

Citral Content in Lemongrass (*Cymbopogon citratus*) Essential Oil at Early and Delayed Harvesting

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The demand for lemongrass (Cymbopogon citratus) is for its high citral content. Early or delayed harvesting of lemongrass affected essential oil and citral (Neral and Geranial) content. The objective of the study was to determine the effects of four maturity stages at harvest of lemongrass on essential oil, chemical composition and citral contents. The plants were harvested at 5.0, 6.0, 7.0 and 8.0 months after planting. After harvesting, the essential oil 3,7-dimethyl-2,6-octadienal (citral) is hydrodistilled from lemon grass in the laboratory, 3,7-dimethyl-2,6-octadienal acetals (citral acetals) are synthesized from citral, used in perfumery, flavour, for fortifying lemon oil and has strong antimicrobial qualities. Infrared spectroscopy (IR) and gas chromatography (GC) were conducted for verification of chemical constitution present in essential oil of lemon grass. Nutritionally, lemon grass is a good source of vitamins A and C, folic acid, magnesium, zinc, copper, iron, potassium, calcium manganese and vitamin E. Chemical composition and citral contents were analysed using gas chromatography-mass spectrometry (GC-MS) analysis. There were significant effects of maturity stages on essential oil and citral contents was found. Lemongrass harvested at 5.0 and 6.0, 7.0 months after planting had significantly higher oil contents than maturity i.e., 8.0 month.

Key words: Infra-red, Gas chromatography, Distillation, Lemon grass, Essential oil, Vitamin E and Antimicrobial activity.

1. INTRODUCTION

Cymbopogon, (Lemongrass) is a fast-growing tropical barbed wire grass, silky heads, Cochin grass, Malabar grass, oily heads, citronella grass or fever grass, tropical plant of graminaceae family native to Sri Lanka and south India. It gives a mild, sweet, and lemony pleasant aroma. It is extracted through steam distillation of the leaves and woody stalks of the Lemongrass plant. The name *Cymbopogon* derives from the Greek words *kymbe* (κύμβη, 'boat') and *pogon* (πώγων, 'beard'), which mean in most species, the hairy spikelet project from boat-shaped spathes. This species including about 55 genus the species (*Cymbopogon citratus*) are generally cultivated for culinary and medicinal purpose. The herb due to their scent, like lemon (*Citrus limon*), It is now widely cultivated in the tropical areas of America and Asia. Lemongrass is a tall, perennial grass is a coarse plant with linear leaves that grows in thick bunches, emerging from a strong base and standing for about 2 feet to 3 meters in height with a meter-wide stretch [1].

Essential oil called as citral or 3,7-dimethyl-2,6-octadienal is present in leaves and twigs of lemon grass which can be extracted easily by hydrodistillation. The essential oil of lemon

grass has many important chemical constituents, which are helpful for many applications. It has cis and trans citral, myrcene, geranial, etc. Citral after distillation can be used for the synthesis of ionones, vitamin A, different types of citral acetals, these acetals have a wide range of applications in perfumery and helpful to reduce antibacterial activities etc. [2].

Lemon grass is a tropical herb of 3–6 feet length, leaves and twigs of this grass have essential oil, which has insect repellent activity. Leaves of this grass dried and stored for making tea, helps to cure many problems of stomach and aesthetic problems. Lemon grass leaves from home were collected, dried under shade to deactivate starch, and cut into small pieces of 1–2 inches. Essential oil having lemon-like aroma was extracted by steam distillation, which can be used as scent and flavouring agents in medicine. It can help in fever reduction, helpful to improve digestion, reduce diarrhoea, and stomach-aches. As diluted oil, it is used to ease pain and arthritis, sterile stimulating, antispasmodic, and pain reliever. Lemon grass plant is shown in Figure 1.

Table 1: Physical characteristics of Citral.

Name	3,7-dimethyl-2,6-octadienal
Molar mass	152.24 g/mol
Appearance	Pale yellow liquid
Odour	Lemon like
Density:	0.893 g/cm ³
Boiling point	229°C
Refractive index:	1.484–1.490



Fig. 1: Cymbopogon citratus plant.

2. MATERIAL AND METHODS

2.1 Material

2.1.1. Planting (Raw Material)

The lemongrass was planted at the home garden. stalks were planted directly into the soil by placing the basal part of the stalk within a depth of about 3 to 4 cm. Lemongrass were harvested at 5.0, 6.0, 7.0 and 8.0 months after planting in month of July. Lemon grass leaves were allowed to dry at room temperature for 2 days and cut into pieces of 2 inches in length then distilled [3]. The isomeric E and Z structure of citral geranial (trans-citral/citral A/E isomer) and neral (cis citral/citral B/Z isomers) are shown in Figure 2.

