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Bangladesh J. Sci. Ind. Res. **45(2)**, 173-176, 2010

Short Communication

BANGLADESH JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

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Chemical Constituents of Essential Oil from *Anethum sowa* L. Herb (Leaf and Stem) Growing in Bangladesh

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Abstract

The oil obtained by the hydro-distillation method from the fresh leaves and stems of *Anethum sowa* L. (Dill) herb was analyzed by GC-MS. Twenty compounds were isolated and identified. The major constituents were apiole (25.39%), o-cymene (15.25%), α-thujene (14.84%), β-phellandrene (7.17%), 6,6-dimethyl-2-(3-oxobutyl) bicyclo(3.1.1) heptan-3-one (6.90%), exo-2-hydroxycineol (5.03%), limonene (4.13%), 3-isopropyl-4-methyl-1-pentyn-3-ol (2.89%), myristicine (2.46%) and dihydroumbellulone (2.14%).

Key words : *Anethum sowa* L. Essential oil, GC-MS, Apiole

Introduction

Anethum sowa L. (Internationally Dill, Bengali Shulfa) belongs to the family *Apiaceae* (*Umbelliferae*) has a very long history of herbal use going back more than 2000 years. It is an annual, glabrous aromatic cold weather condiment crop in northern plains of India and Bangladesh (Husain *et al.*, 1988). It is also grown widely in other countries of South East Asia and Japan for its fresh aromatic leaves and fruit (Anonymous, 1985). *Anethum sowa* L. has also been sometimes referred to as a variety of *Anethum graveolens* L. the European Dill, whose cultivation is preferred in Europe and USA. Its fruits are longer but less fragrant than *Anethum graveolens* L. (*Umbelliferae*). The Dill herb grows up to 76 cm. in height, which has small feathery leaves and stands on sheathing foot-stalks with linear and pointed leaflets. Stem is erect, branched, cylindrical, striated, smooth and pale green (Anonymous, 1985 ; Chopra, 1982 ; Husain *et al.*, 1988).

Both seed and freshly cut entire herb including stem, leaf and fruit are widely used for flavoring of food, beverages, fragrance in cosmetics and in various medicinal preparations. The oil and its emulsion in water are used in gastrointestinal disorders and an important ingredient of gripe water (Anonymous, 1985; Chopra, 1982). Biological and pharmacological studies of this plant revealed antimicrobial, antioxidative and antispasmodic activities (Baslas, 1971; Woolf, 1999; Maruzzella, 1960).

Essential oils of Dill herb and seed have been reported by many researchers (Guenther, 1953; Koedam *et al.*, 1979; Lawrence, 1980; Schreier *et al.*, 1981; Husain *et al.*, 1994; Denys *et al.*, 1995; Ahmed, 1990; Huopalahti, 1984. Halva, 1988; Virmane and Data 1970). The purpose of this study was to determine the chemical constituents of Dill herb essential oil, the content of aroma causing compounds as well as to determine the feasibility of large scale herb production in Bangladesh. The literature search shows that, there is no previous report on the chemical composition of the essential oil of Dill herb grown in Bangladesh.

Materials and Methods

The fresh Dill herb was collected from the district of Sirajgonj in Bangladesh in December 2002. The plant was identified by Bangladesh National Herbarium Centre, Dhaka. A voucher specimen (DACB Accession Number-31,282) of the plant was deposited in the Herbarium.

The essential oils of leaves and stems were obtained by hydro-distillation method from finely chopped fresh herb after separation of its root in a Clevenger type apparatus for 2 hours. The oil was collected, dried over anhydrous sodium sulphate and refrigerated at 4^{o} C. The yield of the oil was 0.30% (w/w) on fresh weight basis.

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GC/MS Analysis

The analysis of the oils was carried out by GC-MS electron impact ionization method on GC-17A gas chromatograph (Shimadzu) with FID detector coupled to a GC-MS QP-5050A mass spectrometer (Shimadzu): fused silica capillary column (30 m x 0.25 mm, 0.25 mm film thickness) coated with DB-1 (J&W). Column temperature 40° C (2 min.) was raised to 250° C at the rate of 5° C/min. Injection port temperature was 250° C and injection volume 0.1 µL. Helium gas was used as carrier gas at constant pressure of 100 Kpa, flow rate 20ml/min. Acquisition parameters full scan : scan range 40-450 amu. Identification of the compounds were confirmed by computer matching of their mass spectral fragmentation pattern with those of compounds in NIST (National Institute for Standard and Technologies) 107 built in Lis Libraries Shimadzu Corporation, Japan. Sample was dissolved in chloroform. Mass spectra were recorded at 70 eV. The GC/MS data of the oil are shown in Table I.

Results and Discussion

In the study Dill yielded 0.3% (w/w) light yellow colored oil with a typical herb odor on fresh weight basis. It is reported in the literature that the oil percentages ranges from 0.1% to 0.46% on fresh weight basis (Denys *et al.*, 1995; El-Gengaihi *et al.*, 1978; Zlatev *et al*., 1974).

