International Scholars Journals

African Journal of Food Science Research ISSN 2375-0723 Vol. 9 (5), pp. 001-004, May, 2021. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Volatile constituents of essential oils isolated from different parts of *Alpinia calcarata* Rosc

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Accepted 15 September, 2020

The essential oils isolated from different parts of *Alpinia calcarata* Rosc. growing in Chittagong, Bangladesh, were analyzed by gas chromatography-mass spectrometry (GC-MS). The leaf oil contained 1,8-cineole (28.48%) and camphor (21.40%) as the major constituents. The stem sheath oil had fenchyl acetate (19.16%) and carotol (16.77%) as the major compounds. On the other hand, the root oil showed fenchyl acetate (51.34%) and borneol (11.44%) as the main constituents.

Key words: *Alpinia calcarata*, essential oil composition, 1,8-cineole, fenchyl acetate.

INTRODUCTION

Alpinia calcarata Rosc. (family: Zingiberaceae) is an important medicinal plant among the seven species of *Alpinia* that occur in Bangladesh, India, Myanmar, Indonesia, Thailand, New Guinea and the Bismark Archipelago (Chopra et al., 1986; Mangaly and Sabu, 1992). It is a perennial herb with non-tuberous pungent rootstock. Its rhizomes showed antinociceptive activities (Arambewela et al., 2004). The economically important part is rhizome, which is a major constituent of many formulations of indigenous system of medicine for relieving throat inflammation, stimulating digestion, purifying blood, improving voice and marinating youthful vigour. The rhizome extract of *A. calcarata* is used as an expectorant in the treatment of bronchitis and asthma for purifying blood, stimulating digestion and improving voice (Kirtikar and Basu, 1935). Drugs prepared from the rhizomes of *A. calcarata* are used in treatment of rheumatism, bronchial catarrh and asthma.

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Abbreviations: GC-MS, Gas chromatography-mass spectrometry; **NIST,** Institute of Standards and Technology; **BCSIR,** Bangladesh Council of Scientific and Industrial Research.

It is also used to stimulate digestion, purify the blood, prevent bad breath, and improve the voice and also to treat inflammation (Jayaweera, 1982; Sharma and Singh, 1980). In Sri Lanka, *A. calcarata* is commonly prescribed by Ayurvedic physicians along with other plant materials in the treatment of arthritis. In addition, anti-inflammatory activity has also been reported (Sharma and Singh, 1980). Rout et al. (2005) reported that the leaf oil contain β-pinene (16.8-29.1%), 1,8-cineole (21.9-24.7%), camphor (4.9-8.0%), while the root oil had camphene (9.0-12.3%), 1,8-cineole (15.1-15.5%), and α-fenchyl acetate (39.1-45.2%) as the major constituents. The analysis of *A. calcarata* has revealed the presence of protocatechinic acid, quercetin, 4-O-methyl-syringic acid, vanillic acid methyl cinnamate and several terpenes and diterpenes as constituents (Merh et al., 1986). 1,8-Cineole had been found to be the major constituent in the oil (Kong et al., 2000; Tewari et al., 1999; Rath et al., 1994; Merh et al., 1986). Chowdhury et al. (2003) reported that the rhizome oil constituents from Bangladesh containing α-fenchyl acetate (51.4%) and 1,8-cineole (15.1%) as major constituents. 1,8-cineole is used as an antiseptic (0-25%) in dentifrices and, mixed with zinc oxide, as a temporary dental filling. It is also used in dentistry as a softening agent to adapt gutta perch fillings and cones to cavities and root canals. Due to its pleasant spicy aroma and taste, 1,8-Cineole is used in flavorings, fragrances, and cosmetics. It is also an

Table 1. Constituents of *Alpinia calcarata* leaf essential oil.

S/N	Name of compound	%
1	℘-Cadinene	0.96
2	℘-Muurolene	0.54
3	5-Nonanol, 5-methyl	2.08
4	Benzene	0.32
5	β -Humulene	1.63
6	Borneol	1.71
7	Bornyl acetate	1.34
8	β -Pinene	6.39
9	Camphene	1.50
10	Camphor	21.40
11	Carotol	6.53
12	Caryophyllene oxide	1.48
13	Daucol	1.18
14	1,8-cineole	28.48
15	Isolimonene	2.78
16	Limonene	2.26
17	Longipinocarvone	1.24
18	α-Phellandrene	0.42
19	α-Pinene	1.35
20	Methyl cinnamate	13.35
21	Myrtenol	0.83
22	O-Cymene	0.74
23	Pinocarvone	0.72

ingredient in many brands of mouthwash and cough suppressant. 1,8-Cineole has been demonstrated to be capable of reducing inflammation and pain. So the present study deals with the investigation of the chemical components in oils obtained from various parts of *A. calcarata* grown in Bangladesh for medicinal as well as commercial exploitation.

