Journal of the Andaman Science Association Vol. 27(2):204-209 (2022)
ISSN 0970-4183, Printed in India

Effect of Drying Methods on Quality Parameters of Lemon Grass (*Cymbopogon flexuosus*) Var. OD-19

G. Devi Priyanka[1,2], Sohini Ghosh[1,2], R. Karthika Devi[1] and Ajit Arun Waman[1*]
[1]*Division of Horticulture and Forestry, ICAR- Central Island Agricultural Research Institute, Port Blair- 744105, Andaman and Nicobar Islands*
[2]*School of Life Sciences, Garden City University, Bengaluru- 560 049, Karnataka*
***Corresponding author's E-mail:** ajit.arun@icar.gov.in*

Abstract

Lemon grass is an important aromatic grass, known for its wider applications in food, fragrance, pharmaceutical and allied industries. In order to study the effect of different drying methods on quality of the produce, present investigation was carried out. Influence of four drying treatments namely shade drying, sun drying, oven drying (45 ºC) and oven drying (55 ºC) were studied in lemon grass variety OD-19. Results revealed that drying methods studied had profound influence on moisture content, chlorophyll content, essential oil content and oleoresin content of the dehydrated produce. It was observed that lemon grass leaves dried using sun drying method had the highest yield of essential oil than that obtained from other treatments. Oven drying of the leaves at 45 ºC resulted in highest recovery of oleoresin content along with higher contents of chlorophyll pigments than those observed from other treatments studied.

Key words: *Aromatic grass, chlorophylls, essential oil, oleoresin, tropical islands*

Introduction

Lemon grass is a tropical plant species of the genus *Cymbopogon* and the botanical family Poaceae. The species *Cymbopogon flexuosus* is also known as East Indian lemon grass, Cochin grass and Malabar grass (Gupta 1969; Joy et al., 2006). The name 'Lemon grass' is derived from its typical odour that is akin to Citrus species (Thomas, 1995). In the Indian trade, lemon grass oil is prominently known as Cochin oil, as almost 90% of the produce is transported from the Cochin port alone. This aromatic grass is commonly grown as a rainfed crop in the high precipitation areas of Kerala apart from its cultivation as an irrigated crop under semi-arid tropical conditions (Singh et al., 1999).

The essential oil responsible for its refreshing aroma is present to the tune of 0.3%, and citral (80-85%) has been identified as the major volatile constituent in the oil (Joy et al., 2001). The essential oil of lemon grass is dark yellow or yellow and is generally extracted using hydro-distillation method (Kamath et al., 2001). The oil exhibits antibacterial (Shanjun et al., 2020), anti-oxidant (Vinutha, 2016), analgesic (Chandrashekar and Prasanna, 2010) and anti-viral properties (Chao et al., 2000). The lemon grass oil is also utilized as preservative because of its hydrophobic nature (Sahoo and Mohanty, 2004).

An improved variety OD-19 (also known as Sugandhi) has been released from the Aromatic and Medicinal Plants Research Station, Odakkali of the Kerala Agricultural University, India for promoting its cultivation in the country. The variety is characterized by red stem and is adapted to a wide range of soil and climatic conditions (Joy et al., 2006). The variety was introduced in the Andaman and Nicobar Islands for its performance evaluation, wherein it exhibited luxuriant growth and profuse flowering. The variety is being promoted for cultivation in the islands.

Drying methods have been reported to influence various parameters such as drying recovery, moisture content, essential oil content, oleoresin content, chlorophyll content etc., which are considered as important quality parameters in dehydrated produce (Joy et al., 2001; Hanaa et al., 2012; Kumar et al., 2014). Hence, to study the effect of various drying methods on quality parameters of lemon grass, the present study was undertaken.

