Annals of Agricultural Science (2012) 57(2), 113–116

Faculty of Agriculture, Ain Shams University

Annals of Agricultural Science

www.elsevier.com/locate/aoas

Original Article

Lemongrass (*Cymbopogon citratus*) essential oil as affected by drying methods

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Received 5 May 2012; accepted 13 May 2012
Available online 25 October 2012

KEYWORDS

Lemongrass;
Cymbopogon citratus;
Essential oil;
Drying methods

Abstract The leaves of lemongrass (*Cymbopogon citratus*) were dried using three different drying methods (sun-drying for 36 h, shade-drying for 48 h and oven-drying at 45 °C for 7 h). The essential oil was obtained by hydro-distillation of the leaves dried by every treatment, and was analyzed by capillary GC and GC/mass instruments. Statistical analysis showed significant differences in the essential oil content of leaves dried by different drying methods. Oven drying gave the highest essential oil percentage (2.45%) compared to shade-drying (2.12%) and sun-drying methods (2.10%). Eighteen components were identified in the essential oil of fresh and dried *C. citratus* leaves obtained by different drying methods, including geranial (citral-a), neral (citral-b) and myrcene as main components. The drying methods had a marked effect on the proportion of the various components.

Introduction

Cymbopogon (family: Poaceae) represents an important genus of about 120 species that grows in tropical and subtropical regions around the world. On account of their diverse uses in pharmaceutical, cosmetics, food and flavor, and agriculture industries. *Cymbopogon* grasses are cultivated on large scale, especially in tropics and subtropics (Akhila, 2010). *Cymbopogon citratus* (DC) Stapf possesses strong lemony odor due to its high content of the aldehyde citral, which has two geometric isomers, geranial (citral a) and neral (citral b) (Shahi et al., 2005). Normally, one isomer does not occur without the other. In addition to citral, the essential oil of *Cymbopogon* spp. consists of small quantities of geraniol, geranyl acetate and monoterpene olefins, such as limonene (in *C. flexuosus*) and myrcene (in *C. citratus*) (Weiss, 1997). *C. citratus* is commonly used in folk medicine for treatment of nervous and gastrointestinal disturbances, and as antispasmodic, analgesic, anti-inflammatory, anti-pyretic, diuretic and sedative (Santin et al., 2009). Studies on extracts from *C. citratus* leaves have demonstrated antioxidant, anti-microbial and anti-fungal activities (Oloyede, 2009; Pereira et al., 2009; Matasyoh et al., 2011).

A literature search was undertaken on the effect of different methods of drying on chemical composition and content of the

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Peer review under responsibility of Faculty of Agriculture, Ain-Shams University.

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http://dx.doi.org/10.1016/j.aoas.2012.08.004

essential oil. The results showed that drying method had a significant effect on oil content and composition of aromatic plants (Venskutonis, 1997; Morsy, 2004; Okoh et al., 2008; Shanjani et al., 2010). For example, the essential oil content of basil plant after drying with different methods (on dry weight basis) was reduced. The percentage loss of the essential oil content after drying was 68.0%, 10.0% and 34.3%, respectively for sun drying, shade drying and oven drying at 50 °C. The drying method also had a significant effect on proportion of the various components (Omidbaigi et al., 2004). Therefore, the aim of this study was to investigate the effect of drying method (sun, shade and oven drying at 45 °C) on the essential oil content and composition of *C. citratus*.

Materials and methods

Material

The fresh leaves of *C. citratus* were collected from the farm of the Ornamental Horticulture Department, Fac. of Agric., Banha Univ. in the first half of March 2009 growing season.

To study the effect of drying method, three methods of drying, (sun-drying, shade-drying with source of ventilation and oven-drying at 45 °C for 7 h) were investigated. In case of sun and shade-drying, 650 g fresh leaves was spread over 2 m^2 of area for 36 and 48 h, respectively.

Methods

Extraction procedure

Fresh and dried leaves of every treatment (100 g in three replications that were cut into small pieces (l × 1 cm)) were subjected to hydro-distillation for 3 h, using Clevenger-type apparatus, according to the method recommended by Guenther (1950).

The extracted essential oils were dried using anhydrous sodium sulfate and stored in sealed vials at low temperature (2 °C) before analysis.

Gas chromatography

GC analyses were performed, using a HP 6890 GC gas chromatograph equipped with a fused capillary column (30 m × 320 μm i.d., film thickness 0.25 μm) coated with 5% Phenyl Methyl Siloxane (HP-5). Oven temperature was held at 50 °C for 2 min and then programed to 240 °C at a rate of 8 °C/min. Detector (FID) temperature was 280 °C and injector temperature was 240 °C; Nitrogen was used as carrier gas with a linear velocity of 30 ml/min. The percentages of compounds were calculated by the area normalization method, without considering response factors.

Gas chromatography–mass spectroscopy

GC–MS analyses were carried out using a Varian 240 GC–MS system equipped with a VF-5 fused capillary column (30 m × 0.25 mm i.d., film thickness 0.25 μm); oven temperature was 50–180 °C at a rate of 5 °C/min, transfer line temperature 250 °C, carrier gas was helium with a flow rate of 1 ml/min, spilt ratio 1:20, ionization energy 70 eV, and mass range 35–390 a.m.u.

