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Qualities of lemongrass (*Cymbopogan citratus*) essential oil at different drying conditions

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Abstract

Cymbopogon citratus is widely used in nutraceutical industries due to its strong lemony odor for its high content of the aldehyde citral and small quantities of geraniol, geranyl acetate and monoterpene olefins. Present studies were conducted to estimate the essential oil at different drying condition viz., sun-drying, shade-drying and oven-drying and analyzed for physicochemical properties (acid value, saponification value and iodine value). The maximum essential oil (3.05%) recovered in oven drying method while, the minimum saponification value (142.59 mgKOH/g) was recorded in sun drying method, however, the minimum acid value (4.14 mgKOH/g) and iodine value (114.31gI_2/100g) were recorded in shade drying method. The essential oils were analyzed by GC/MS instruments and identified eleven different components. Among the components identified, geranial (citral-a), neral (citral-b), caryophellene and limonene were found major components in the lemongrass essential oils.

Highlights

High amount of nutraceutical, neral and geranial were recovered by shade drying method. The drying methods do not have any effect on time of oil recovery.

Keywords: Lemongrass, drying, saponification value, iodine value, acid value

Cymbopogon (family Poaceae) is an important grass having about 120 species which grows in tropical and subtropical regions all over the world. It is highly valued due to their essential oil which is of high commercial value. It is recorded that this genus has about140 species out of which about 45 have been reported from India (Jagadish, 1975). The Cymbopogon species produce essential oils rich in monoterpenes such as citral, citronellal, citronellol, linalool, elemol, 1,8-cineole, limonene, geraniol, β-carophyllene, methyl heptenone, geranyl acetate and geranyl formate (Ganjewala *et al.*, 2008). On account of their diverse uses in pharmaceutical, cosmetics, food and flavor, and agriculture industries, Cymbopogon citratus possesses strong lemony odor because it contains high amount of two geometric isomer of citral aldehyde, viz., geranial and neral, as reported by Shahi *et al.*, (2005). Weiss (1997) also reported that the essential oil of Cumbopogon spp. has small quantities of geraniol, geranyl acetate and monoterpene olefins, such as limonene and myrecene. In another experiment, the oil of C. citratus was extracted by hydro-distillation and Gas Chromatography-Mass Spectrometry analysis was carried out by Matasyoh *et al.*, (2011). They reported that the oil was dominated by monoterpene hydrocarbons which accounted for 94.25% of the total oil and characterised by a high percentage of geranial (39.53%), neral (33.31%), and myrecene (11.41%). In general, C. citratus is used frequently

in traditional medicine for treatement of nervous and gastrointestinal disturbance, as the lemongrass oil has antispasmodic, analgesic, anti-inflammatory, anti-pyretic, diuretic and sedative properties (Santin *et al.*, 2009). Studies on extracts from C. citratus leaves have demonstrated the presence of antioxidant, anti-microbial and anti-fungal activities (Oloyede, 2009; Pereira *et al.*, 2009).

The extraction and characterization of bioactive molecules from medicinal plant is very essential for the new drugs with high therapeutic value. Recently the demand for using medicine of natural origin is increasing due to awareness of potential harmful effect of synthetics additives (Reische, 1998). *Cymbopogan citratus* is a great interest due to its commercially valuable essential oil and widely use in food industries as well as in traditional medicine.

Therefore, the present study was conducted to explore the oil content, chemical properties and characterizing the lemongrass essential oil under different drying condition.

Materials and Methods

The fresh leaves of *C. citratus* were collected from the farm of the Project Directorate for Farming Systems Research, Modipuram, and Meerut, India during January 2014. To study the effect of drying methods, three methods of drying, (sun-drying, shade drying with source of ventilation and oven drying at 45°C for 7 hrs.) were investigated. In case of sun and shade-drying, 2 kg fresh leaves were spread over $2m^2$ of area for 36 and 48 hours respectively.

Extraction procedure

Fresh and dried leaves were cut into small pieces and hydro- distillation was carried out for extraction of oil by using Clevenger-type apparatus for a total period of 4 hours as per method of Guenther (1950). The extracted essential oils were dried using anhydrous sodium sulfate and stored in sealed vials at low temperature for future use.