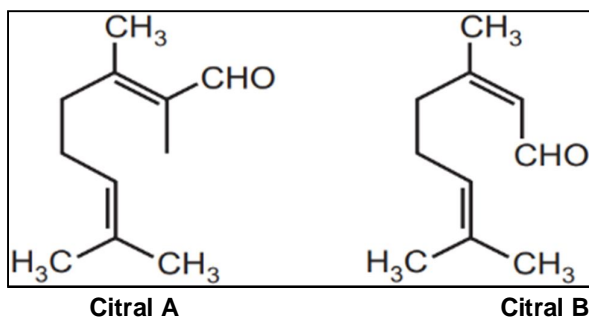


Fig. 2: Structure of Citral (A) geranial and (B) neral.

2.1.2. Reagent

Reagents were used by anhydrous sodium sulphate (Na_2SO_4) analytical (A.R.) grade, purchased from mark was used to remove moisture content from essential oils and n-hexane analytical (A.R.) grade purchased from E-mark.

2.2 Methods

2.2.1. Hydrodistillation of samples

Two hundred grams of the freeze dried sample were subjected to hydrodistillation. The hydrodistillation was carried out by laboratory (Dean and Stark apparatus) technique [4] as shown in Figure 3. The technique is effective in separating high boiling-point organic compounds from mixtures. The steam vaporizes the oil at the boiling point (100°C) of water or lower. The hot vapours can be cooled down and condensed into liquid of two distinct layers n-hexane were added to trap the condensed oil, through the top of the condenser. Later and hexane were collected every hour. Then, new portion of hexane was added through the condenser. The mixtures were combined and dried over anhydrous Na_2SO_4 and then filtered [5]. Finally, the hexane solution was evaporated or removed by using a

rotary evaporator method at 40°C to give a pale yellowish colour essential oil which was then stored at 4°C for analysis for determination of chemical constituents of essential oil.

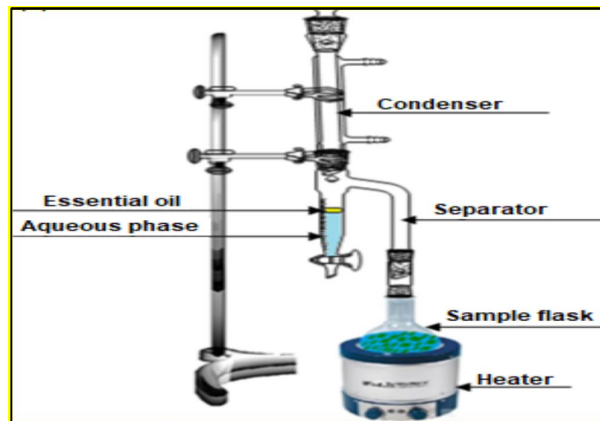


Fig. 3: Hydrodistillation laboratory (Dean and Stark) apparatus.

2.3. Analytical equipment used

2.3.1. Infrared spectrophotometer

The FT-IR spectra were performed on Perkin Elmer 577 FT-IR spectrophotometer from KBr pellets in the range 4000-400 cm^{-1} . Infrared spectroscopy can be used as good analytical tool identification of essential oil.

