attempt in providing the phytochemical composition of the non volatile compounds adds to the ever increasing knowledge and contributes to the medicinal understanding of the genera.

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