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RESEARCH ARTICLE OPEN ACCESS

Production of Perfume and Determination of the Physiochemical Features from Locally Available Lemongrass Leaves Extract

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Abstract

The main purpose of this work is to extract essential oil from locally and readily available Lemongrass as natural plants for the formulation of perfume as opposed to synthetic chemicals, with the end goal of eliminating the negative consequences that are associated with the usage of synthetic chemicals. Plants with no established edible use are considered waste in most parts of Nigeria, especially those considered as wild. However lemongrass (Cymbopogon citratus) leaves containing essential oils, can be used for the production of perfumes that can mask body odours and living homes. Lemongrass essential oil obtained through Soxhlet Extraction was used to formulate perfume using n-Hexane as Solvent media. At 65°C and 150 minutes, the oil yields obtained during extractions were 1.55%, 1.67%, 1.710%, %, 1.73% and 1.80%, respectively. The physicochemical properties of the formulations revealed that the essential oil has a saponification value of 21.04mgKOH/g. And at the same temperature, the density of the lemongrass oil was 0.8865gcm3 at a boiling point of 224℃. The essential oil was used successfully for the formulation and production of perfume resulted at 15% to 20% strength with Sandalwood as the top note, Lemongrass as the middle note and Lavender as the base note.

Keywords: Essential oil, Solvent Extraction, Perfume, Fragrance, Physiochemical Parameters, Lemongrass, Formulation, Solvents, Techniques, Yield, Notes, Perfume Concentration

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I. INTRODUCTION

In recent years, there has been a rise in researches being conducted on a diverse assortment of plants all over the world for the use in the production of food, pharmaceuticals cosmetics, and others. Often, the production of synthetic chemicals is one example of an industrial activity that contributes to pollution and other environmental problems due to its direct negative impacts on the natural world; therefore, there is a global move towards the use of raw material sources that are less harmful to the environment in a variety of manufacturing processes.

In an effort to reduce reliance on essence derived from synthetic sources and to save money that would otherwise be spent on the purchase of essential oils for the production of high-end perfumes, a novel search has been initiated for underutilized plants that can serve as sources of essential oils. The use of locally available lemongrass (Cymbopogon citratus) for the production of essential oil and perfume formulation is of very essence, as people have utilized a variety of methods, including the application of perfumes and other aromatic materials for the benefits of scent (www.worldhistory.org 2021), in order to mask or accentuate the fragrance of their bodies Oloyede (2009). Perfume refreshes the air and its fragrance like flowers around living environment is made up of three different notes, which are the base note, middle note and the top note, which these distinctive components blend to form an

harmonious scent that complements one another (Newton, 2020; Aftel, 2001; Groom, 2012). The essential oil from lemongrass leaves is also widely used in perfumes, cosmetics, medicines, germicides and insecticides (Agbafor and Akubugwo, 2007; Kotzekidou et al., 2008, Mahanta, et al., 2007), which therefore serve as a consumable plant by the general population Ekpenyong (2017).

In Nigeria, there exists a wide array of plants ranging from the largely known and highly utilized to the underutilized plants for which in-depth studies have not being done on their potential uses (Ugbogu et al., 2014). Locally, the lemongrass (Cymbopogon citratus) plant is known as "Eti" by the Edo's, "Ikon eti" by the Efik's, "Tsauri" by the Hausa's, "Myoyaka makara" by the Ibibio's, "Achara ehi" by the Igbo's, and "Kooko oba" by the Yoruba's and Ikpoo Okom by the Epie-Atissa's (Ijaw). Essential oils are made from various parts of plants, such as stems, leaves, roots, flowers (Hesham, Rassem et al., 2016), and at such lemongrass which is locally and readily available is harvested four times per annum and have a lifespan of four to eight years (www.nhb.gov.in, 2014).

There are numerous techniques such as solvent extraction, hydro-distillation, enfleurage, microwave aided hydro-distillation, superficial Carbon dioxide extraction, cold pressing, and soxhlet extraction that can be utilized in the distillation of essential oils and the formulation of perfumes. However, the three most popular techniques are solvent extraction (Suryawanshi et al., 2016), hydro-distillation Hydro-distillation (Jigisha K. Parish et al., 2011), effleurage extraction (Hunter, M. (2010); Manniche, L. (1999). But, solvent extraction is one extraction technique used to obtain the extract which increases oil output and regulate the oil's composition. It could also be applied to fragile plants in order to achieve a better yield of essential oil with a smaller amount of harvesting (Chrissie et al., 1996), and at a low temperature it could achieve a higher yield of extract while suffering a lower loss of heat-sensitive bioactive components (Suryawanshi et al., 2016). This is a preferred method that exceeds the optimal temperature and will trigger the enzymatic and chemical breakdown of the polyphenolic components (Akowuah and Zhari, 2010). This proves that extract of essential oil from locally and available Lemon grass as natural plants for the formulation of perfume as opposed to synthetic chemicals is achievable, which also determine the extent of oil yield as well as the physiochemical parameters of the extracted oil from dried lemongrass.

Furthermore, numerous in-depth analyses have been carried out in order to evaluate the quality of lemongrass powder that was made using a variety of drying techniques, including drying in the sun, drying in the shade, drying in the oven, drying in the microwave, and drying in the freezer (Hanaa et al., 2012). The extraction procedures and the type of solvent used have a large influence on the quality and quantity of essential oil produced. The results obtained in the extraction of oil using n-Hexane as solvent are stated in table 4.3a and 4.2b. After extraction was completed, a simple distillation was set-up and used to separate the solvent from the oil at 60^{o}C until complete separation was achieved. The solvent reduces over time, leaving the essential oil. The resulting oil was pale yellow-green in color, with an aromatic odour. Because of its high volatility, it has a cooling taste. It was kept in an airtight container and kept out of direct sunlight. The essential oil was water-insoluble but soluble in alcohol and oil, in which case the locally and readily available Lemongrass for the production of essential oil and perfume formulation as a natural plant sources as opposed to synthetic chemicals was achievable, both in terms of oil yield as well as the physiochemical parameters. And the end goal of eliminating the negative consequences that are associated with the usage of synthetic chemicals was also tenable.