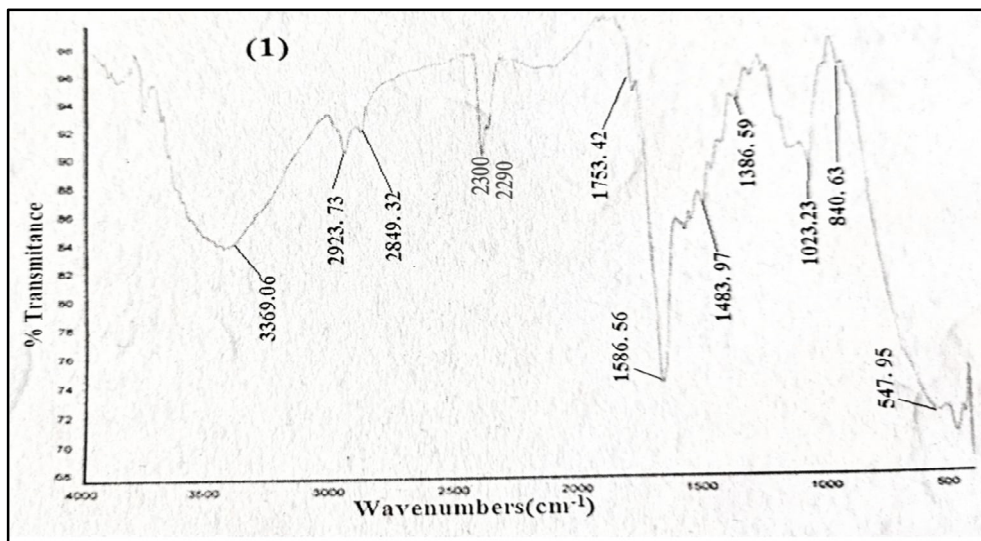


Fig. 4: IR spectra of Citral.

The IR spectral data of lemongrass oil exhibits strong characteristic broad peaks at 3369.06cm^{-1} and peaks at 2923.73cm^{-1} , 2849.32cm^{-1} , 2300cm^{-1} , 2290cm^{-1} , 1753.42cm^{-1} , 1586.56cm^{-1} , 1483.97cm^{-1} , and 1386.69cm^{-1} ,

2.3.2. Gas chromatograms

Citral contents were also analysed by using gas chromatography-mass spectrometry (GC-MS). The recorded gas chromatogram showing sharp peaks of geranial and neral of essential oil i.e. citral shown in Figure 4.

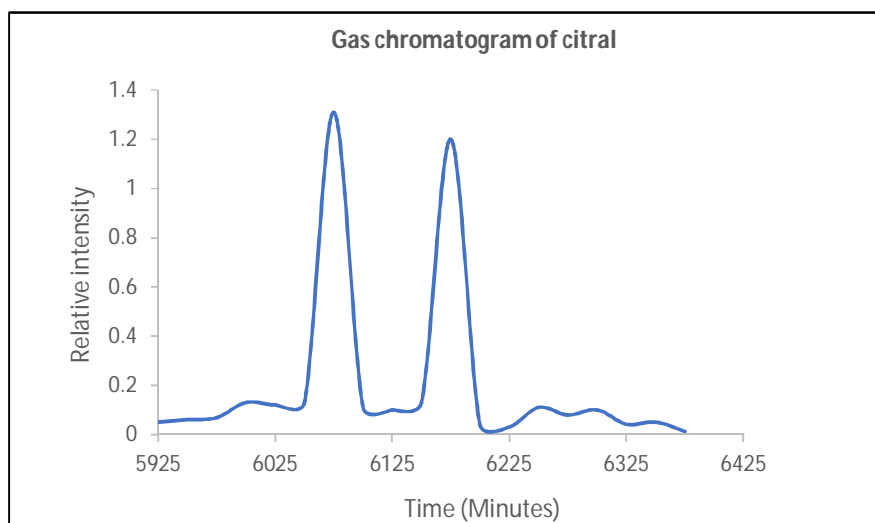


Fig. 4: Gas chromatogram of Citral.

2.3.3. Determination of essential oil content

The samples were removed after freeze drying and then weighed with a balance. The percentage yield of essential oil was determined using the formula given below, where the amount of essential oil recovered (g) was determined by weighing the oil after moisture was removed. The essential oil percentage was calculated by following formula.

$$\text{Percentage of essential oil} = \frac{\text{Essential oil weight} \times 100}{\text{Fresh sample weight} \times \text{air-Dried sample weight}}$$

$$\text{Air-Dried sample weight} = \frac{100 - \text{Moisture content}}{100}$$

3. Results and discussion

Essential oil from lemon grass was extracted by hydrodistillation. This oil, also known as citral, is tested for its chemical composition and functional groups by IR spectroscopy and obtained the results. Citral acetals by using citral was synthesized and tested by GC and IR spectroscopy, results are obtained as in Table 1 and graphs are plotted as in Figure 5 and 6 [6].

Table 1: Citral (%) and harvesting months of planting.