Table 1 Effect of drying methods on essential oil percentage (%) in the leaves of *Cymbopogon citratus* (on dry wt. basis).

Drying method	Essential oil (%)
Fresh	2.86
Sun drying	2.10
Shade drying	2.12
Oven drying	2.34
LSD at 0.05	0.218

Table 2 Analysis of variance for drying methods.

Source of variation	DF	MS
Drying method	3	0.389*
Error	8	0.013
Total	11	

* Significant at 0.05.

The components of the oils were identified by comparison of their mass spectra with those of a computer library or with authentic compounds.

Statistical analysis

The statistical analysis was carried out using the Least Significant Difference (LSD) test at 0.05% according to Snedecor and Cochran (1982).

Result and discussion

A pale yellow essential oil with yield of 0.67% (on fresh weight basis) was obtained from fresh lemongrass plant. This result agrees with some works who reported that oil content of a normal cut should average 0.25–0.50%, but with good management and selected strains could be yielded up to 0.66–0.90% (Weiss, 1997; Maiti et al., 2006).

The method of drying had a significant effect on the essential oil content of *C. citratus* (Tables 1 and 2). Lemongrass leaves dried in an oven at 45 °C had the highest essential oil content (2.34%) on dry weight basis. While, lemongrass leaves dried in sunshine and in shade afforded oil at percentages of 2.10% and 2.12%, respectively with no significant difference between them.

Eighteen components were identified in the essential oil of fresh and dried *C. citratus* leaves by different drying methods, which represented 99.29–88.41% of the oil components. The chemical constituents of oils are presented in (Fig. 1) and (Table 3). The components are listed in order of their retention time on the VF-5 column.

The major components of the essential oils were geranial (31.53%, 39.86% and 37.24%), neral (30.08%, 34.52% and 31.28%) and myrcene (16.61%, 14.49% and 15.42%) in oils extracted from lemongrass leaves dried by sun, shade and oven drying, respectively; the quality of lemongrass is generally determined by its citral content.

Comparison of the results showed that different used drying methods had no effect on the major components of the essential oil, but had a significant effect on their percentages.

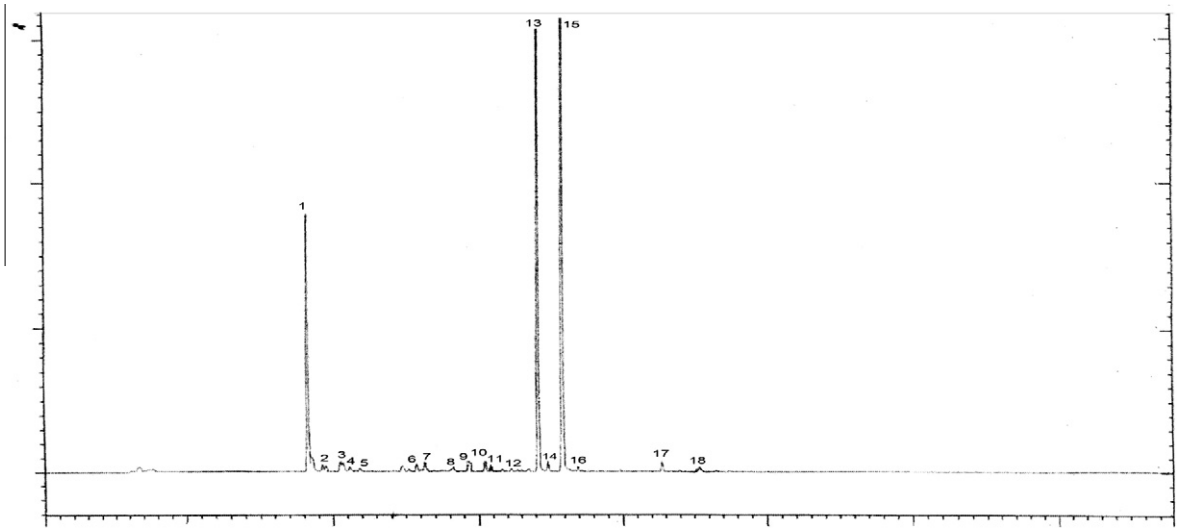

Fig. 1 Gas chromatogram of lemongrass *C. citratus* oil.

Table 3 Essential oil components of *Cymbopogon citratus* as affected by different drying methods of leaves.

