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# EXTRACTION OF OIL AND FORMULATION OF PERFUME FROM LEMONGRASS

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## ABSTRACT

Lemon grass (*Cymbopogon citratus*) essential oil is used in many aspects, such as flavouring industries, medicinal material and food technology. Perfume is a fragrant liquid made from an extract that has been distilled in alcohol and water. The research aimed at perfume production. Extraction of oil from the plant material; formulation of perfume from the extract and the infrared spectroscopy of the essential oil were conducted. Lemon grass leaves, n-Hexane and ethanol are the major materials and reagents used in the extraction process.Essential oil sample was deposited on HATR plates with ZnSe and the FTIR recorded in the range of 4000 – 650 $cm^{-1}$ by accumulating 64 scans per spectrum with a resolution of 4$cm^{-1}$. 1.9g (1.3%) and 1.01g (0.67%) of the essential oil were extracted from 150g each of the plant material using solvent extraction and steam distillation methods respectively. The result showed that, solvent extraction method gave a high yield of the oil extracted. FT-IR of the extracted oil sample showed the presence of –OH (33399.7$cm^{-1}$), >C=O (1651.2$cm^{-1}$), -$CH_3$ (1453.7$cm^{-1}$), -CH (2929.7$cm^{-1}$), and >C=C< (1420.1$cm^{-1}$). More researches should be carried out on extraction of essential oil using various plant materials due its simple operation method.

**Keywords:** Lemon grass, Essential oil, Perfume, Solvent extraction and Steam distillation.

## INTRODUCTION

Between 2010 and 2015, Nigeria Imported essential oils and perfumes of up to two hundred and forty five billion, six hundred million naira (Obiora, Jonah, Ikenna and Christian, 2019). Perfume is one of the commodities that can be produced locally using commonly available resources, such as lemon grass leaves. But as a result of politics of the 21st century, it is now largely imported. Lemon grass (*Cymbopogon citratus*) essential oil is used in many aspects, such as flavouring industries, medicinal material and food technology. Perfume is an aromatic liquid made from an extract that has been distilled in alcohol and water. Since the beginning of recorded history, humans have attempted to improve their own odour by using perfume, which emulates nature's pleasant smells (Aftab *et al.,* 2005). Many ordinary and man-made materials have been used to make perfume to apply to the skin and clothing, to put in cleaners and cosmetics, or to scent the air. Because of differences in body chemistry, temperature, and odours, no perfume odours exactly the same on any two different people (Adefemi and Awokunmi, 2010). Many ancient perfumes were made by extracting natural oils from plants through burning and steaming. Today, most perfumes are used to odor bar soaps (Omotade and Oloyede, 2009).

Lemongrass which is also called *C. citratus* belongs to the *Poaceae* family which counts more than 635genera and 9000 species. This

herb plant is commonly distributed around the world. There are more than 140 cultivated species only for the *Cymbopogon*, 52 of them grow in Africa, 45 in India, 6 in Australia, 6 in South America, 4 in Europe (only in Montenegro), 2 in North America, and the others in South Asia. *Cymbopogon exuosus* and *Cymbopogon citratus* stand for the two major species greatly cultivated for their essential oils in different regions of the world. *C. citratus* is known by numerous international common names, such as West Indian lemon grass or lemon grass (English), citronelle or verveine des indes (French), hierba limon or zacate de limón (Spanish), xiang mao (Chinese), capimcidrao or capim-santo (Portuguese), and locally there are identi ed more than 28 native names from different countries of the world. The genus *Cymbopogon* has been reviewed comprehensively in several articles (Avoseh, Oyedeji, Rungqu, Nkeh-Chungag, and Oyedeji, 2015; Haque, Ramadevi and Naebe, 2018).

Most essential oils are extracted from plant materials. Extractions are used to obtain a plant's vigorous botanical constituents that function as its "life force" (Adnan *et al.* 2010). They are essentially the liquefied version of a plant, and they effectively allow its beneficial compounds to reach the blood stream more rapidly than they would by simply consuming the plant. Herbal extract is produced when a botanical material is introduced to a solvent in which some of the plant material components dissolve. Eventually, the solvent becomes infused with the botanical materials that it has pulled from the source plant, and this is what is referred to as the "extract." The solution that leftovers at the end of the process can be liquid or the liquid can be removed to turn the remnants of the botanical into a solid. The solvents can act as preservatives or as agents that help plant cells to crack down and release their contents (Chavan, Lokhande and Rajput, 2005). There are various methods used to extract essential oil from lemon grass leaves, such as Steam Distillation and Solvent Extraction.