S. No.	Months	Citral Oil contents (%)	
		Geranial	Neral
1.	5 Month	40.03	30.58
2.	6 Month	45.58	34.63
3.	7 Month	44.14	33.67
4	8 Month	37.33	27.99

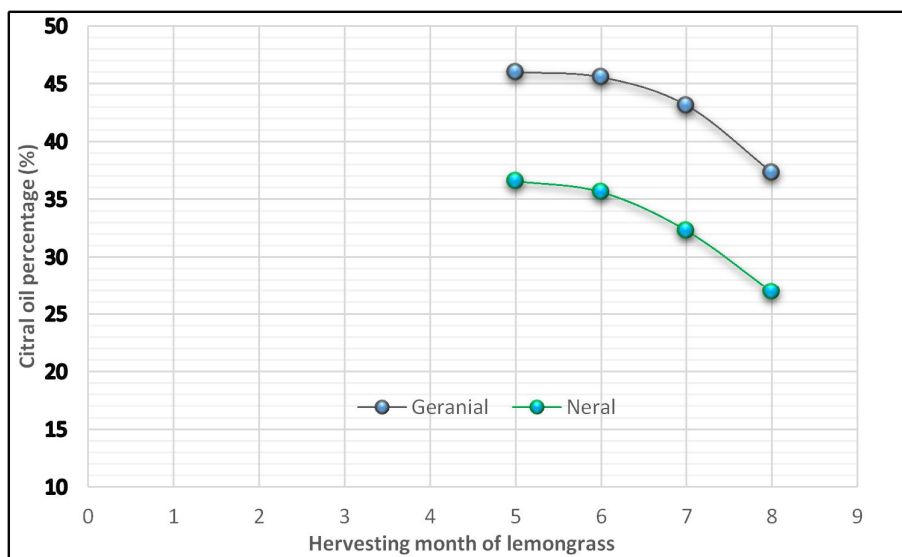


Fig. 5: Relationship between Citral (%) and harvesting months of planting.

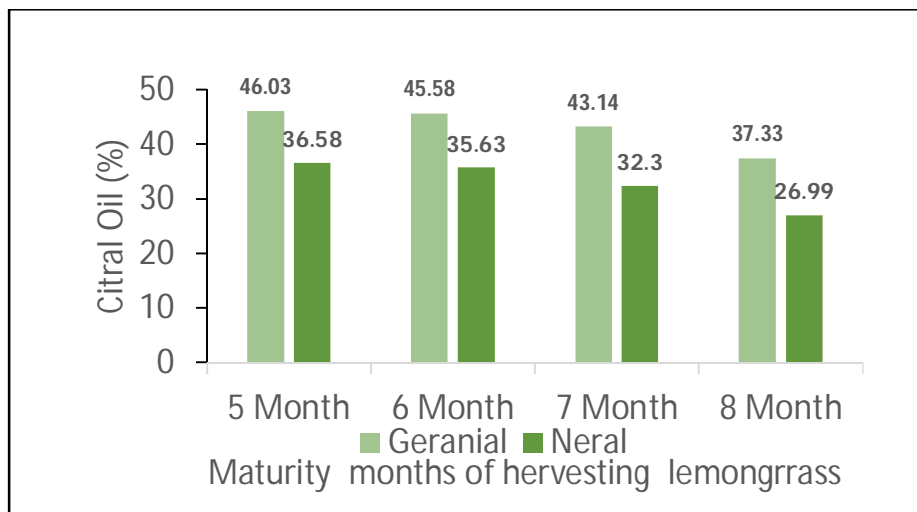


Fig. 6: Citral (Geranial and Neral) percentage (%) at 5,6,7 and 8 maturity months of harvesting of lemongrass (*Cymbopogon citratus*) in month of July.

3.1. Interpretation of IR spectra of lemon grass

The IR spectral data of lemon grass oil exhibits strong characteristic broad peaks at 3369.06 show the presence of OH and peaks at 2923.73, 2849.32, 2300 and 2290 cm^{-1} show the C–H stretching, a peak at 1753.42 shows the unsaturated conjugated C=O group present in citral, and peaks at 1586.56, 1483.97, and 1386.69 show the C=C stretching,

3.2. Essential Oil Content Percentage (%)

Essential oil content is a crucial criterion in determining the quality of lemongrass oil. Figure 5 shows that there was significant negative quadratic relationship between essential oil content and maturity at harvest of lemon-grass. Essential oil content decreased with the increase in maturity stages at harvest. Essential oil content varies considerably with growth. Fresh grass leaves has maximum content of essential oil.

4. Conclusion

The essential oil and citral content showed significant differences when lemongrass was harvested at different maturity stages. The optimum percentage of essential oil was obtained when lemongrass was harvested at 5.0 to 5.5 months after planting. Thus, lemongrass should be harvested between 5.0 to 5.5 months after planting to achieve optimum essential oil.

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