Oil yield

Lemongrass oil which was recovered by complete hydro distillation of lemongrass transferred to measuring cylinder, volume of the oil was recorded and expressed as oil content (%) as follow

$$Oil\ content\ (\%) = \frac{Oil\ weight}{Sample\ Weight}\ x\ 100$$

Gas Chromatography- mass spectroscopy

The essential oil extracted from the *Cymbopogan citratus* leaves of different treatments, and, GC-MS analysis was carried out with the use of Varian GC-MS 4000. The capillary column was of VF-5 (30 m . 25 mm i.d., film thickness 0.25 µm). The column temperature for GC and GC/MS were 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. The 4 ppm stock solution was prepared by diluting in n-Hexane and injected 1µml stock solution in the GCMS. The components of the essential oils were identified by comparison of their mass spectra with those of a computer library or with authentic compounds.

Table 1. Physiochemical Properties of Lemongrass oil at different drying treatments.

Treatments	Essential oil (%)	Saponification value (mg KOH/g)	Iodine value (gI_2/100g)	Acid Value (mgKOH/g)
Fresh Leaves	0.77±0.41	145.85±0.11	117.11±0.19	4.29±0.24
Sundry Leaves	2.50±0.09	142.59±0.21	115.80±0.12	4.57±0.42
Shade dry Leaves	2.65±0.05	143.61±0.28	114.31±0.14	4.14±0.18
Oven dry Leaves	3.06±0.21	144.60±0.24	116.19±0.12	4.46±0.16

Chemical properties

The chemical properties of lemon grass essential oil viz. saponification value, iodine value, acid values were analyzed using the standard methods (AOAC, 1998)

Saponification value

2 g of the oil sample was added to a flask with 30cm^3 of ethanolic KOH attached to a condenser for 30 minutes to ensure the sample was fully dissolved. After cooling the sample, 1cm^3 of phenolphthalein was added and titrated with 0.5M HCl until a pink endpoint has reached.

Saponification value (SV) was calculated from the equation (mg KOH/g)

$$SV = \frac{(S - B)xMx56.1}{Sample\ Weight\ (g)}$$

Where S = sample titre value, B = Blank titre value, M = Molarity of the HCl, 56.1 = Molecular weight of KOH

Iodine value

Iodine value was estimated following the procedure suggested by Akpan *et al*. (2006). In this method, 0.4gm of the oil was weighed into a conical flask and 20 ml of carbon tetra chloride was added. Then 25 ml of Dam's reagent was added to the flask and mixture was swirled vigorously after inserting a stopper on the flask. The flask was then kept in the dark for 2 hours 30 minutes. After that, 20 ml of 10% aqueous potassium iodide and 125 ml distilled water were added by using a measuring cylinder. The content of the flask was titrated with 0.1M sodium thiosulphate solution until the yellow colours almost disappear. Further, few drops of 1% starch indicator was added and the titration was continued by adding thiosulphate drop wise, until blue colour disappeared after vigorous shaking. The same procedure was also followed for blank test.

The iodine value (IV) is given by the expression (gI_2/100g)

$$IV = \frac{12.69\ C\ (V1 - V2)}{M}$$

Where C = Concentration of sodium, V1 = Volume of sodium thiosulphate used for blank, V2 = Volume of sodium thiosulphate used for determination, M = Mass of the sample.

Acid value

100 ml of neutral ethyl alcohol was heated with 10 g of oil sample in a 250cm^3 beaker until the mixture began to boil. The heat was removed and was titrated with N/10 KOH solution, using two drops of phenolphthalein as indicator with consistent shaking for which a permanent pink colour was obtained at the end point.

The Acid value was calculated using the expression (mg KOH/g); A.V = 0.56 x No. of ml. N/10 KOH used.

Statistical analysis

The collected data are statistically analysed by using OPSTAT developed by CCS Haryana Agricultural University, Hisar, India.

