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Chemo-profiling of *Curcuma aromatica* Salisbury rhizomes and leaves from South India

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Abstract
Wild yellow root, *Curcuma aromatica* is a camphoraceous plant of genus curcuma and zingiberaceae family. It is one of the species related to *Curcuma longa*, also known as wild turmeric, vanaharidra or Kasturi Arisina. *Curcuma aromatica*, the traditional aromatic and medicinal cosmetic is the second most commonly cultivated and utilized species next to *Curcuma longa*. In the present study, an attempt has been made to evaluate the chemical composition of rhizome and leaf essential oil. Essential oil content obtained by hydro-distillation of fresh rhizomes and dry leaves was 3.4 and 1.4% respectively. Oxygenated monoterpenes, monoterpene hydrocarbons, sesquiterpenes and sesquiterpene hydrocarbons are the predominant constituents of both rhizome and leaf essential oil. The major volatile components of rhizome oil are cedrene, Xanthorrhizol, ar-curcumene, camphor, and germacrone. Leaf oil is composed of ar-curcumene, isofuranogermacrone, 1,8-cineole, Xanthorrhizol and camphor. The bioactive compounds are considered the promising source of natural anti-carcinogenic and anti-Inflammatory agents.

Keywords: *Curcuma aromatica*, essential oil, rhizome, leaf oil

Introduction
Curcuma genus of Zingiberaceae family comprises of about 80-110 species that are spread all over Southeast Asia, China, India, New Guinea and Northern Australia. The crop grows wild throughout India and is commonly cultivated in Kerala and West Bengal. *Curcuma aromatica* is one of the species related to *Curcuma longa* (common turmeric), also known as wild turmeric, Vanaharidra, Kasturi Arisina or Kasturi Manjal. *Curcuma aromatica*, the traditional aromatic and medicinal cosmetic is the second most commonly cultivated and utilized species next to *Curcuma longa*. Its rhizomes are light yellow in colour with a pleasant, camphoraceous aroma [1]. It is considered as an endangered wild turmeric, although popular regionally, due to non-availability of planting material for large scale cultivation. It is a promising drug for therapeutic purpose due to its wound healing, anti-inflammatory, anti-oxidant anti-tumour and immunomodulatory properties. The rhizome is as an antidote and a blood purifier. It is a useful component for treating bruises, worm infestations, fever, skin infections and as tonic for women after child birth [2-4]. The fresh leaves are aromatic and are extensively used in culinary preparations. *C. longa*, is rich in curcuminoids content, while, *C. aromatica* has higher essential oil content (4-8%) with unique chemical composition is as a promising source of natural anti-carcinogenic and anti-Inflammatory chemicals. The present research aims at understanding the bioactive principles of rhizome and leaf essential oil by GC-MS.

Materials and Methods
Plant material
The rhizomes of *C. aromatica* were collected from Mangaluru and cultivated in Aromatic garden (Sugandha Vana), Department of Horticulture, UAS(B), GKVK, Bangalore. The crop was raised in the month of March 2018 and harvested in the month of December 2018. Fresh matured rhizomes and dried leaves were collected for further analysis.

Extraction of volatile oil from turmeric rhizomes
Essential oil was extracted from the fresh rhizomes and dried leaves of *C. aromatica*. As per the available literature, fresh rhizome paste and dried leaves were independently subjected to hydro-distillation in Clevenger's apparatus for three and a half hours. The mauve colored oil obtained was collected and dried over minimum amount of anhydrous sodium sulphate to

remove any traces of water. The oil extracted was transferred to vials and stored in refrigerator for further analysis [5-7].

Chemo-profiling of Volatile constituents by GC-MS

The quantification of bioactive principles were carried out in Perklin-Elmer (Clarus 680 GC) and Mass Spectrometer Clarus 600 (EI), with a fused silica column, packed with Elite-5MS (5% biphenyl 95% dimethylpolysiloxane, 30 m × 0.25 mm ID × 250μm df) and the components were separated using Helium as carrier gas at a constant flow of 1 ml/min. The injector temperature was set at 260°C during the chromatographic run. The 1μL of extract sample injected into the instrument the oven temperature was as follows: 60 °C (2 min); followed by 300 °C at the rate of 10 °C min−1; and 300 °C, where it was held for 6 min. The mass detector conditions were: transfer line temperature 240 °C; ion source temperature 240 °C; and ionization mode electron impact at 70 eV, a scan time 0.2 sec and scan interval of 0.1 sec. The fragments from 40 to 600 Da. The spectrums of the components were compared with the database of spectrum of known components stored in the GC-MS NIST (2008) library [5, 6, 8].

