SHORT COMMUNICATION

Study of Leaf Oil Composition from Various Accessions of *Curcuma longa* L. Grown on Partially Reclaimed Sodic Soil

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Abstract

The essential oils of *Curcuma longa* L. (Zingiberaceae) were extracted from senescenced leaves by hydrodistillation and analyzed by GC/MS. Leaf essential oils of turmeric were found to be rich in monoterpenes. The GCMS analysis of leaf essential oil of 29 accessions showed presence of total 41 compounds mainly *α*-phellandrene, p-cymene, *α*-terpinolene and p-cymen-8-ol as the four major compounds. Based on identification of three major compounds from each oil, 13 compounds viz. *β*-Myrcene, *α*-Phellandrene, *α*-Terpinene, Limonene, 1,8-Cineole, p-cymene, *τ*-terpenine, *α*-Terpinolene, 1,3,8-p-Menthatriene, p-menth-1-en-4-ol, Borneol, p-menth-1-en-8-ol and p-cymen-8-ol were found to be the major constituents from each accession. The number of compounds in accessions varied from five in NBH-20 to 22 in Prabha. Out of 41 compounds, δ-Elemene was reported only in R. Sonia while β-Bisabolene was detected in Roma and P. Peetabh only. Based on the major compound(s) of turmeric leaf oil, industrial applications can be explored.

Keywords: *α*-Phellandrene, Accession, Leaf essential oil composition, Turmeric.

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Introduction

Turmeric (*Curcuma longa*) is a rhizomatous herbaceous perennial plant belongs to the family Zingiberaceae. *C. longa* is perennial plant native to southern Asia. Turmeric is known worldwide for its multipurpose use in medicine, cosmetics, food flavoring and textile industries (Mundle and Mengre, 2011). It is also used for preserving food (Jayaprakasha *et al*., 2005). Turmeric contains pungent, odoriferous oils and oleoresins; the rhizomes have been reported to possess wide spectrum of pharmacological activities (Anand *et al*., 2008). Pharmacological activities of turmeric are due to presence of phenolic compounds; curcuminoids i.e. curcumin, demethoxycurcumin and bisdemethoxycurcumin as well as volatile oil, sugars, proteins, and resins (Jurenka, 2009). Its rhizome has been mentioned as analgesic (Agarwal *et al*., 2011), antiseptic (De *et al*., 2009) and wound healing (Saraswathy *et al*., 2012).

Turmeric rhizome contains 3-5% volatile oil. The volatile oils of the rhizomes and leaves of *C. longa* can be obtained by steam distillation or solvent extraction, and show a wide spectrum of medicinal applications (Singh *et al*., 2002). Essential oil of turmeric extracted from rhizome contains *α*-turmerone, *β*-turmerone and ar-turmerone whereas leaf oil contains *α*-phellandrene (18.2%), 1,8-cineole (14.2%) and *p*-cymene (13.3%) as major constituents. Turmeric rhizome oil has ar- tumerone as a major compound (Jayaprakasha *et al*., 2002) which has shown antimicrobial (Singh *et al*., 2002), larvicidal (Mau *et al*., 2003), and anti-oxidant activities (Mau *et al*., 2003). Essential oil of *Curcuma* also exerts triglyceride-lowering activity on serum as well as liver triglycerides (Mau *et al*., 2003). A number of anti-insect properties of turmeric have been documented in the literature. The insect repellent components in turmeric are turmerones and ar-turmerone (Su *et al*., 1982). Leaf essential oil of turmeric is used extensively in perfumery, pharmaceuticals and aromatherapy (Kar *et al*., 2014). *α*-phellandrene found to be promote immune response on normal murine cells *in vivo.* Antinsect potential of turmeric leaf oil has been reported (Tripathi *et al*., 2002).

Here, from the partially reclaimed sodic soil; 29 accessions of *C. longa* were analysed for the major constituents of leaf essential oil.Here we report the three major compounds of turmeric leaf essential oil identified from each accession.

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Material and Method

Experimental location

Twenty nine accessions of *C. longa*were grown at the Distant Research Centre (26°42′ N, 80°49′E, 122.7m altitude) of CSIR-National Botanical Research Institute, Lucknow, U.P., India during June 2012 to Feb 2013. The soil of the experimental plot was clay loam texture, having pH=8.62, electrical conductivity=0.25 dS/m, organic carbon 0.40%. The plants were grown at 40 × 20 cm spacing under uniform agronomic management.