The main aim of this research is to make perfume from lemon grass with these objectives, extraction of oil from the plant material; formulation of perfume from the extract and infrared spectroscopy of the extracted essential oil. The significance of this research work focuses on the production of perfumes from natural sources as against artificial chemicals thereby reducing any side effect resulting from synthetic chemicals. The success of this work will stimulate the expansion of the perfume industry locally because of available, cheap raw materials. More jobs will be created by those that will be engage in planting/cultivation of the plant as well as establishing small size extraction plants. There will be decline on the resources spent on importation of lemon grass fragrance by end users (Omotade and Oloyede, 2009).

## MATERIALS AND METHODS

### Steam Distillation

The system for steam distillation of lemon grass oil consists of two distillation stills, condenser and collector (Gupta, Sunita and Saharan, 2009). The distillation still has a capacity to hold 1-1.5 kg of plant material per consignment. Steam is produced by heating water in first still. Steam thus produced is passed in the second still. 150g of lemon grass (chopped or unchopped) is filled in second still and its lid is fitted firmly, so that oil and vapor do not leak out. Steam is injected in the second still with the help of linking tube from the first still. The upcoming steam carries away the oil from

the plant material i.e. lemon grass and both oil as well as steam pass to the condenser through vapor line, where these vapors are condensed; oil and water are removed in the collector. Oil being lighter floats on top of the water. The mixture of oil and water was divided in the separating funnel. The separating funnel is than kept for 24 hours residence time, after which water was detached and discarded from bottom whereas the oil was collected in a separate beaker. The oil thus obtained is lemon grass oil having 80-85% critical content and some unstable terpenes (Chavan, Lokhande and Rajput, 2005; Gupta, Sunita and Saharan, 2009).

**Solvent Extraction**

60g of the dry sample of lemongrass were weighed from the sliced lemongrass sample and placed in a 500mL clean flat bottom flask. 300mL of n-hexane solvent were poured into the 500mL flask and stopped. The flask and content were allowed to stand for 72hrs; this was done to extract all the oil content in the lemongrass and for complete extraction. After which the extract was decanted into another 500mL beaker. 200mL of ethanol were added to extract the essential oil since essential oil is soluble in Ethanol. The mixture was then transferred to 500mL separating funnel and separated by a process called liquid-liquid separation process. The content of the separating funnel was allowed to come to equilibrium, which separated into two layers (depending on their different density). The lower Ethanol extract and the upper Hexane layer were collected into two separate 250mL beaker and were placed in a water bath at 78$^{o}$C. This was done to remove the Ethanol leaving only the natural essential oil. The yield of oil was determined by weighing the extract on an electronic weighing balance. The difference between the final weight of the beaker with extract and the initial weight of the empty beaker gave the weight of essential oil (Dey, Mohapatra and Misra, 2005; Chantal, Prachakoli and Ruangviriyachai, 2012). 10mL of lemon grass essential oil extract were measured and placed in a beaker containing 5mL of alcohol. 5mL of the fixatives were added to the mixture to improve the longevity of the perfume. The solution was shaken and poured into a bottle (Dey, Mohapatra and Misra, 2005).

Carry 630 FTIR of the Agilent Technologies was used to determine the functional groups present in the essential oil. Essential oil sample was deposited on HATR plates with ZnSe and the FTIR recorded in the range of 4000 – 650 $cm^{-1}$ by accumulating 64 scans per spectrum with a resolution of 4$cm^{-1}$. Data were then processed using the IR solution software.

## RESULTS

Quality and quantity of essential oil largely depends on the extraction procedures. In this research, the following result was obtained in the extraction of oil and formulation of the perfume from lemongrass leave. The amount of oil extracted from various methods in shown in Table 1.