Results and Discussion

The *C. aromatica* rhizomes and leaves were harvested on complete maturation (9 months). The essential oil content on hydro-distillation of fresh rhizomes and dried leaves was 3.4% and 1.4% respectively [9]. The composition of rhizome and leaf oil was determined by GC-MS and the components were identified with reference to the MS library. Both rhizome and leaf oil reported a complex mixture of mono and sesquiterpenes. In rhizome oil a total of 11 components were identified, corresponding to 91.24% of the total components (Table 1, Fig 1). The major components of fresh rhizome oil were cedrene (25.088%), xanthorrhizol (21.44%) and ar-curcumene (18.032%). The other odour defining components reported are camphor (3.33%), β-elemene (1.057%), α-bisabolene (1.596%), E-β-farnesene (2.32%), germacrone (9.709%), isofuranogermacrone (5.194%).

Table 1: Gas-Chromatography Mass Spectrometry analysis of *C. aromatica* rhizome oil

Sl.no	Component	RT(min)	Area%
1	Camphor	8.071	3.330
2	β-elemene	11.312	1.057
3	α-zingiberene	11.457	1.100
4	α-bisabolene	11.812	1.596
5	E-β-Farnesene	12.072	2.32
6	ar-curcumene	12.567	18.032
7	Isofuranogermacrone	12.697	5.194
8	Cedrene	12.952	25.088
9	γ-elemene	13.418	2.369
10	Germacrone	15.143	9.709
11	Xanthorrhizol	15.919	21.441

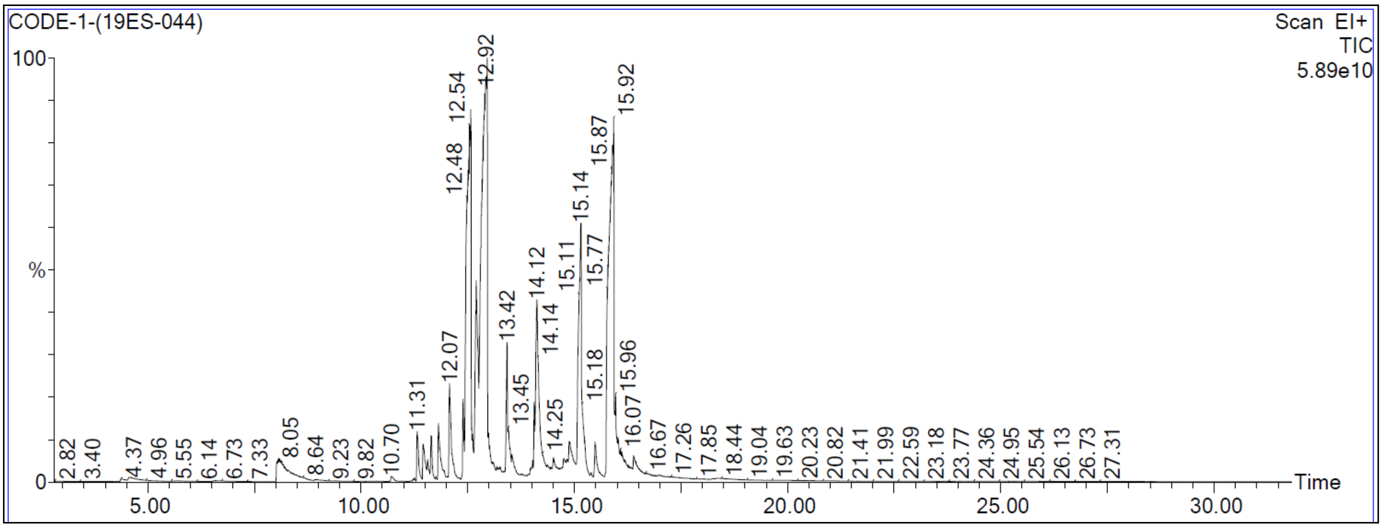

Fig 1: GC-MS Profile of *C. aromatica* Rhizome oil

Leaves recorded a total of 10 components, corresponding to 79.34% of the total components (Table 2, Fig 2). The leaf oil is composed of germacrone (23.134%), ar-curcumene (13.807%), isofuranogermacrone (11.419%), 1,8-cineole (10.824%), xanthorrhizol (5.614%) and caryophyllene (4.851%). The other odour defining components reported are camphor (1.876%), β-elemene (1.957%), γ-elemene (3.805%).