Materials and methods

Collection of plant samples and processing

Fresh leaves of *Cymbopogon flexuosus* var. OD-19 were collected from experimental field of Division of Horticulture and Forestry, ICAR-Central Island Agricultural Research Institute, Port Blair, Andaman and Nicobar Islands. Fresh leaves were used for determining leaf morphological parameters. Leaf length (cm) was measured by selecting healthy and recently matured leaves from harvested tillers, whereas leaf width (cm) was recorded at the widest part of the lamina. Leaf weight (g) was recorded using analytical balance and thickness of the leaf (mm) was measured by using Vernier calipers. Leaves were cut into small pieces of about 10 cm length and subjected to different treatments viz. shade drying (T_1), sun drying (T_2), oven drying at 45 ºC (T_3) and oven drying at 55 ºC (T_4).

Analysis and record of observations

Variations in colour of fresh leaf samples and dehydrated powders thereof were studied using the Royal Horticultural Society colour chart (RHS, 6th Edition, 2015-2019 Reprint). For estimating drying recovery, 200 g fresh leaves from each treatment were placed in glass trays and final weight of the leaves was measured accurately using electronic weighing balance (CY-104, Citizon, India). The determination was carried out using five replications and drying recovery (%, w/w) was calculated. Fresh leaves and leaf powder samples from various treatments were used for determination of moisture content. For this, pre-determined weight of sample was taken in pre-weighed Petri plates, which were then placed in hot air oven (Deep Vision Instruments, India) for drying at 105 ºC for 3 h. Three replications were maintained in each treatment. Weight of the dried samples was recorded and moisture content was calculated (%, w/w).

For determination of photosynthetic pigments, samples were accurately weighed to 0.125 g and placed in a test tube and 6.25 ml of dimethyl sulphoxide was added to it followed by incubation for 48 h at room temperature in dark. The supernatant was used to read the absorbance at 665 nm, 649 nm and 480 nm using Bio-spectrometer (Eppendorf). The analysis was carried out in triplicate. The contents of chlorophyll a, chlorophyll b, and carotenoids were calculated using following formulae given by Wellburn (1994) and values were converted into µg/mg.

Chlorophyll a (µg/ml) =
$12.19 \times A_{665}$ nm $- 3.45 \times A_{649}$ nm

Chlorophyll b (µg/ml) =
$21.99 \times A_{649}$ nm $- 5.32 \times A_{665}$ nm

Carotenoids (µg/ml) =
$1000 \times A_{480} - 2.14 \times$ chlorophyll a $- 70.16 \times$ chlorophyll b

Powdered and sieved samples (40 g) from each treatment were used for extraction of essential oil using Clevenger apparatus for the oils lighter than water (Borosil Glass Works Ltd., India) over a heating mantle (GMC010, Borosil Glass Works Ltd., India). Condensation was carried out using a closed water circulation system (Dweep Aqua Saver, ICAR-CIARI, Port Blair, India). Traces of moisture from essential oil were removed by drying over anhydrous sodium sulphate (Waman, 2020). Quantity of essential oil obtained was measured and expressed in percentage (v/w). For extraction of oleoresins, 10 g of powdered and sieved sample from each treatment was used. Extraction was done by Soxhlet apparatus (Borosil Glass Works Ltd., India) using acetone as a solvent for 2 h. Heating and condensation were done as described above. After extraction, the solvent was recovered until no traces of it remained (Singh et al., 2007). The oleoresin percentage was calculated on w/w basis.

Results and discussion

The present investigation was carried out in order to know the effect of different drying treatments on quality parameters of lemon grass (*Cymbopogon flexuosus*) var. OD-19. Morphological characters of plants such as plant height, number of tillers, number of leaves in each tiller have been reported to have significant correlation with essential oil content and yield (Joy et al., 2006) and hence record of these morphological parameters is required. In the present study, mean leaf length, width, thickness and weight was recorded as 144.28 ± 1.702 cm, 1.88 ± 0.059 cm, 0.13 ± 0.005 mm and 5.08 ± 0.351 g, respectively.

The variety was developed by Kerala Agricultural University and was introduced under island conditions. Under Kerala conditions, the variety produces leaves of 1-1.75 m (Joy et al., 2001) and considering the growth under island condition, it could be promoted under island conditions.