Results and Discussion

The *Cymbopogon* species produce essential oils rich in monoterpenes such as citral, citronellal, citronellol, linalool, elemol, 1,8-cineole, limonene, geraniol, β-carophyllene, methyl heptenone, geranyl acetate and geranyl formate. Pale yellow colour lemongrass oil extracted from fresh lemongrass plant with a yield of 0.76% on fresh weight basis. This result agrees with some workers who reported that oil content should average 0.25-0.5% but with good management and selected strain could yielded up to 0.66-0.90% (Hanaa *et al*., 2012).

The method of drying had a significant effect on the essential oil content of Lemongrass (Table 1). Lemongrass leaves dried in an oven at 45°C for 7 hr. had the highest essential content (3.06%) on dry weight basis. While, lemongrass leaves dried in sunshine and shade, contains the essential oil 2.50% and 2.65% respectively. The maximum oil yield was recorded in oven drying samples followed by shade

Table 2. Essential oil components of Cymbopogon citratus as affected by different drying methods of leaves

No.	Compound	RT (min.)	Fresh (%)	Sun-drying (%)	Shade drying (%)	Oven-drying (%)
1	Myrcene	11.87	12.39±0.16	14.21±0.22	10.23±0.15	12.68±0.41
2	Limonene	11.91	0.38±0.12	0.31±0.08	0.39±0.32	0.38±0.01
3	Citronellal	12.66	1.56±0.16	3.21±0.19	2.89±0.12	3.94±0.21
4	Cis-Carveol	13.12	0.61±0.05	0.91±0.05	0.68±0.02	1.23±0.05
5	Nerol	14.61	0.12±0.09	0.24±0.07	0.20±0.02	1.02±0.08
6	Neral	15.12	42.15±0.35	34.23±0.28	39.35±0.26	35.81±0.24
7	Geraniol	15.64	0.75±0.02	1.21±0.04	1.54±0.11	1.81±0.12
8	Geranial	16.44	35.12±0.21	28.54±0.41	33.26±0.19	31.00±0.31
9	Carveol	20.98	0.23±0.04	0.59±0.04	0.42±0.07	0.35±0.01
10	Geranyl acetate	22.19	0.26±0.08	0.86±0.16	0.54±0.09	1.25±0.21
11	Caryophellene	26.00	0.35±0.01	0.32±0.08	0.31±0.04	0.34±0.02