Collection of plant material

Partially scenescenced leaves of 29 accessions of turmeric were harvested in from December to January. About 50% of leaves were harvested weighed, washed and chopped for the oil extraction.

Extraction of essential oil

The chopped leaves were hydro-distilled for 6 hours in a Clevenger-type apparatus. The distilled essential oil was collected and dried over the anhydrous sodium sulphate to remove any water traces. Collected volatile fraction (essential oil) was kept in vials, stored in refrigerator for GCMS analysis.

GCMS analysis

GCMS analysis was performed using Thermo Trace GC Ultra coupled with Thermo Fisher DSQ II mass spectrometers (Thermo Scientific,

USA) with electron impact ionization at 70 eV to generate mass spectra. Thermo TR50 column 30mL 0.25mm (polysiloxane column coated with 50% methyl and 50% phenyl groups) was used for chromatographic separation of metabolites. With an initial 5 min solvent delay time at 50^0C, the oven temperature was increased to 250^0C at 4^0C min^{-1}, 5 min isocratic and cooled down to 50^0C followed by an additional 5 min delay. The injector temperature was set at 250^0C. Helium flow was maintained at 1mL min^{-1} and split ratio was maintained at 1:50. The resulting GCMS profile was analyzed using WILLY and NIST mass spectral library (http:// www.nist.gov/data/nist1a.htm).

Result and Discussion

Major three constituent profile of the oil is given in Table 1. Leaf essential oil was characterized by GCMS. The volatile oil of the leaves showed a wide spectrum of medicinal applications (Singh *et al*., 2002). The essential oils composition of turmeric varies in both rhizome and leaf (Lawrence, 2000). Leaf essential oils of turmeric found to be rich in monoterpenes. Based on the GCMS analysis of leaf oil, four major important compounds viz. *α*-phellandrene, p-cymene, *α*-terpinolene and p-cymen-8-ol were characterized.

The GCMS analysis of leaf essential oil of 29 accessions revealed total 41 compounds. The number of compounds in accessions varied from 5 in NBH-20 to 22 in Prabha. Matching the peaks from WILLY and NIST mass spectral library resulted in identification of 62.45% compounds in NBH-4 to 98.89% in Roma (Fig. 1). Of the total 41 compounds, 13 compounds viz. *β*-Myrcene, *α*-Phellandrene, *α*-Terpinene, Limonene, 1,8-Cineole, p-cymene, *τ*-terpenine, *α*-Terpinolene, 1,3,8-p-Menthatriene, p-menth-1-en-4-ol, Borneol, p-menth-1-en-8-oland p-cymen-8-ol constituted the three major compounds of 29 turmeric accessions. *α*-Phellandrene was present in the highest quantity (32.04 to 70.27%) in NBH-6, NBH-7, NBH-8, NBH-10, NBH-18 accessions and Azad-1 and KTS-2 varieties. p-cymene was the characteristic compound of NBH-1, NBH-2, NBH-3, NBH-5, NBH-19, NBH-20, and variety R. Sonia, present in 19.51 to 75.95%. *τ*-terpenine was highest in Prabha and RH-5 (41.93 and 61.34, respectively). In accessions NBH-9, NBH-11, NBH-12, NBH-13, NBH-14, NBH-15, NBH-16, NBH-17, NBH-21, NBH-22 and Roma, *α*-Terpinolene was the major compound (40.77-75.75%). 1,8- Cineole was highest in P. Peetabh (20.31%) while p-cymen-8-ol was highest in NBH-4 (38.57%).

α-Phellandrene was present in the second highest amount (4.71 to 18.21%) in accessions NBH-2, NBH-12, NBH-19, NBH-22, RH-5 and

Table 1: Major three compounds (%) of leaf essential oil of *C. longa* L. accessions.