**Table 1:** Amount of Oil Extracted

| S/N | Method | Amount of Leaves (g) | Amount of Oil Extracted (g) | Percentage (%) |
|---|---|---|---|---|
| 1. | Solvent extraction | 150 | 1.90 | 1.30 |
| 2. | Steam distillation | 150 | 1.01 | 0.67 |

The amount of essential oils obtained by solvent extraction method was 1.9 g of essential oil per 150g of dry lemongrass sample. This gave about 1.30% yield of essential oil per 150g of dry lemongrass. The temperature used was 78°C i.e. the boiling point of ethanol. The volume of oil was measured at every 3hr interval to determine the oil yield at varying time. As time lapses, the ethanol solvent decreases, thereby leaving the essential oil in the mixture (Chavan, Lokhande and Rajput, 2005).

The result obtained from steam distillation process was 1.01g weight of 150g of lemongrass sample giving up to 0.67% yield of oil. The essential oil extraction the oil produced was pale yellow, with pungent odour and has a cold nature. Because of its high volatility, it was stored in a well filled air-tight container confined from light in cool place (Basavaraja *et al.*, 2011). The essential oil is insoluble in water, miscible in alcohol and other organic solvents. This indicates that it's made up of organic compounds (Omotade and Oloyede, 2009).

From the Fourier-transform infrared spectroscopy of the essential oil, absorption bands at 3339.7, 1651.2, 1453.7, 2924.3 and 1043.7 $cm^{-1}$ were observed as shown in Figure 1.

**Table 2:** Result from Fourier Transform Infrared Analysis of the Oil

| S/N | Wave number ($cm^{-1}$) | Functional Group | S/N | Wave number ($cm^{-1}$) | Functional Group |
|---|---|---|---|---|---|
| 1 | 33399.7 | -OH | **6** | 1420.1 | >C=C< |
| 2 | 2974.4 | $-CH_3$ | **7** | 1326.9 | -OH (from 1° or 2°) |
| 3 | 2929.7 | -C-H (methyne stretching) | **8** | 1088.4 | C-C |
| 4 | 1651.2 | >C=O | **9** | 969.1 | C-H |
| 5 | 1453.7 | $-CH_3$ (asymmetric) | **10** | 1043.7 | C-C stretching |

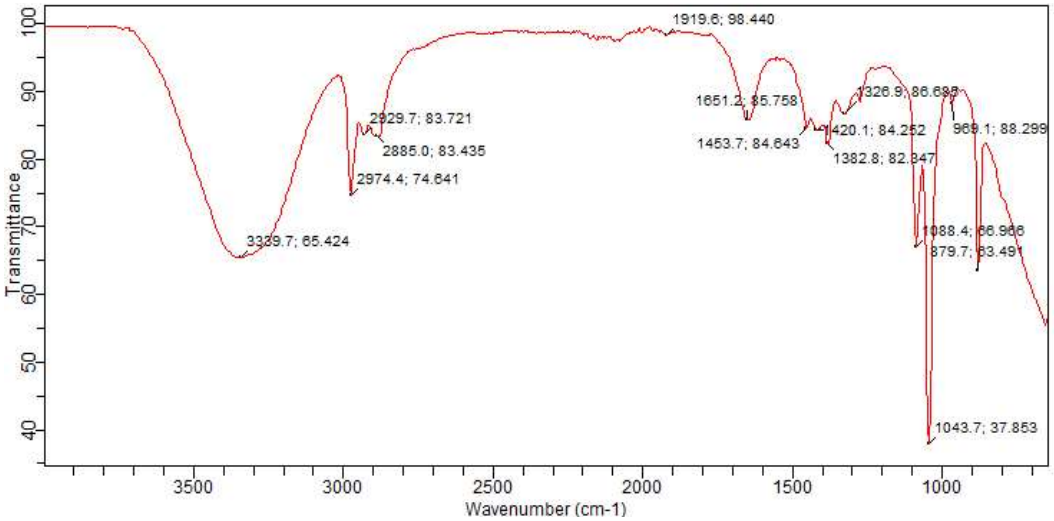


**Figure 1:** FTIR Spectrum of Essential Oil Lemon Grass Leaves

## DISCUSSION

From the experiment carried out it was observed that the best method used in the extraction of the essential oil from grass is solvent extraction method because it gave more quantity of the oil than the other methods. Omotade and Oloyede, (2009)