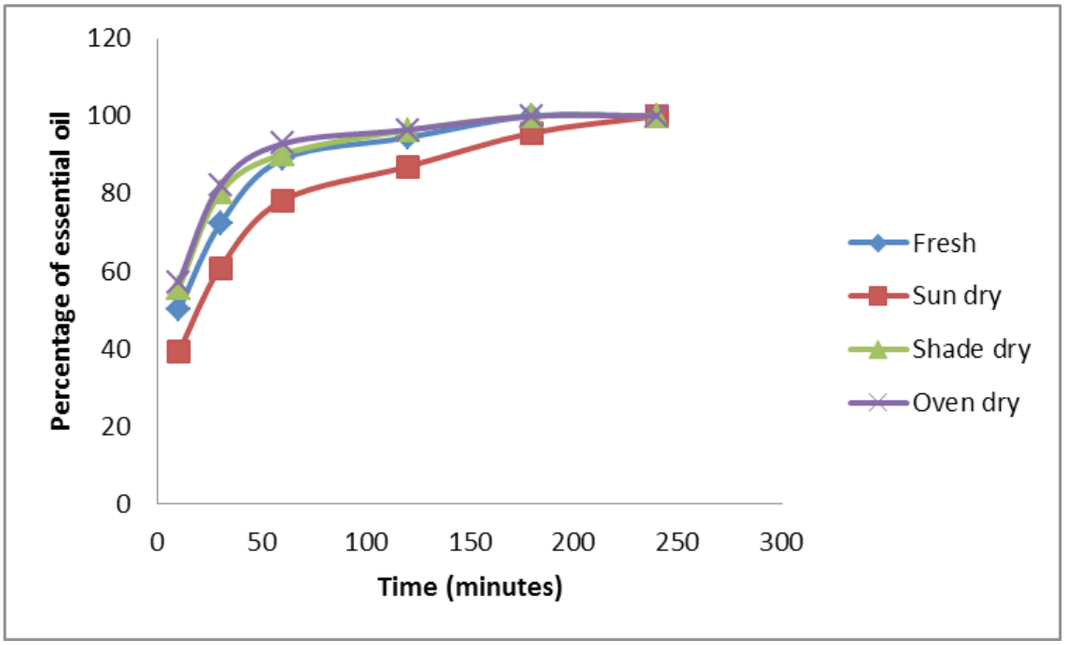

Figure 1. Effect of drying treatments on Lemongrass Oil extraction

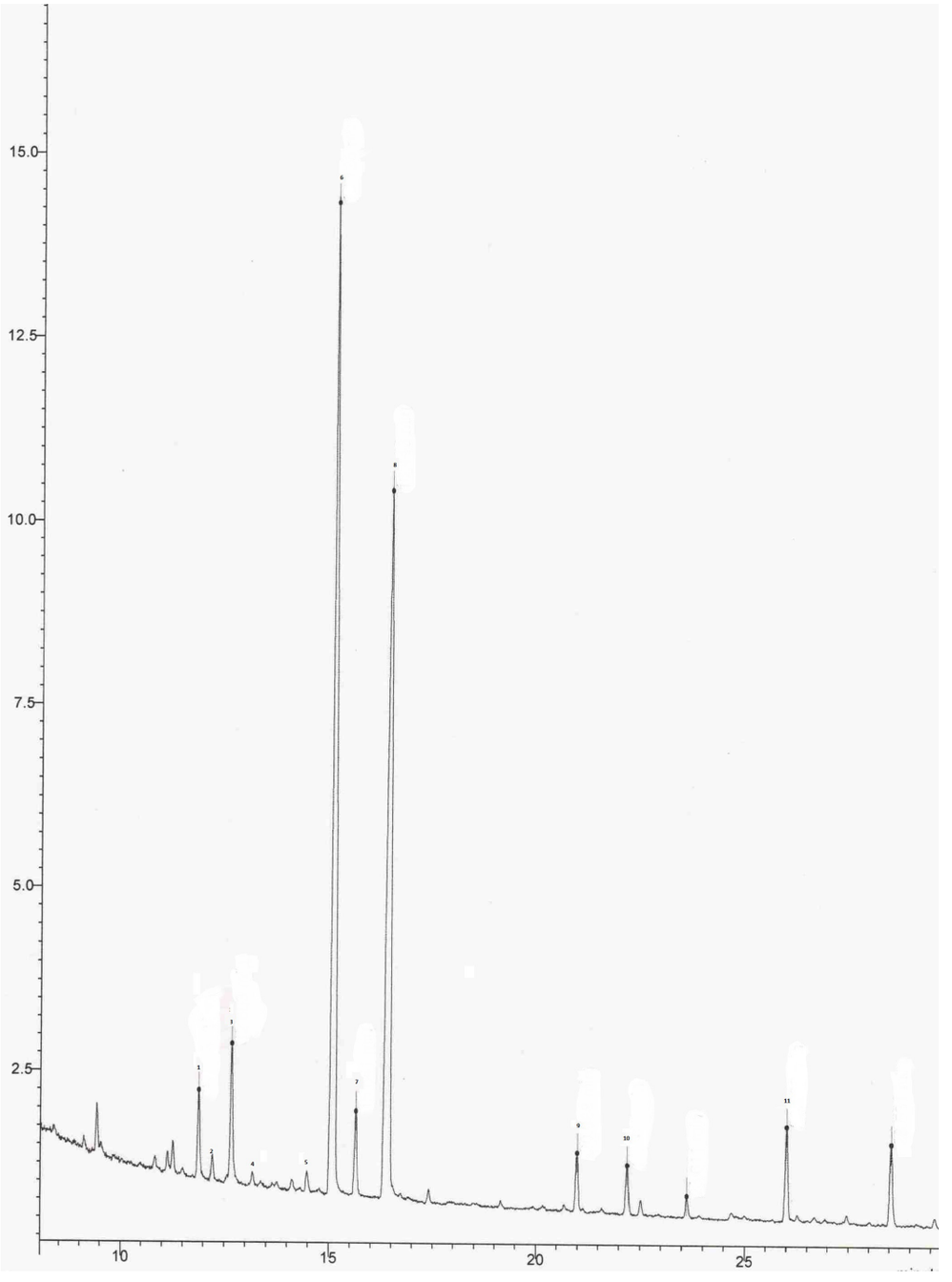

Figure 2. GCMS chromatogram of Lemongrass (C. citratus) oil.

