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Chemical examination of the leaf essential oil of *C. mutabilis* Sckornickova *et al*. from southern India.

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Abstract

The chemical investigation on volatile oil obtained by hydrodistillation of the air dried leaves of *C.mutabilis* Sckornickova *et al.* (Zingiberaceae) from the South Indian plains was done by GC and GC-MS. The leaf oil of *C.mutabilis* have been found to contain 1H-1-Silaindene (15.96%), alpha.-Farnesene (5.55%), 5- Benzofuran acetic acid (7.04%), alpha.-Caryophyllene (6.68%), 1,6,10-Dodecatriene (7.91%), Caryophyllene (8.12%), beta.-Pinene (2.12%), beta.-Elemenone (5.40), Curlone (1.35%), Ar-tumerone (3.29%), Tumerone (2.53%), 2,4,6-Cycloheptatrien-1-one (9.64%), Geranylgeraniol (1.91%), Nerolidol-2 (1.81%) and gamma.-Elemene (1.81%).

Key Words: *C.mutabilis* Sckornickova *et al* ; Zingiberaceae; essential oil composition; GC-MS; *1H-1-Silaindene; Caryophyllene; 2,4,6-Cycloheptatrien-1-one; 5- Benzofuran acetic acid*

Introduction

The family Zingiberaceae, generally known as 'Spice family', form an important group with considerable economic potential, with genera such as *Aframomum*, K. Schum., *Alpinia* Roxb., *Amomum* Roxb., *Curcuma* L., *Elettaria Maton., Kaempferia* L. and *Zingiber* Boehm. Many members of this family have been used in Ayurvedic and other natural system of medicine from time immemorial and some are well known spices. They are also well known for other uses such as medicinal, traditional, food and ornamental. Nearly 250 species of gingers are used as ornamentals in different parts of the world.

The genus name *Curcuma* was coined by Linnaeus in 1753 in his Species Plantarum. The name *Curcuma* originates from the Arabic word 'Kurkum', meaning yellow, which probably refers to the colour of the rhizome or the flowers. The genus *Curcuma* L., with around 120 species (Skornickova *et al.,* 2004) distributed in tropical and subtropical Asia consists of a rather homogenous group of rhizomatous perennials. The genus is easily recognized by its inflorescence, a spike with prominent spiral bracts, which laterally fuse or adnate to the peduncle and form pouches, each subtending a cincinnus of flowers and a cluster of, often coloured, sterile, terminal bracts called 'coma'.

In India, except for a few ubiquitous species, the genus is mainly concentrated in the South West and North East India, and has not been revised since Baker (1892) who reported 29 species (Karthikeyan *et al.*, 1989, Jain and Prakash 1995). From South West India, Fischer[5] reported eight species. But this has been proved as gross underestimate by the subsequent addition of twelve more species, bringing the total number of South West Indian species to 20 of which 12 taxa are endemic to this region[6].

The species belonging to the genus *Curcuma* can be grown in the diverse tropical conditions from sea level to a height of 1500 m on the hilly slopes, in the temperature range of 20 to 30°C. A rainfall of 150 cm ore more or an equivalent amount of irrigation is essential for optimum growth and development of *Curcuma* species. Ideal soil requirements for the growth of *Curcuma* are loose, friable loamy or alluvial soil suitable for irrigation that should have efficient drainage capacity. The species are naturally found in mixed deciduous tropical forests and tropical broad-leaved evergreen forests of the tropical and subtropical regions. There is no available documented literature about the origin and distribution of African and South American *Curcuma* species. The members of the genus in these regions are important resources and have great potential in terms of commercial values as source of spices, medicines and horticultural products. (Apavatjrut *et al.*, 1999, Cao *et al.*, 2001, Cao and Komatsu, 2003, Joe *et al.*, 2004, Sasaki *et al.*, 2004)

Curcuma species are widely used as spices, medicines and dyes. The most common species, *C. longa* is a source of the widely used condiment turmeric. Its rhizome oil contains ar-turmerone, turmerone, turmerol and á-atlantone as the major constituents. Â-Curcumene, ar-curcumene, xanthorhizol, germacrone, camphor and curzerenone are the major constituents in essential oil of *C. aromatica*. The major *Curcuma* species previously studied for their essential oils were *C. longa, C. aromatica, C. wenyujin, C. mangga, C. xanthorrhiza, C. aeruginosa, C. schuanensis, C. heyneana, C. amada, C. ochrorhiza, C. inodora, C. zedoaria* and *C. ceasia.*

C.mutabilis Sckornickova, Sabu and Prasanth Kumar is one of the most interesting species due to the variations in colour of flowers. Corolla can vary from whitish pink, pink-red, reddish orange, dark pink to dark violet, labellum and lateral staminodes can be found in pure white colour, white with yellow or reddish streaks in the throat of labellum or base of the lateral staminodes, different shades ranging from creamy, light yellow to deep yellow colour. Since there is no correlation between colour of corolla and staminodes, combination of these

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two characters makes wide range and infact almost every individual possess slightly different look (Velayudhan *et al*., 1999) had described this species as *C.nilamburensis* based on a collection from Nilambur,Malappuram District, Kerala, S.India. Unfortunately, the same is not validly published according to the St. Louis code because the description lacked a Latin diagnosis and a type was not designated. In addition, the publication by Velayudhan *et al* (1999) is of limited circulation. Hence, the species was validly published under *C.mutabilis* by Skornickova *et al.* (2004) This species is endemic and reported only from the type locality. Here, we report the first systematic study on the chemical profile of the leaf essential oil of *C. mutabilis* by GC-MS analysis from Southern India.