Twenty constituents have been identified in the oil by GC and GC/MS (Table I). The constituents are listed in the order of their peak. The oil is characterized by fairly high concentration of monoterpenes (56.87%) comprising of monoterpene hydrocarbons (44.01%) and oxygenated monoterpenes (12.86%). Only one sesquiterpene a-selinene (1.08%) consisted of the sesquiterpene hydrocarbon, a diterpene compound phytol (1.67%) consisted of the oxygenated diterpene, phenylpropanoid constituents apiole (25.39%) and myristicine (2.46%) were identified in the oil. Undecane (1.22%) and 3-isopropyl-4-methyl-1-pentyn-3-ol (2.89%) were also found in the investigation as alkane and alcohol type compounds respectively.

Other components were present in an amount of 8.42%. Beside these, the predominant components were: o-cymene (15.25%), a-thujene (14.84%), b-phellandrene (7.17%), 6,6-dimethyl-2-(3-oxobutyl)bicycle (3.1.1) heptan-3-one (6.90%), exo-2-hydroxycineole (5.03%), limonene (4.13%), and dihydroumbellulone (2.14%). Apiole an undesirable toxic constituent was found in the highest amount of the oil. This ingredient brings down its quality. This constituent could be separated or removed from the oil by fractional distillation (Shankaracharya *et al*., 2000). Though it is toxic in nature it can be used as synergist with insecticides. It has also shown a stronger oviposition deterrent against Callosobruchus maculates than d-carvone (Lichtenstein *et al.*, 1974 ; Tomar *et al*., 1979; Tripathi *et al.*, 2001).

The literature survey revealed that the compounds like α-thujene (0.19-0.41%), α-pinene (0.98-2.16%), β-phellandrene (11.87-19.08%), dill ether (16.62-30.18%) and myristicine (0.01-0.19%) were found in the herb oil (Denys *et al*., 1995). In another publication (Halva *et al.*, 1988) the compounds α-pinene (1.2-1.4), β-phellandrene (6.4-8.5%), dill ether (21.6-37.7%), limonene (2.1-2.8 %) and myristicine (0.3-2.1%) were reported. In the present study almost the similar compounds as the earlier reports (Denys *et al*.,

Table I. Chemical composition of the Dill herb (leaf and stem) essential oil

Compounds	Relative%
α- pinene[c]	1.09
α- thujene[c]	14.84
o-cymene[c]	15.25
ß-phellandrene[c]	7.17
Limonene[c]	4.13
Terpinolene[c]	1.53
Undecane[f]	1.22
Dill ether[b]	1.48
1,3-cyclohexadiene,2-methyl-5-(1-ethylethyl)-, monoepoxide[b]	1.75
6,6-dimethyl-2-(3-oxobutyl) bicyclo (3.1.1) heptan-3-one.	6.90
Camphenol-6[b]	1.34
Lilac alcohol B [b]	1.12
exo-2-hydroxycineole[b]	5.03
3-isopropyl -4-methyl-1-pentyn-3-ol[g]	2.89
Dihydroumbellulone[b]	2.14
Cyclohexanone,2-isopropyl-2,5-dimethyl	1.52
Myristicin[a]	2.46
Apiol[a]	25.39
α-selinene[d]	1.08
Phytol[e]	1.67

Notes: Compounds arranged in the order of the peak numbers. Superscripts a, b, c, d, e, f & g indicates for phenylpropanoid, oxygenated monoterpenes, monoterpene hydrocarbons, sesquiterpene, diterpene, alkane, alcohol constituents respectively.

1995; Halva *et al.*, 1988) were found. In addition to that, another 5 compounds like (1) phytol, (2) α-selenene, (3) 6,6-Dimethyl-2-(3-oxobutyl) bicycle (3.1.1)heptan-3-one, (4) 3-Isopropyl-4-methyl-1-pentyn-3-ol and (5) cyclohexanone, 2-isopropyl-2,5-dimethyl were also found. It appears that these five compounds were first identified in this study.

Conclusion

The results of this study are of interest in respect to the processing of dill herb. The distillation and the drying process are to be performed in such a way that minimum loss of volatile components occurs. These essential oils have the potential to be used in food as flavoring and natural preservatives, pharmaceuticals, cosmetics and may also be considered as active ingredients in medical preparations.

Acknowledgement

Authors are thankful to the Director, BCSIR Laboratories, Dhaka. Bangladesh for giving the permission to conduct the research work. The authors offer their thanks to Md. Zamilur Rahman, S.O., and Md. Mosharraf Hossain, Jr. Tech., BCSIR Labs., Dhaka and Saimuzzaman (Babu) of Roads Res. Lab. Mirpur, Dhaka, for the assistance during the investigation. Authors are grateful to Bangladesh National Herbarium Centre Scientist Mr. Samsul Hoque for identifying the plant.

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Received : November 03, 2008;
Accepted : September 09, 2009