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CHEMICAL CHARACTERIZATION AND ANTIMICROBIAL SCREENING OF FLOWERS OF *Curcuma neilgherensis* FROM EASTERN GHATS OF INDIA

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The essential oil was obtained from the flowers of *Curcuma neilgherensis*, studied for antimicrobial activity, and characterized chemically. *Curcuma neilgherensis* Wt., (Zingiberaceae) is a wild turmeric species and is known as kondapasupu by the primitive tribes in the forested areas of Eastern Ghats, India. It is one of the endangered medicinal plants in Eastern Ghats and is being used to treat skin diseases, throat infections, sneezing, and respiratory disorders, including asthma, in folk medicine [1–3]. In view of the growing interest in natural product applications in the food, cosmetics, and pharmaceutical industries, and because the chemical components and biological activities of the flowers of *Curcuma neilgherensis* have not been reported. The present study was conducted to chemically characterize the essential oils of the flowers and to study their antimicrobial activity. The findings of the study were useful in developing new drug molecules and for sustainable utilization and management of wild resources of medicinal plants.

The flowers of *C. neilgherensis* were collected from the forests of Tirumala hills of Eastern Ghats of Andhra Pradesh, India (March, 2004), and the specimen was identified by the authors with the help of regional flora [4] and deposited at Sri Krishnadevaraya University Herbarium (SKU), Anantapur for future reference.

The essential oil was analyzed by means of GC-FID and GC-MS on a Nucon gas chromatograph. The retention indices were calculated, and the chemical components were identified by application of a modified Kovats procedure [5].

TABLE 1. Essential Oil Composition of *C. neilgherensis* Flowers

Compound	Retention Indices[a]	% composition	Compound	Retention Indices[a]	% composition
Limonene	1029	3.45	Cinnamyl acetate	1445	0.59
β-Thujone	1121	1.17	Geranyl acetate	1384	6.62
cis-Limonene oxide	1134	2.67	Naphthalene derivative	1649	2.46
trans-Pinocarveol	1139	0.86	Globulol	1583	0.58
Hexyl butyrate	1191	0.89	Myristicin	1519	1.16
Estragole	1196	1.73	*cis*-Nerolidol	1566	1.46
trans-Dihydrocarvone	1215	1.01	*cis*-Calamenene	1521	2.43
α-Copaene	1378	1.81	*t*-Muurolol	2189	2.93
Linalool	1101	5.51	Ethyl ester of C_{16} acid	2204	4.11
Cadinene	1538	26.96	β-Bisabol	2204	2.50
cis-Carvyl acetate	1247	4.39	*cis*-α-Santol	1121	11.15
2-Tridecanone	1814	1.12	Zingiberene	1121	0.50
Palustral	1933	10.39	Zerolidol	1559	1.00

GC-MS analysis performed on Shimadzu-17A coupled with Shimadzu QA 5050A (quadruple) mass-spectrometer equipped with EI and a fused silica column DB5. RI[a]: retention indices.

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TABLE 2. Antimicrobial Properties[a] of *C. neilgherensis* Flower Oil

Microorganisms[b]	Zone of inhibition of pure oil (10 µL/disc)	Standards (30 µg/disc)	MIC (µg/mL)
Bacillus cereus MTCC 1429	14	22[c]	31.2
Bacillus subtilis MTCC 121	10	22[c]	31.2
Micrococcus luteus MTCC 1541	16	22[c]	25
Micrococcus roseus MTCC 2522	18	22[c]	31.2
Staphylococcus aureus MTCC 737	16	23[k]	31.2
Escherichia coli MTCC 1687	16	18[t]	31.2
Pseudomonas aeruginosa MTCC 1688	22	22[t]	15.6
Klebsiella pneumoniae	18	28[t]	15.6
Proteus vulgaris MTCC 1771	–	–	–
Candida albicans MTCC 183	14	25[v]	15.2
Candida tropicalis MTCC 184	16	25[v]	<15.2

[a]Antimicrobial activities represented as inhibition zones, in mm, including the disk diameter, 6 mm; [b]microbial strains obtained from Indian Institute of Microbial Technology (IMMT) Chandigarh, India; standards: [c]ampicillin, [k]kanamycin, [t]tetracycline, [v]vancomycin, obtained from Hi-media, Mumbai, India; MIC: minimum inhibition concentration calculated by National Committee for Clinical Laboratory Standards. Performance Standards for Anti-Microbial Susceptibility Testing; –: no activity observed.

Twenty-three identified compounds, which accounted for 99.45% of the total composition of the oils, are reported in Table 1. The major chemical components are cadinene (26.96%), *cis*-α-santol (11.15%), palustrol (10.39%), geranyl acetate (6.62%), linalool (5.51%), and limonene (3.45%).

The agar disc diffusion method was used to determine the antimicrobial activity of the essential oil [6], and minimum inhibition concentrations were determined by using NCCCLS guidelines [7]. The antimicrobial activity of the essential oil was equal to standard antibiotics. The observed microbicidal activity was correlated with the composition. The results of the bioassay are presented in Table 2.

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