EXPERIMENTAL

Plant Material

Fresh aerial parts of *C. mutabilis* were harvested during flowering in the month of May and June 2012 from the type locality Nilambur, Malappuram District, Kerala, S.India. A voucher specimen was deposited at the Calicut University Hrbarium (CALI). The shade dried plant materials of 1 year old plants were hydrodistilled [13] at 100° C for 3-4 hours using a Clevenger(1928) -type apparatus. The oil obtained, in a yield of 2.6% on dry weight basis, was cooled to room temperature and allowed to stand until oil layers were clear and finally the extracted oil was collected. The oils thus obtained were dried over anhydrous sodium sulfate and kept in refrigerator at 40 C prior to analysis.

GC-MS Analysis

GC was performed on a 6850 NETWORK GC SYSTEM, AGILENT TECHNOLOGIES and MS was recorded on a 5975C VLMSD WITH TRIPLE AXIS DETECTOR, AGILENT TECHNOLOGIES under the following conditions:

Carrier gas, helium; injector temperatures, 220 ^{0} C and 225 ^{0} C, respectively, using a capillary column (HP5MS Nominal length: 30.0 m Nominal diameter: 250.00 ìm Nominal film, thickness: 0.25ìm.). Oven temperature programmed from 5 min at 60^0 C, then rising at 5^0 C/ min to 110^0 C, then 3^0 C from 110^0-200 ^{0} C, then 5^0 C/min to 220^0 C and maintained at 220^0 C for 5 minutes and sample was injected in split mode.

Identification of Compounds

Compounds were identified by comparing the retention indices of the peaks on a RTX wax column with literature values, computer matching against the library spectra built up using pure substances and components of known essential oils and finally confirmed by comparison of mass spectra of peaks and retention indices with published data Mc- Carron *et al*., 1995 Adams, 1989, Swinggar and Silverstein, 1987)

.The relative proportion of each individual component of the oil was expressed as a percentage relative to the total peak area.

Results and Discussion

C. mutabilis is one of the most variable species we have ever come across the genus. Most remarkable is difference in colour of flowers. This species so far known only from its type locality, Nilambur. The chemical profile of *C. mutabilis* have never been reported. In present study we isolated the volatile oil from the leaves and subjected to GC/MS analysis, the major compounds detected were 1H-1-Silaindene (15.96%), alpha.-Farnesene (5.55%), 5- Benzofuran acetic acid (7.04%), alpha.-Caryophyllene (6.68%), 1,6,10-Dodecatriene (7.91%), Caryophyllene (8.12%), beta.-Pinene (2.12%), beta.-Elemenone (5.40), Curlone (1.35%), Ar-tumerone (3.29%), Tumerone (2.53%), 2,4,6-Cycloheptatrien-1-one (9.64%), Geranylgeraniol (1.91%), Nerolidol-2 (1.81%) and gamma.-Elemene (1.81%).

Table 1. Percentage composition of the leaf oils of *C. mutabilis* Sckornickova *et al*.

Compound	Area (%)	R.T (min)
beta.-Pinene	2.12	7.41
Cyclohexane, 1-ethenyl-1-methyl-2,4-bis (1-methylethenyl)-	3.41	25.72
Caryophyllene	8.12	26.99
alpha.-Caryophyllene	6.68	28.61
1,6,10-Dodecatriene, 7, 11-dimethyl-3-methylene-, (Z)- 7.91	28.93	7.04
5-Benzofuranacetic acid	7.04	30.75
alpha.-Farnesene	5.55	31.37
gamma.-Elemene	1.88	33.42
Nerolidol 2	1.81	33.90
Caryophyllene oxide	1.91	34.60
2,4,6-Cycloheptatrien-1-one	9.64	35.72
2-Pyridinamine		
Ar-tumerone	3.29	37.89
Tumerone	2.53	38.00
Fumaric acid	0.81	38.55
beta.-Elemenone	5.40	38.64
Curlone	1.35	38.81
1(2H)-Naphthalenone	2.46	40.68
3,5-Octadiene, 2,2,4,5,7,7-hexamethyl-, (E,Z)-	1.46	40.75
Bicyclo[6.1.0]nonane		
Naphthalene	5.78	40.84
Phytol	4.91	44.72
1H-1-Silaindene, 2,3-dihydro-1-methyl-1-propyl-	15.96	44.99

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