MATERIALS AND METHODS

Plant material

Fresh leaves of *A. calcarata* were collected from the plants grown in the campus of Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratory, Chittagong during June 2007. One-voucher specimen (Y-112) was deposited in the herbarium of BCSIR Laboratory, Chittagong.

Extraction of essential oil

The experiment was conducted when the plants were flowering. Samples of different plant parts (leaf, stem sheath and roots) were harvested from healthy, well-grown, two-year-old plants. Freshly harvested samples (500 g each) in triplicate were subjected to hydrodistillation using a modified Clevenger-type glass apparatus for 4 h for isolation of oils separately from different parts. The oil samples were stored at 0°C in air-tight containers after drying them over anhydrous sodium sulfate for gas chromatography-mass spectrometry (GC-MS) analysis.

GC-MS analysis

The essential oil from rhizomes of *A. calcarata* was analyzed by GC-MS electron impact ionization (EI) method on GC-17A gas chromatograph (Shimadzu) coupled to a GC-MS QP 5050A Mass Spectrometer (Shimadzu); fused silica capillary column (30 m x 0. 25 mm; 0.25 ∝m film thickness), coated with DB-5 (J and W); column temperature 100°C (2 min) to 250°C at the rate of 3°C/min; carrier gas, helium at constant pressure of 90 Kpa. Acquisition parameters full scan; scan range 40-350 amu.

Identification of the compounds

Compound identification was done by comparing the National Institute of Standards and Technology (NIST) library data of the peaks with those reported in literature, mass spectra of the peaks with literature data. Percentage composition was computed from GC peak areas on DB-5 column without applying correction factors.

RESULTS AND DISCUSSION

The oil yields from different plant parts were: leaf 0.14%, stem sheath 0.06%, root 0.08% and 23, 13 and 6 compounds, respectively (Tables 1, 2 and 3). There were similarities and differences among the oils. 1,8-cineole

Table 2. Constituents of *Alpinia calcarata* stem sheath essential oil.

S/N	Name of Compound	%
1	1,8-cineole	11.78
2	L-camphor	8.76
3	Borneol	3.33
4	4-Terpinenol	1.96
5	Terpinyl acetate	15.09
6	Fenchyl acetate	19.16
7	γ-Cadinene	2.94
8	Methyl cinnamate	6.53
9	β-Elemene	1.49
10	cis-p-Mentha-2,8-dien-ol	1.97
11	Carotol	16.77
12	Daucol	3.13
13	Longifolene-I2	7.09

Table 3. Constituents of *Alpinia calcarata* root essential oil.

S/N	Name of Compound	%
1	1,8-cineole	8.14
2	Borneol	11.44
3	Fenchyl acetate	51.34
4	Thymol methyl ether	7.49
5	Carotol	10.85
6	Juniper camphor	10.73

and carotol were the common components of all parts oils. The leaf oil was rich in 1,8-cineole (28.48%), camphor (21.40%), methyl cinnamate (13.35%), carotol (6.53%), β–pinene (6.39%), isolimonene (2.78%), limonene (2.26%) and 5-nonanol, 5-methyl (2.08%). The stem sheath oil was rich in fenchyl acetate (19.16%), carotol (16.77%), terpinyl acetate (15.09%), 1,8-cineole (11.78%) and L-camphor (8.76%). The root oil was rich in fenchyl acetate (51.34%), borneol (11.44%), carotol (10.85%), juniper camphor (10.73%) and 1,8-cineole (8.14%). 1,8-cineole is the common compound of all the reported oils in the world including ours (Kong et al., 2000; Tewari et al., 1999; Rath et al., 1994; Merh et al., 1986). Variations in compositions of oils isolated from different plant parts of *Alpinia breviligulata* and *Alpinia chinensis* were reported from Vietnam (Dung et al., 1994, 1995). α-Fenchyl acetate was found to be one of the major constituents in the root oil of these two species (Dung et al., 1994, 1995) and rhizome oil of *A. calcarata* (Tewari et al., 1999).

Conclusion

It may be concluded that *A. calcarata*, growing widely in Bangladesh, may be utilized as a source for the isolation of natural 1,8-cineole and fenchyl acetate, respectively for medicinal and commercial use.

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