The RHS colour chart codes of ventral and dorsal side of the fresh leaves were 141B (Deep yellowish green) and N138C (Pale green), respectively. Colour codes of dried powdered samples from each treatment have been presented in Table 1. Though all the samples were in Moderate Yellow Green group, colour codes varied among the treatments. Drying recovery showed significant variations among the treatments (Table 2). The oven dried (45 ºC) samples showed highest drying recovery (36.95%) followed by sun drying (32.55%), shade drying (31.30%), while oven drying at 55 ºC exhibited the lowest recovery (28.50%).

Table 1. Drying recovery (%) and moisture content (%) in lemon grass leaves as influenced by drying treatments

Drying Treatment	Drying recovery (%)	Moisture (%) in dried produce
T_1 (Shade Drying)	31.30 ± 0.094 b	7.19 ± 0.058
T_2 (Sun Drying)	32.55 ± 0.502 b	6.96 ± 0.213
T_3 (Oven Drying 45 ºC)	36.95 ± 1.171 a	6.97 ± 0.044
T_4 (Oven Drying 55 ºC)	28.50 ± 0.306 c	5.86 ± 0.553

Values followed by similar alphabet in the column do not differ significantly using least significant difference at 5% level of significance

Initial moisture content in the fresh sample was 69.67 ± 0.856%, which decreased after drying (Table 2). Moisture content of dried samples varied from 5.86% (oven drying at 55 ºC) to 7.19% in shade drying treatment. The moisture content of sun dried sample (6.96%) and oven dried 45 ºC sample (6.97%) remained statistically similar. These findings are in conformity with earlier report by Ahmed and Langthasa (2022) in drumstick leaves wherein moisture content was in the order: shade drying> sun drying > oven drying (60 °C).

Table 2. RHS Colour chart values of all drying treatments

Treatment	Fan/ colour Group	Sheet	Colour Name
T_1 (Shade Drying)	3/ Yellow Green group	148A	Moderate yellow green
T_2 (Sun Drying)	3/ Yellow Green group	148B	Moderate yellow green
T_3 (Oven Drying 45 ºC)	3/ Yellow Green group	N 148B	Moderate yellow green
T_4 (Oven Drying 55 ºC)	3/ Yellow Green group	N 148A	Moderate yellow green

In the present investigation, chlorophyll a, chlorophyll b, total chlorophylls, chlorophyll a:b ratio and total carotenoids were estimated in the dried leaf powder samples of all the drying treatments (Table 3). The initial concentration of chlorophyll a, chlorophyll b and total chlorophyll of fresh leaves were 1.51, 0.48, 1.99 µg/mg, respectively. The concentrations of chlorophyll a, chlorophyll b and total chlorophyll of Oven dried (45 ºC) samples were the highest (2.01, 0.96, 2.97 µg/mg, respectively), which decreased in shade drying (1.02, 0.68, 1.70 µg/mg, respectively), followed by Oven dried 55 ºC sample (1.28, 0.39, 1.67 µg/mg, respectively), while the lowest values of photosynthetic pigments (0.70, 0.23, 0.93 µg/mg, respectively) were recorded in sun dried samples. These results are in agreement with report by Kumar et al. (2014) who reported differences in chlorophyll content of roselle leaves dried using different methods.

Table 3. Photosynthetic pigments of dried lemon grass leaf powder after drying treatments

Treatment	Chl. a (µg/mg)	Chl. b (µg/mg)	Total chl. (µg/mg)	Total Carotenoids (µg/mg)
T_1 (Shade Drying)	1.02 ± 0.038	0.68 ± 0.068	1.70 ± 0.102	0.11 ± 0.007
T_2 (Sun Drying)	0.70 ± 0.066	0.23 ± 0.022	0.93 ± 0.087	0.12 ± 0.020
T_3 (Oven Drying 45 ºC)	2.01 ± 0.022	0.96 ± 0.079	2.97 ± 0.022	0.25 ± 0.035
T_4 (Oven Drying 55 ºC)	1.28 ± 0.011	0.39 ± 0.037	1.67 ± 0.032	0.16 ± 0.032