Accession	*Major three compounds (%)*		
NBH-1	p-cymen (52.9)	p-cymen-8-ol (8.7)	Limonene (2.4)
NBH-2	p-cymen (52.0)	*α*-Phellandrene (11.9)	p-cymen-8-ol (4.5)
NBH-3	p-cymen (26.5)	*α*-Terpinolene (15.0)	p-cymen-8-ol (3.2)
NBH-4	p-cymen-8-ol (38.6)	p-cymen (9.5)	*α*-Terpinolene (4.9)
NBH-5	p-cymen	p-cymen-8-ol (4.8)	*α*-Terpinolene (4.2)
NBH-6	*α*-Phellandrene (70.3)	*α*-Terpinolene (10.1)	*β*-Myrcene (2.1)
NBH-7	*α*-Phellandrene (36.7)	*α*-Terpinolene (19.7)	p-cymen (14.2)
NBH-8	*α*-Phellandrene (53.8)	*α*-Terpinolene (9.2)	Limonene (1.9)
NBH-9	*α*-Terpinolene (40.8)	p-cymen-8-ol (11.1)	p-cymen (8.9)
NBH-10	*α*-Phellandrene (50.7)	*α*-Terpinolene (14.2)	p-cymen (11.4)
NBH-11	*α*-Terpinolene (65.1)	*α*-Terpinolene (4.1)	*α*-Terpinene (3.2)
NBH-12	*α*-Terpinolene (74.6)	*α*-Terpinolene (4.7)	*α*-Terpinene (4.3)
NBH-13	*α*-Terpinolene (68.7)	1,8- Cineole (5.9)	*α*-Phellandrene (5.0)
NBH-14	*α*-Terpinolene (62.4)	p-cymen-8-ol (5.2)	p-menth-1-en-4-ol (3.5)
NBH-15	*α*-Terpinolene (59.8)	p-cymen-8-ol (4.9)	p-cymen (4.3)
NBH-16	*α*-Terpinolene (59.0)	p-cymen (7.7)	p-cymen-8-ol (6.0)
NBH-17	*α*-Terpinolene (65.2)	1,8- Cineole (7.5)	*α*-Phellandrene (6.9)
NBH-18	*α*-Phellandrene (32.0)	*α*-Terpinolene (21.3)	p-cymen (17.3)
NBH-19	p-cymen (19.5)	*α*-Phellandrene (18.2)	*β*–Caryophyllene (8.2)
NBH-20	p-cymen (76.0)	p-cymen-8-ol (3.3)	Limonene (1.4)
NBH-21	*α*-Terpinolene (46.9)	p-cymen (9.1)	*α*-Phellandrene (4.5)
NBH-22	*α*-Terpinolene (56.6)	*α*-Phellandrene (7.2)	*α*-Terpinene (6.6)
Azad-1	*α*-Phellandrene (45.7)	1,8- Cineole (14.2)	*τ*-terpenine (10.9)
KTS-2	*α*-Phellandrene (36.4)	*τ*-terpenine (24.4)	p-cymen (14.1)
P. Peetabh	1,8- Cineole (20.3)	Borneol (18.9)	p-menth-1-en-4-ol (9.5)
Prabha	*τ*-terpenine (41.9)	p-cymen (10.6)	p-menth-1-en-8-ol (9.3)
RH-5	*τ*-terpenine (61.3)	*α*-Phellandrene (17.0)	p-cymen (5.3)
R. Sonia	p-cymen (28.1)	p-menth-1-en-8-ol (18.1)	1,3,8-p-Menthatriene (10.0)
Roma	*α*-Terpinolene (75.8)	*α*-Phellandrene (5.8)	*α*-Terpinene (5.2)