extracted 2.4 and 1.4g of essential oil from 150g of lemon grass leaves by solvent extraction and steam distillation methods respectively. Dey, Mohapatra and Misra, (2005) extracted 1.0, 1.5 and 2.2g of essential oil from 200g of lemon grass leaves by steam distillation, water distillation and solvent extraction methods respectively. Adefemi and Awokunmi, (2010) extracted 0.62 and 1.27g of essential oil from 120g of dry lemon grass leaves by steam distillation and solvent extraction methods respectively. Steam distillation method yielded less amount of oil compared to the solvent extraction method, this is because most volatile components of the oil gets missing during the heating process (Dey, Mohapatra and Misra, 2005; Agarwal and Manish, 2011). Steam Distillation is the most popular method used to extract and separate essential oils from plants for use in natural products. This happens when the steam vaporizes the plant material's volatile compounds, which finally go through a condensation and collection process (Chanthal, Prachakoli, and Ruangviriyachai 2012).

Solvent extraction method employs food grade solvents like hexane and ethanol to separate essential oils from plant material. It is best suited for plant materials that yield low amounts of essential oil, that are largely resinous, or that are delicate aromatics unable to withstand the pressure and distress of steam distillation. This method also produces a better fragrance than any type of distillation method. Through this process, the non-volatile plant material such as waxes and pigments, are also extracted and sometimes removed through other processes. Once the plant material has been treated with the solvent, it produces a waxy aromatic compound called a "concrete." When this concrete substance is mixed with alcohol, the oil particles are released. The abovementioned chemicals used in the process then remain in the oil and the oil is used in perfumes by the perfume industry or for aromatherapy purposes. Solvent extraction encompasses the following methods; Hypercritical $CO_2$ (Carbon dioxide), Maceration, Effleurage (Chanthal, Prachakoli and Ruangviriyachai, 2012).

From Table 2, the IR analysis carried out on lemon grass essential oil, a broad absorption band observed at 3339.7 $cm^{-1}$ was due to the presence of -OH functional group in the essential oil, this was confirmed by the emergence of 1336.9$cm^{-1}$ that -OH from either primary or secondary alkanol is present in the oil. Omotade and Oloyede, (2009) discovered the occurrence of –OH functional group in essential oil extracted from lemon grass leaves. At 1651.2$cm^{-1}$, it was confirmed that carbonyl group is present in the essential oil confirming the occurrence of either alkanals or aldehydes. Dey *et al.,* (2009) discovered the occurrence of –CH (methyne stretching bond), at 2924.3$cm^{-1}$ from IR analysis of an essential oil extracted from lemon grass leaves. Chanthal, Prachakoli, and Ruangviriyachai, (2012) also found an aldehyde compound (-CHO) in the lemongrass oil in extraction process. At 1453.7$cm^{-1}$ methyl (asymmetric) bend was observed which proved long chain hydrocarbon linkage; this was confirmed at 1043.7 $cm^{-1}$ which is C-C stretching to confirm the long chain.

## CONCLUSION AND RECOMMENDATION

The amount of oil from solvent extraction method was found to be higher than that obtained from steam distillation method. Kinetic studies of steam distillation process showed that, oil is not instantly extracted if stem is injected to the dry lemon grass, but

wetting or swelling of the grass inside the distillation still is needed for initial 10-15 minutes for diffusion and osmosis of oil inside the grass. IR analysis of the lemon grass leaves showed the presence of –OH functional group and the presence of some other stable compounds such as aldehydes and ketones. It also contains some unstable components, such as terpenes.

The following recommendations were made,

- ✓ Politics should always play a positive game towards educational policies, especially the entrepreneurship education in order to reduce the rate of perfume importation and improve the production of perfume locally using naturally available resources.
- ✓ More researches should be carried out on extraction of essential oil using various plant materials due its simple operation method.
- ✓ More perfume production companies should be provided in order to create more job opportunities in developing countries especially the populace Nigeria.

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