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Chemical composition of the essential oil from the aerial parts of *Chrysanthemum cinerariifolium* growing in Nepal

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Abstract
The essential oil from aerial parts of *Chrysanthemum cinerariifolium* growing in Nepal was obtained by hydrodistillation and analyzed using gas chromatography-mass spectrometry (GC-MS). The oil contained 74 different compounds among which camphor (11.0%), chrysanthenone (7.6%), α-cadinol (4.8%), γ-muurolene (4.6%) and *cis*-chrysanthenol (4.4%) were the major ones. These major constituents of the oil were different from the flower essential oil of the same plant from Northern India.

Keywords: Pyrethrum, *Tanacetumcinerariifolium*, camphor, chrysanthenone.

1. Introduction
Chrysanthemum is the largest among 1300 genera in the family of Asteraceae and comprises one of the main groups of the medicinally important Anthemideae tribe [1, 2]. There are about 300species in this genus [3] of which *Chrysanthemumcinerariifolium* (Trevir.) Vis. [syn. *Pyrethrum cinerariifolium* Trevir., *Tanacetumcinerariifolium* (Trevir.) Sch.Bip.]has held great importance as a potent insecticide since ancient times [4]. The pyrethrin found in *C. cinerariifolium* is an effective natural insecticide, which causes the “knockdown effect” by acting on the nervous system of the insects and prevents various insect-borne diseases like malaria and dengue [4, 5]. The importance of this natural insecticide is even more considering severe adverse effects and toxicity of synthetic insecticides to humans [5, 6].Pyrethrin is a biodegradable insecticide and does not accumulate in water or air and has low mammalian toxicity [7].
Besides its insecticidal and molluscicidal [3] characteristics, pyrethrum has shown activity against herpes simplex virus, *in-vitro* [8]. Various sesquiterpene lactones [STLs] are found in the glandular trichome of the leaves, of which pyrethrosin has shown cytotoxic, phytotoxic, antibacterial, and antifungal effects [6].
C. cinerariifolium thrives best in dry climate with well drained sandy oil [9]. Kenya accounts for about 83% of the world production of *C. cinerariifolium* [10] and it is also found commonly in the northern part of India and many parts of Nepal where it is mainly famous for its ornamental value. Bhakuni *et al.* have studied floral essential oil of North Indian *C. cinerariifolium* and identified 22 compounds accounting for 85.3% of the total oil, the major compound being *trans*-chrysanthemic acid [9]. In this report, we present agas chromatographic – mass spectral (GC-MS) analysis of the essential oil from the aerial parts of *C. cinerariifolium* from Nepal.

2. Materials and Methods
2.1 Plant Material
The plant materials of *C. cinerariifolium* were collected from Biratnagar city (26°28′ N, 87°16′ E, 72 m above sea level) in Morang district of Koshi Zone in Nepal on 17 May 2011. The plant was identified by Tilak Gautam, and a voucher specimen has been deposited at the herbarium of the Tribhuvan University, Post-Graduate Campus, Botany Department in Biratnagar. The fresh aerial part (100 g) was crushed and hydrodistilled using a Clevenger type apparatus for 4 hours to give clear, pale yellow essential oil (0.1 g), which was stored at

4 °C until analysis.

2.2 Gas Chromatographic-Mass Spectral Analysis

The essential oil of *Chrysanthemumcinerariifolium* was analyzed by GC-MS using an Agilent 6890 GC with Agilent 5973 mass selective detector (MSD)[operated in the EI mode (electron energy = 70 eV), scan range = 40-400 amu, and scan rate = 3.99 scans/sec], and an Agilent Chem Station data system. The GC column was an HP-5ms fused silica capillary with a (5% phenyl)-polymethylsiloxane stationary phase, film thickness of 0.25 μm, length of 30 m, and internal diameter of 0.25 mm. The carrier gas was helium with a column head pressure of 48.7 kPa and a flow rate of 1.0 mL/min. Injector temperature was 200 °C and detector temperature was 280 °C. The GC oven temperature program was used as follows: 40 °C initial temperature held for 10 min; increased at 3 °C/min to 200 °C; increased at 2 °C/min to 220 °C. A 1% w/v solution of the sample in CH_2Cl_2 was prepared and 1 μL was injected using a 10:1 split injection technique.