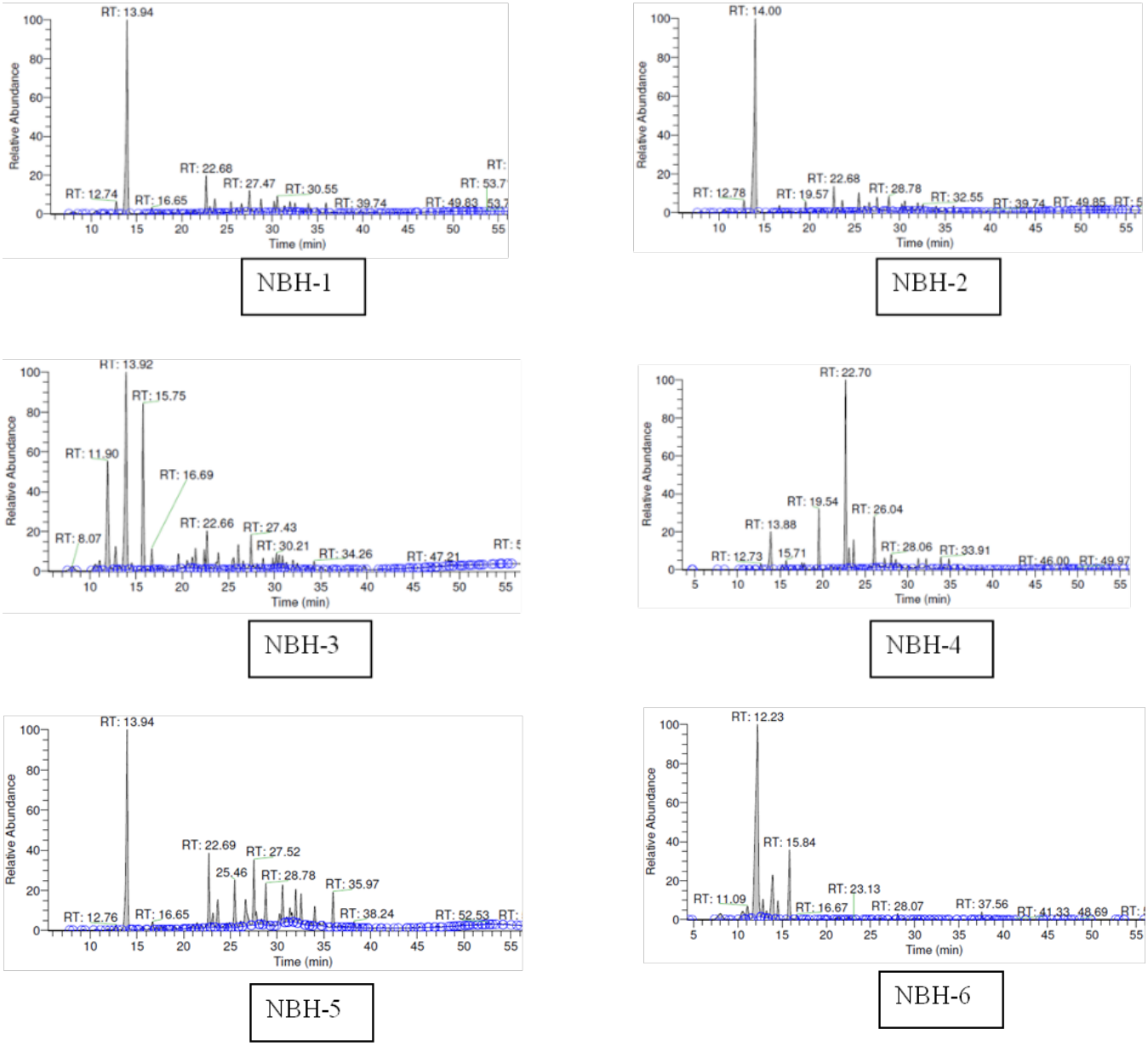

Fig. 1: GCMS chromatogram of leaf essential oil of *C. longa* L. accessions.

Roma while 1,8-Cineole was present as second major compound (5.91 to 14.17%) in accessions NBH-13, NBH-17 and Azad-1. p-cymene was also recorded as the second major compound (6.98-10.55%) in NBH-4, NBH-11, NBH-16, NBH-21 and Prabha. In the same way, τ-terpenine was detected as second major compound in KTS-2 (24.37%). In accessions NBH-3, NBH-6, NBH-7, NBH-8, NBH-10 and NBH-18, α-Terpinolene was the second major compound (9.20-21.26%). In varieties P. Peetabh and R. Sonia; Borneol (18.86%) and p-menth-1-en-8-ol (18.08%) were present as second important compound, respectively. p-cymen-8-ol (3.28-11.09%) was second major compound in NBH-1, NBH-5, NBH-9, NBH-14, NBH-15 and NBH-20.

Raina *et al*. (2002) showed the presence of terpinolene (26.4%), 1,8-cineole (9.5%), α-phellandrene (8.0%) and terpinen-4-ol (7.4%) as the major constituents in samples from the plains of northern India. Raina *et al*. (2005) identified three main constituents; α-phellandrene (53.4%), terpinolene (11.5%) and 1,8-cineole (10.5%) from leaf essential oil. The leaf oil of *C. longa* from Vietnam contained mainly α-phellandrene (24.5%), 1,8-cineole (15.9%), p-cymene (13.2%) and β-pinene (8.9%) (Dung *et al*., 1995). The quantitative and qualitative composition of leaf essential oil was found to be different in all 29 accessions. From our analysis of turmeric leaf oil of 29 accessions, α-phellandrene (17 accessions); p-cymene (19 accessions), α-terpinolene (17 accessions) and p-cymene-8-ol (10 accessions) emerged as major chemical constituents. Out of 41 compounds, δ-Elemene was reported only in R. Sonia while β-Bisabolene was detected in Roma and P. Peetabh only. Thymol was characterised in KTS-2 and P. Peetabh; Germacrone in NBH-8 and NBH-13; τ-Elemene in Prabha and P. Peetabh and Curlone was detected in NBH-10, Prabha and Roma. The volatile oils from leaves of *C. longa* were usually dominated by monoterpenes, particularly *p*-cymene, *α*-phellandrene, terpinolene, *p*-cymen-8-ol, cineole, and

myrcene while the major part of the oil from roots and rhizomes contained sesquiterpenes.