drying and sun drying. These results are in agreement with those obtained from the essential oil extraction from Mentha piperita (Adanela *et al.*, 2013). This is due to shorter exposure of lemongrass leaves in oven drying method which might be causing lesser loss of essential oil.

The methods of drying have no significant effect on the qualities of essential oil in respect of saponification value, iodine value and acid value (Table 1). The average saponification value of lemongrass oil was 144.16 ± 0.21 mg KOH/g. Higher saponification justifies the enrichment of fat or oil content and can be used for cosmetics industries. The average Iodine value 115.85±0.57 g I_2/100g of lemongrass oil was obtained, which showed that the oil belongs to the class of Non-drying oils (Kochhar, 1998). These values indicate that lemongrass oil is in the range of semi drying oils, consisting predominantly polyunsaturated fatty acids mainly oleic and lenoliec fatty acid. This class of oils whose iodine value is between 100-150 possesses the property of absorbing oxygen on exposure to the atmosphere (Warra *et al*., 2011). An Acid value of lemon grass oil was recorded 4.35 mg KOH/g. This acid value is lower than the reported acid value of olive oil, shea nut fat or shea nut butter, indicating for its suitability in cosmetic industries. It has also been observed that the quantity of lemongrass oil was increase with time, by hydro distillation for all the samples of drying treatments including the fresh leaves. It was found that the extraction of lemongrass reached its optimum point at 60 minutes of hydro distillation (Figure 1). This indicates that there was no significant effect of drying parameter on the content of lemongrass oil extraction.

Eleven components were identified in the essential oil of fresh and dried C. citratus leaves by different drying methods. The chemical constituents of oils are presented along with their retention time in Table 2 and in Figure 2 of GCMS chromatograph. Tajidin *et al.* (2012) reported 65 chemical compounds in the essential oil of lemongrass where only 13 of the compounds were present in different maturity stages. However, they reported that the percentage citral content and percentage composition of geranial and neral were higher when lemongrass was harvested at 6.5 months after planting. The major components were geranial (citral-a), neral (citral-b), caryophellene and limonene in the essential oils of lemongrass leaves under different drying treatments. Ranitha *et al.* (2014a) and Abdurahman *et al.* (2013) also reported that the lemongrass oil contains neral, geranial and myrcene as main constituents and some minor compounds such as linalool, geranic acid and citronellol. The results of different components present (Table 2) in the essential oil, showed that drying method had no significant effect on the major component of the essential oils but had a significant effect on their percentages. The same effects were also found in case of other essential oil bearing plant (Adanela *et. al.*, 2013). Ranitha *et al.* (2014b) reported that there were no significant difference between the constituents of essential oil obtained by microwave assisted hydrodistillation and those obtained by conventional hydrodistillation by their GCMS studies. Among the different oil components estimated, neral and geranial content were higher compare to the other components. Kalita *et al.* 2012 reported that the major constituent of lemongrass oil were alpha citral (41.89%) followed by beta citral (34.90%), 1- methyl-1-ethylcyclopentane (3.13%) and toluene (2.83%) in Sikkim region. Edwin *et al.* (2012) also observed higher percentage of essential oil in dried samples as compared to fresh samples and the essential oil of C. citratus was mainly composed of monoterpenes hydrocarbons, of which, citral is the main component.

Conclusion

Oven drying of lemongrass oil leaves is more suitable and recommended for the extraction of higher essential oil recovery, whereas the shade drying is suitable and recommended for the higher percentage major component recovery. This might be due to exposure of lemon grass leaves sample in very low temperature during shade drying. But, there was no significant effect of drying on the physiochemical properties and dynamic of essential oil extraction by hydro distillation.

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