Identification of the oil components was based on their retention indices (RI), determined by reference to a homologous series of *n*-alkanes, and by comparison of their mass spectral fragmentation patterns with those reported in the literature [11] and stored on the MS library [NIST database (G1036A, revision D.01.00)/Chem Station data system (G1701CA, version C.00.01.080)]. The percentages of each component are reported as raw percentages based on total ion current without standardization.

3. Results and Discussion

The chemical composition of the essential oil of aerial parts of *C. cinerariifolium* was determined by GC-MS and the results are summarized in Table 1. A total of 69 compounds were identified, accounting for 93.7% of the composition. The major components were camphor (11.0%), chrysanthenone (7.6%), α-cadinol (4.8%), γ-muurolene (4.6%) and *cis*-chrysanthenol (4.r %). Considerable amounts of terpinen-4-ol (3.6%), *trans*-pinocarveol (3.3%), borneol (3.5%), shyobunol (3.4%) were also found.

The floral essential oils of *C. cinerariifolium* have been previously analyzed. *C. cinerariifolium* floral essential oil from Kenya was dominated by the sesquiterpenoids (*E*)-β-farnesene (41.4%), β-cubebene (17.3%), nerolidol (14.2%), spathulenol (7.4%), and *trans*-chrysthanthemic acid (4.5%) [12]. A floral essential oil from India, on the other hand, was rich in *trans*-chrysanthemic acid (19.6%), β-eudesmol (9.8%), nerolidol (9.6%), decanoic acid (7.6%), α-eudesmol (7.1%) and guaiol (5.9%) [13]. Not surprisingly, these floral essential oils have very different compositions than the essential oil from the aerial parts of *C. cinerariifolium* presented in this work.

Table 1: Essential oil composition of *Chrysanthemumcinerariifolium*

RI	Compound	%	RI	Compound	%
809	2-Hexanol	0.8	1217	*trans*-Carveol	0.4
854	(2*E*)-Hexenal	0.4	1225	*neoiso*-Dihydrocarveol	0.3
856	(3Z)-Hexenol	2.3	1261	*cis*-Chrysanthenyl acetate	0.5
890	2-Hexen-1-ol	0.3	1270	Unidentified	1.4
891	*n*-Hexanol	1.0	1311	(*Z*)-Patchenol	0.9
941	α-Pinene	0.2	1315	Unidentified	1.9
981	1-Octen-3-ol	1.5	1356	Eugenol	0.5
992	Dehydro-1,8-cineole	0.4	1419	(*E*)-Caryophyllene	0.9
994	6-Methyl-5-hepten-2-ol	0.2	1458	(*E*)-β-Farnesene	0.4
996	3-Octanol	0.2	1477	*trans*-Cadina-1(6),4-diene	0.2
1016	α-Terpinene	0.3	1481	γ-Muurolene	4.6
1024	*p*-Cymene	0.2	1484	*ar*-Curcumene	0.3
1028	Limonene	0.2	1497	α-Zingiberene	1.0
1030	1,8-Cineole	2.4	1516	*cis*-Dihydroagarofuran	0.7
1032	Benzyl alcohol	0.2	1525	δ-Cadinene	1.7
1043	Phenylacetaldehyde	0.4	1534	Italicene Ether	0.3
1066	*cis*-Sabinene hydrate	0.4	1550	Unidentified	1.0
1097	*trans*-Sabinene hydrate	0.7	1552	Unidentified	0.9
1100	Linalool	0.2	1559	Unidentified	1.2
1103	Filifolone	2.3	1565	(*E*)-Nerolidol	0.3
1105	Hotrienol	1.1	1576	Germacrene D-4-ol	1.4
1112	2-Phenylethyl alcohol	1.2	1581	*ar*-Turmerol	0.5
1120	Isophorone	1.0	1583	Caryophyllene oxide	2.1
1125	Chrysanthenone	7.6	1601	Viridiflorol	2.2
1138	*trans*-Pinocarveol	3.3	1609	Humulene epoxide II	0.2
1144	Camphor	11.0	1628	1-*epi*-Cubenol	1.1
1162	*cis*-Chrysanthenol	4.4	1631	Caryophylla-4(12),8(13)-dien-5α-ol	0.8
1165	Borneol	3.5	1633	Caryophylla-4(12),8(13)-dien-5β-ol	1.9