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References

Agarwal, K.A., Tripathi, C.D., Agarwal, B.B. and Saluja, S. 2011. Efficacy of turmeric (curcumin) in pain and postoperative fatigue after laparoscopic cholecystectomy: a double-blind, randomized placebo-controlled study. *Surgical Endoscopy* **25**(12): 3805-3810.

Anand, P., Thomas, S.G. Kunnumakkara, A.B., Sundaram, C., Kuzhuvelil B.H., Sung, B., Tharakan, S.T., Misra, K., Priyadarsini, I.K., Rajasekharan, K.N. and Aggarwal, B. 2008. Biological activities of curcumin and its analogues (Congeners) made by man and Mother Nature. *Biochemical Pharmacology* **76**: 1590-1611.

De, R., Kundu P., Swarnakar, S., Ramamurthy, T., Chowdhury, A., Nair, G.B. and Mukhopadhyay, A.K. 2009. Antimicrobial activity of curcumin against *Helicobacter pylori* isolates from India and during infections in mice. *Antimicrobial Agents Chemotherapy* **53**(4): 1592-1597.

Dung, N.X., Tuyet, N.T.B., Leclercq, P.A. 1995. *Journal of Essential Oil and Research* **1**: 7: 701.

Jayaprakasha, G.K., Rao, L.J.M. and Sakariah, K.K. 2002. Improved HPLC method for the determination of curcumin, demethoxycurcumin, and bisdemethoxycurcumin. *Journal of Agriculture and Food Chemistry* **50**: 3668-3672.

Jayaprakasha, G.K., Rao, L.J.M. and Sakariah, K.K. 2005. Chemistry and biological activities of *C. longa. Trends in Food Science & Technology* **16**(12): 533-548.

Jurenka, J.S. 2009. Anti-inflammatory properties of curcumin, a major constituent of *Curcuma longa*: A review of preclinical and clinical research. *Alternative Medicine* **14**(2): 141-153.

Kar, B., Kuanar, A., Singh, S., Mohanty, S., Joshi, R.K., Subudhi, E and Nayak, S. 2014. *In vitro* induction, screening and detection of high essential oil yielding somaclones in turmeric (*Curcuma longa* L.). *Plant Growth Regulation* **72**: 59-66.

Lawrence, B.M. 2000. Progress in Essential Oils. Turmeric Oil. *Perfumer and Flavorist.* **25**(6): 32-38.

Mau, J., Laib, E., Wang, N., Chen, C., Chang, C. and Chyau, C. 2003. Composition and antioxidant activity of the essential oil from *Curcuma zedoaria*. *Food Chemistry* **82**: 583-591.

Mundle, N.J. and Mengre, S. 2011. Preliminary phytochemical evaluation of the oil extracted from leaves of *Curcuma longa* L. and its application as biofuel. *International Journal of Pharmaceutical and Phytopharmacological Research* **1**(2): 73-77.

Saraswathy, N., Rohit, R., Shanmugan, K., Sozheeswari, S.C. and Ramalingam, P. 2012. A preliminary investigation of Turmeric-Agar composite film as bioactive wound dressing material on excision wound in rat model. *Indian Journal of Natural Products and Resources.* **3**(2): 237-241.

Singh, G., Singh, O.P. and Maurya, S. 2002. Chemical and biocidal investigations on essential oils of some Indian *Curcuma* species. *Progress in Crystal Growth and Characterization of Materials* **45**(1-2): 75-81.

Su, H.C.F., Robert, H. and Jilani, G. 1982. Isolation, purification and characterization of insect repellents from *Curcuma longa* (L). *Journal of Agriculture and Food Chemistry* **30**: 290-292.

Tripathi, A.K., Prajapati, V., Verma, N., Bahl, J.R., Bansal, R.P., Khanuja, S.P.S. and Kumar, S. 2002. Bioactivities of the leaf essential oil of *Curcuma Longa* (Var. Ch-66) on three species of stored-product beetles (*Coleoptera). Journal of Economic Entomology* **95**(1): 183-189.