Essential oils are aromatic liquids extracted from different parts of the plants like leaves, barks, seeds, flowers and peels (Tongnuanchan and Benjakul, 2014). Essential oil content from various drying methods was determined, results of which suggested that sun dried sample showed the highest essential oil content (0.50%) followed by shade drying (0.45%), while oil content was the lowest (0.38% each) in the oven dried samples, irrespective of the drying temperature used (Table 4). The oil content is known to vary with type of tissues, temperature, time, drying method employed etc. (Mashkani et al., 2018). The earlier report suggested essential oil content of 0.29% and 0.63% in lemon grass based on drying recovery of fresh leaves and dry leaves, respectively (Gupta, 1987). Variety OD-19 grown under Kerala condition has been known to have 0.3 to 0.4% oil content (Joy et al., 2007), while content was relatively higher in the present study, thereby indicating potential of promoting lemon grass under island conditions.

Table 4. Yield of Essential oil (%) and oleoresin (%) as influenced by drying treatments

Drying Treatment	Essential Oil (%)	Oleoresin (%)
T_1 (Shade Drying)	0.45 ± 0.075	7.54 ± 0.780
T_2 (Sun Drying)	0.50 ± 0.000	7.57 ± 0.232
T_3 (Oven Drying 45 ºC)	0.38 ± 0.000	8.59 ± 0.791
T_4 (Oven Drying 55 ºC)	0.38 ± 0.000	8.34 ± 0.345

Oleoresin content varied with the drying methods studied (Table 4). The oven dried (45 ºC) sample had the highest oleoresin content of 8.59%, which was followed by oven drying at 55 ºC (8.34 %), sun drying (7.57 %) and shade drying (7.54%). Earlier report in this variety suggested oleoresin recovery of 8.023% in its air dried leaves (Joy et al., 2007). Recovery of oleoresins from aromatic plants and spices is known to vary with species, genotypes, growing environment, drying methods, solvents used, extraction method etc. (Joy et al., 2007; Waman et al., 2020, 2021). Thus, such variations noticed in the present study could be justified.

Conclusion

It could be concluded that the drying methods influenced quantitative as well as qualitative parameters in lemon grass. Sun dried sample had highest essential oil content, while drying recovery, moisture content, oleoresin content, and chlorophylls were the highest in oven dried (45 ºC) sample. Considering the high essential oil content observed in the study, this crop and variety in particular has potential for cultivation in the Andaman Island condition. Findings of the study could help in establishing processing units of lemon grass under island conditions.

Acknowledgements

Authors are thankful to the Director, ICAR-CIARI, Port Blair for providing necessary facilities for conducting this study. Help rendered by Dr. Pooja Bohra, ICAR-CIARI, Port Blair during the study and in manuscript preparation is gratefully acknowledged.

References

Ahmed, S. & Langthasa, S. (2022). Effect of dehydration methods on quality parameters of drumstick (*Moringa oleifera* Lam.) leaf powder. J. Hortl. Sci. 17(1):137-146.

Chandrashekar, K.S. & Prasanna, K.S. (2010). Analgesic and anti-inflammatory activities of the essential oil from *Cymbopogon flexuosus*. Pharmacogn. J. 2(14):23-25.

Chao, S.C., Young, D.G. & Oberg, C.J. (2000). Screening for inhibitory activity of essential oils on selected bacteria, fungi and viruses. J. Essent. Oil Res. 12(5):639–649.

Mashkani, M.R.D., Larijani, K., Mehrafarin, A. & Badi, H.N. (2018). Changes in the essential oil content and composition of *Thymus daenensis* Celak. under different drying methods. Ind. Crops Prod. 112:389–395.

Gupta, B.K. (1969). Studies in the genus *Cymbopogon* Spreng. Proc. Indian Acad. Sci. 70:241–247.

Gupta, R.S. (1987). Trial cultivation of some medicinal and aromatic plants in Malwa region of Madhya Pradesh (India), Part II Analysis of essential oils. Indian Perf. 31(4):370-374.

Hanaa, A.M., Sallam, Y.I., El-Leithy, A.S. & Aly, S.E. (2012). Lemon grass (*Cymbopogon citratus*) essential oil as affected by drying methods. Ann. Agric. Sci. 57:113–116.