Table 2: Gas –Chromatography Mass Spectrometry analysis of *C. aromatica* leaf oil

Sl.no	Component	RT(min)	Area%
1	α-pinene	4.099	2.051
2	1,8-Cineole	5.780	10.824
3	Camphor	8.060	1.876
4	β-elemene	11.302	1.957
5	caryophyllene	11.637	4.851
6	ar-curcumene	12.467	13.807
7	Isofuranogermacrone	12.692	11.419
8	γ-elemene	13.408	3.805
9	Germacrone	15.143	23.134
10	Xanthorrhizol	15.809	5.614

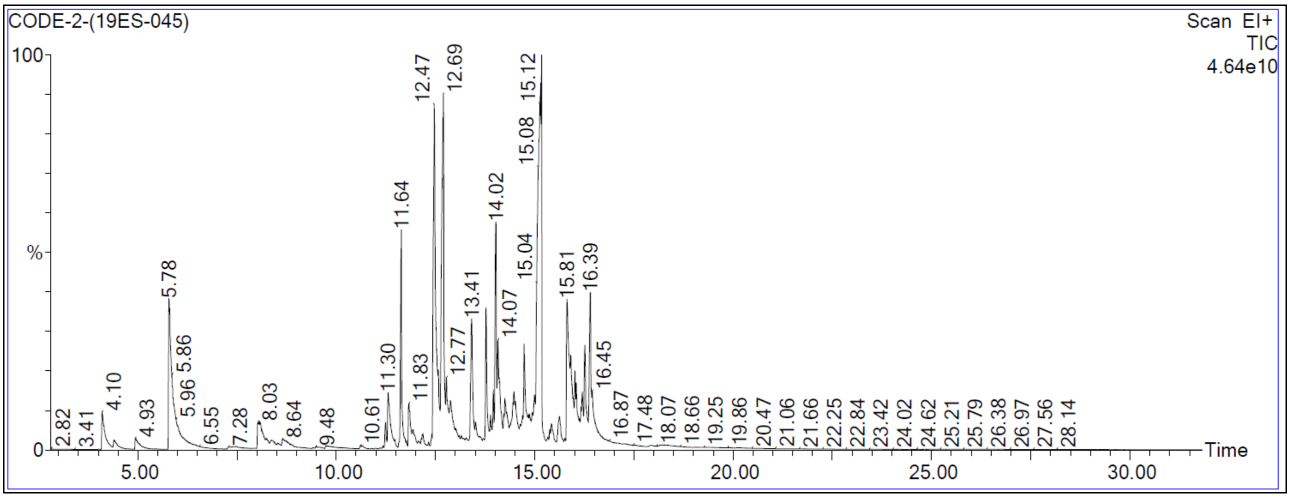

Fig 2: GC-MS Profile of *C. aromatica* Leaf oil

The composition of rhizome oil was similar to that of leaf oil. The components identified are in accordance with [6, 8-13]. Wherein, Choudhury *et al.*, 1996 [5] reported that the Indian rhizome oil contained 34% β-curcumene, 15% ar-curcumene, and 11%zingiberene as major components. While, [14] reported 19% ar-curcumene, 26% β-curcumene and 26% Xanthorrhizol. Choudhury *et al*., 1996 reported that the fresh leaf oil collected in Assam, India, reported 1.4% α-pinene, 20.0% 1, 8-cineole, 18% camphor, 1.1% β-elemene and 11.8% germacrone. While, the leaf oil of N.E India, reported 6.0% 1, 8-cineole, 28.5% camphor, 0.7% β-elemene and 1.2% germacrone [6]. On comparison with the reports available, the chemo-profile of *C.aromatica* rhizome oil cultivated in Bangalore is comparable to that of Kerala, India and Java, Indonesia.

Germacrone, one of the unique compound absent in *C.longa*, is known to possess anti-tumour properties by promoting apoptosis and inducing cell cycle arrest. Also, it prevents influenza virus and *S. aureus*. 1,8-cineole imparts the camphory note and contributes to the healing of bronchitis and upper respiratory disorders. Xanthorrhizol is considered as a promising source of natural anti-carcinogenic agent. β-elemene, β-turmerone and ar-turmerone have reported to show antioxidant and anti-tumour activity [10].

Conclusions

Curcuma aromatica is one of the species related to *Curcuma longa*. On comparison, *C. longa* is rich in curcuminoids while *C. aromatica* is rich in volatile oil with unique composition. The present research highlights on the importance of *C. aromatica* as a medicinal aromatic plant with unique bioactives. The dried leaves treated as a waste can be utilized as a source of essential oil rich in bioactive principles. The pharmacological bioactives are proven to revalidate the traditional and ayurvedic concept of wild turmeric as a potent herb that has not been explored much as compared to its utility.

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