1166	δ-Terpineol	0.4	1642	τ-Muurolol	2.7
1173	*cis*-Pinocamphone	0.2	1646	α-Muurolol (= Torreyol)	0.5
1176	Terpinen-4-ol	3.6	1651	β-Eudesmol	0.4
1190	α-Terpineol	1.2	1655	α-Cadinol	4.8
1193	Methyl salicylate	1.3	1686	Caryophylla-4(15)5,10(14)-trien-1α-ol	0.8
1195	Myrtenol	1.0	1691	Shyobunol	3.4
1202	Nopol	0.4	1737	Oplopalone	1.2
1207	Verbenone	0.5	1954	Hexadecanoic acid	0.3
1208	*trans*-3(10)-Caren-2-ol	0.2	2108	(*E*)-Phytol	0.2
				Total Identified	93.7

4. Conclusion

The essential oil of the aerial parts of *Chrysanthemumcinerariifolium* was analyzed by GC-MS. Camphor and chrysanthenone were the major constituents of the oil comprising 11.0% and 7.6%, respectively, of the total compounds present. The main constituents of the aerial part-essential oil of the plant from Nepal were different from the floral essential oils of the plant from Kenya or India.

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6. References

1. Keskitalo M, Angers P, Earle E, Pehu E. Chemical and genetic characterization of calli derived from somatic hybridization between tansy (*Tanacetum vulgare L.*) and pyrethrum (*Tanacetumcinerariifolium* (Trevir.) Schultz-Bip.). Theor Appl Genet 1999; 98:1335-1343.
2. Abad MJ, Bermejo P, Villar A. An approach to the genus *Tanacetum L.* (Compositae); Phytochemical and pharmacological review. Phyter Res 1995; 9(2):79-92.
3. Kumar A, Singh SP, Bhakuni RS. Secondary metabolites of *Chrysanthemum* genus and their biological activities. Curr Sci 2005; 89(9):1489-1501.
4. Kikuta Y, Ueda H, Takahashi M, Mitsumori T, Yamuda G, Sakamori k *et al.* Identification and characterization of a GDSL lipase- like protein that catalyzes the ester-forming reaction for pyrethrin biosynthesis in *Tanacetumcinerariifolium*- a new target for plant protection. Plant J 2012; 71:183-193.
5. Grdisa M, Babic S, Perisa M, Carovic-Stanko K, Kolak I, Liber Z *et al.* Chemical Diversity of the Natural Populations of Dalmatian Pyrethrum (*Tanacetumcinerariifolium* (TREVIR.) SCH. BIP.) in Croatia Chem Biodivers 2013; 10:460-472.
6. Ramirez AM, Saillard N, Yang T, Franssen MCR, Bouwmeester HJ, Jongsma MA. Biosynthesis of Sesquiterpene Lactones in Pyrethrum (*Tanacetumcinerariifolium*). PLoS One, 8 (5):e65030.
7. Liu Z, Gao S. Micropropagation and induction of autotetraploid plants of *Chrysanthemumcinerariifolium* (Trev.) Vis Vitr Cell Dev Biol-Plant 2007; 43:404-408.
8. Sassi AB, Harzallah-Skhiri F, Bourgougnon N, Aouni M. Antimicrobial Activities of four Tunisian *Chrysanthemum* species. Indian J Med Res 2008; 127:183-192.
9. Bhakuni RS, Kahol AP, Singh SP, Kumar A. Composition of North Indian Pyrethrum (*Chrysanthemumcinerariifolium*) flower oil. J Essent Oil Bear Plants 2007; 10(1):31-35.
10. Sharafzadeh S. Pyrethrum, Coltsfoot and Dandelion: Important Medicinal Plants from Asteraceae Family 2011; 5(12):1787-1791.
11. Adams RP. Identification of Essential Oil Components by Gas Chromatography/ Mass Spectrometry. Edn 4, Allured Publishing, Carol Stream. Illinois, 2007.
12. Saggar P, Wamicha WN, Chhabra SC, Ndalut P. Isolation, identification and bioassay of repellent factors in the essential oil of pyrethrum for grain protection against *Sitophilus zeamais* (Molts.). Pyrethrum Post 1997; 19(4):126-130.
13. Bhakuni RS, Kahol AP, Singh SP, Kumar A. Composition of north Indian pyrethrum (*Chrysanthemum cinerariaefolium*). Journal of Essential Oil Bearing Plants 2007; 10(1):31-35.