Joy, P.P., Thomas, J., Mathew, S., Jose, G. & Joseph, J. (2001). Aromatic plants, In: *Tropical Horticulture* Vol. 2, Bose, T.K., Kabir, J., Das, P. and Joy, P.P., Eds. Eds. Naya Prokash, Calcutta, pp. 633-733.

Joy, P.P., Skaria, B.P., Mathew, S., Mathew, G. & Joseph, A. (2006). Lemon grass: the fame of Cochin. Indian J. Arecanut Spices Med. Plants 8(2):55-64.

Joy, P.P., Mathew, S., Skaria, B.P. & Mathew, G. (2007). Development of lemongrass oleoresin for flavouring. Final Report of ICAR Cess Fund Scheme. Aromatic and Medicinal Plants Research Station, Odakkali, Asamannoor PO, Kerala, India, pp. 1-121.

Kamath, A., Asha, M.R., Ravi, R., Narasimhan, S. & Rajalakshmi, D. (2001). Comparative study of odour and GC- olfactometric profiles of selected essential oils. Flavour Frag. J. 16(6):401-407.

Kumar, S.S., Manoj, P., Shetty, N.P. & Giridhar, P. (2014). Effect of different drying methods on chlorophyll, ascorbic acid and antioxidant compounds retention of leaves of *Hibiscus sabdariffa* L. J. Sci. Food Agric. 95(9):1812–1820.

Sahoo, J. & Mohanty, B. (2004). Indigenous methods of preserving manuscripts: an overview. The Orissa Historical Res. J. 47(3):28-32.

Shanjun, G., Guangzhi, L., Jianguo, L., Jing, C., Lina, L., Zhen, L., Xiule, Z., Shoumin, Z., Rick, F.T. & Shuzhen, Z. (2020). Antimicrobial activity of lemongrass essential oil (*Cymbopogon flexuosus*) and its active component citral against dual-species biofilms of *Staphylococcus aureus* and *Candida* species. Front. Cell Infect. Microbiol. 10:603858.

Singh, S, Singh, A., Singh, V.P., Tajuddin, Singh, U.B. & Roy, S.K. (1999). Resource utilization efficiency, productivity and economics of traditional agricultural crops and aromatic crops under rain fed conditions of sub-tropical North India. J. Medicinal Aromatic Plant Sci. 21(4):972-977.

Singh, G., Maurya, S., de Lampasona, M. & Catalan, C. (2007). A comparison of chemical, antioxidant and antimicrobial studies of cinnamon leaves and bark volatile oils, oleoresins and their constituents. Food Chem. Toxicol. 45:1650.

Thomas, J. (1995). Lemongrass, In: *Advances in Horticulture* Vol. II- *Medicinal and Aromatic Plants*,

Chadha, K.L. and Gupta, R., Eds. Malhotra Publishing House, New Delhi, p. 726.

Tongnuanchan, P. & Benjakul, S. (2014). Essential oils: extraction, bioactivities, and their uses for food preservation. J. Fd. Sci. 79:R1231-R1249.

Vinutha, M. (2016). Studies on antibacterial, antioxidant and anticancerous activity using essential oil from *Cymbopogon flexuosus* (Stapf). Intl. J. Adv. Res. 4:1324-1341.

Waman, A.A. (2020). Essential oil composition of clove and nutmeg from Andaman and Nicobar Islands, India. Indian J. Biochem. Biophys. 57:95-100.

Wellburn, A.R. (1994). The spectral determination of chlorophylls a and b, as well as total carotenoids, using various solvents with spectrophotometers of different resolutions. J. Plant Physiol. 144:307-313.

Waman, A.A., Bohra, P., & Devi, R.K. (2020). Performance of improved varieties of true Cinnamon (*Cinnamomum verum* J. Presl.) in Andaman Islands, India. Pantnagar J. Res. 18(3):243-248.

Waman, A.A., Bohra, P., Roy, T.K. & Shivashankara, K.S. (2021). Seed morphological and biochemical studies in certain wild nutmegs. Trees, 35:939-945.

Received: 10th November 2022 **Accepted: 15th December 2022**