No.	Compound	RT	Fresh	Sun-drying	Shade-drying	Oven-drying
1	Myrcene	9.15	15.69	16.16	14.49	15.42
2	Limonene	9.78	0.41	0.42	0.43	0.40
3	*E,E*-cosmene	10.37	0.20	0.23	0.21	1.26
4	*Z*-β-Ocimene	10.60	0.97	*t*	0.17	0.22
5	*E*-β-Ocimene	10.94	0.41	0.28	0.26	0.27
6	α-Terpinolene	12.87	1.02	1.09	1.09	1.06
7	Citronellal	13.16	0.60	2.06	2.03	3.01
8	Cis-Verbenol	14.10	0.15	0.15	0.15	0.18
9	Linalool	14.66	1.03	2.06	2.03	2.44
10	Cis-Carveol	15.23	1.18	1.49	1.35	1.47
11	Atrimesol	15.41	0.26	0.15	*t*	0.19
12	Nerol	16.15	0.17	0.27	0.22	0.29
13	Neral	17.15	34.98	30.08	34.52	31.28
14	Geraniol	17.44	0.53	0.86	0.95	1.31
15	Geranial	18.01	40.72	31.53	39.86	37.24
16	Carveol	18.48	0.18	0.65	0.38	0.73
17	Geranyl acetate	21.38	0.51	0.7	0.49	0.67
18	Caryophellene	22.66	0.28	0.23	0.20	0.21
			99.29	88.41	98.83	97.63

$t < 0.05$.

These results are in agreement with those obtained in other essential oil-bearing plants (Morsy, 2004; Omidbaigi et al., 2004; Sefidkon et al., 2006).The relatively higher proportions of geranial and neral in the essential oil of shade dried lemongrass leaves were more pronounced than those in the other two drying methods. While, myrcene content in oven dried lemongrass leaves' essential oil was higher than that in essential oils in leaves dried by using the other two methods.

It could be concluded that drying of *C. citratus* leaves in the oven at 45 °C for 7 h. is more suitable and recommended for obtaining higher essential oil content. Whereas, for higher percentages of major components (citral-a and citral-b) shade drying with source of ventilation for 48 h is more suitable.

References

Akhila, A., 2010. Essential oil-bearing grasses: the genus *Cymbopogon*. CRC Press, Taylor and Francis Group, p. 108.

Guenther, E., 1950. In: The Essential Oils, vol. IV. D. Van Nostrad company, Inc., New York, USA, pp. 20–65.

Matasyoh, J.C., Wagara, I.N., Nakavuma, J.L., Kibural, A.M., 2011. Chemical composition of *Cymbopogon citratus* essential oil and its effect on mycotoxigenic *Aspergillus* species. Afr. J. Food Sci. 5 (3), 138–142.

Maiti, S., Raju, S., Geetha, K., Mandal, K. (2006). Good Agricultural Practices for Patchouli, Geranium and Lemongrass. National Research Centre for Medicinal and Aromatic Plants, Boriavi, Anand-387310, Gujarat, India. pp. 16–17.

Morsy, N. F. (2004). Quality evaluation of the essential oil of basil plant dried by different methods. M. Sc. Thesis, Food Sci. and Techno. Dept., Fac. of Agric., Cairo Univ., Egypt.

Okoh, O.O., Sadimenko, A.P., Afolayan, A.J., 2008. The effects of drying on the chemical components of essential oils of *Calendula officinalis* L. Afr. J. Biotechnol. 7 (10), 1500–1502.

Omidbaigi, R., Sefidkon, F., Kazemi, F., 2004. Influence of drying methods on essential oil content and composition of Roman chamomile. Flavour Frag. J. 19, 196–198.

Oloyede, O.I., 2009. Chemical profile and antimicrobial activity of *Cymbopogon citratus* leaves. J. Nat. Prod. 2, 98–103.

Pereira, P.P., Puntel, R.L., Boschetti, T.K., Morel, A.F., 2009. Antioxidant effects of different extracts from *Melissa officinalis*, *Matricaria recutita* and *Cymbopogon citratus*. Neurochem. Res. J. 34, 973–983.

Santin, M.R., Dos Santos, A.O., Nakamura, C.V., Filho, B.P.D., Ferreira, I.C.P., Ueda-Nakamura, T., 2009. In vitro activity of the essential oil of *Cymbopogon citratus* and its major component (citral) on *Leishmania amazonensis*. Parasitol. Res. J. 105, 1489–1496.

Sefidkon, F., Abbasi, K., Khaniki, G.B., 2006. Influence of drying and extraction methods on yield and chemical composition of essential oil of Satureja hortensis. J. Food Chem. 99, 19–23.

Shahi, A., Kaul, M., Gupta, R., Dutt, P., Chandra, S., Qazi, G., 2005. Determination of essential oil quality index by using energy summation indices in an elite strain of *Cymbopogon citratus* (DC) Stapf [RRL(J)CCA$_{12}$]. Flavour Frag. J. 20, 118–121.

Shanjani, P.S., Mirza, M., Calagari, M., Adams, R.P., 2010. Effects drying and harvest season on the essential oil composition from foliage and berries of *Juniperus excels*. Ind. Crop. Prod. J. 32, 83–87.

Snedecor, G.W., Cochran, W.G., 1982. Statistical Methods, sixth ed. Iowa State Univ., Press, Iowa, USA.

Venskutonis, P., 1997. Effect of drying on the volatile constituents of thyme (*Thymus vulgaris* L.) and sage (*Salvia officinalis* L.). J. Food Chem. 59 (2), 219–227.

Weiss, E.A., 1997. Essential Oil Crops. CAB International, Wallingford, UK, pp. 86–103.