II. MATERIALS AND METHODS

A. *Experimental Materials*

Detailed descriptions of the materials used in this work are given in this section.

1. **Lemongrass (Cymbopogon citratus):** The fresh leaves of Lemongrass (Cymbopogon

citratus) leaves were collected from a local garden, sorted to remove unwanted plants, washed and dried in a shaded moisture free environment.

2. **Chemicals:** All chemicals used in this study are analytical grades and they include: n-Hexane, diethyl-ether and ethanol, potassium hydroxide (KOH), ethanoic potassium hydroxide, phenolphthalein, HCl and benzyl salicylate.
3. **Glassware:** Various sizes of Duran beakers, conical flasks, round-bottom flasks and decanters was used. Glassware utilized is the separation funnel, condenser, thermometer, pipette and burette.

B. ***Equipment***

The detailed descriptions of the equipment used in this work in this section.

1. **Digital Weighing Balance:** The weighing balance of Model No.FA2104 was used to determine the absolute weight of chemicals, oils and other substances used throughout this work.
2. **Heating Mantle:** Heating mantle was used for heating to temperature up to 100℃ and used to evaporate the excess n-Hexane left after the oil has being extracted.
3. **Viscometer:** A viscometer of Model NDJ-55 was used to determine the viscosity of the oil.
4. **Sieve Shaker:** A sieve shaker was used for the particle analysis of the dried and powdered lemongrass sample.
5. **Other materials required**: Other materials utilized are rubber stopper, ice cubes maker, knives, olive oil, aluminum foils, and Crusher (Mortar and Pestle).

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III. DETERMINATION OF OIL YIELD

The yields of the oil was determined by taking the ratio of the weight of the extracted oil to the weight of the sample with respect to varying temperature and time.

$$\%\ oil\ yield\ (w/w) = \frac{Weight\ in\ gram\ of\ extracted\ oil}{Weight\ in\ gram\ of\ sample} \quad (1)$$

The yield obtained with varying temperature and time is shown in Table 1 and 2 respectively.

Table 1: Solvent extraction at varying temperature.

Weight of dried sample (g)	Temp (℃)	Weight of extracted oil (g)	Yield (%)
130	45	2.09	1.58
127.91	50	2.17	1.69
125.74	55	2.24	1.78
123.50	60	2.29	1.85
121.21	65	2.34	1.93

Table 2: Solvent Extraction at Varying Time.

Weight of dried sample (g)	Time (minutes)	Weight of extracted oil (g)	Yield (%)
130	30	2.11	1.62
127.89	60	2.18	1.68
125.74	90	2.26	1.73
123.45	120	2.29	1.76
121.16	150	2.36	1.82

IV. RESULTS AND DISCUSSIONS

The experiment was carried out to extract essential oil from lemongrass, which has high essential oil content and was used in the formulation of perfume. The lemongrass essential oil was successfully extracted from dry lemongrass leaves using solvent extraction (soxhlet extraction method). The essential oil was used successfully in perfume formulation by using fixatives and different solvents (alcohols) as ingredient as the type of solvent, quality of sample and type of equipment used are the factors that affected the yield in this research experiment. Changes in the quantity of solvent used also affected the yield hugely. Proper particle analysis of the dried

lemongrass sample ensured that the particles of the sample used in this experiment were of uniform sizes to prevent discrepancies in the results and reduce the time spent on the experiments. Fig. 1 shows the effect of varying temperature on the yield and it indicates that the yield increases with temperature, but never exceed 65ºC, with regards to related literature beyond destroying the extract. While the effect of varying time on the yield is shown in Fig. 2.

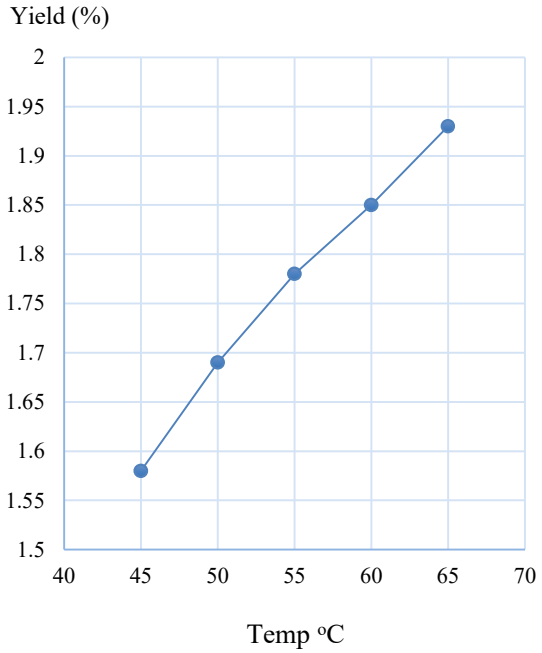

Fig. 1: Graph of yield against temperature

With respect to the Physiochemical analysis of the extracted lemongrass oil, Table 3 shows the evaluation of the physicochemical properties of the extract from the lemongrass such as moisture content, relative density, acid value, viscosity, saponification value and pH in accordance with the Association of Official Analytical Chemists (AOAC), specific gravity value by methods of Pearson (1976) and American Petroleum Institute (API) value (Haldar *et al,* 2009). It further shows that the liquid had a

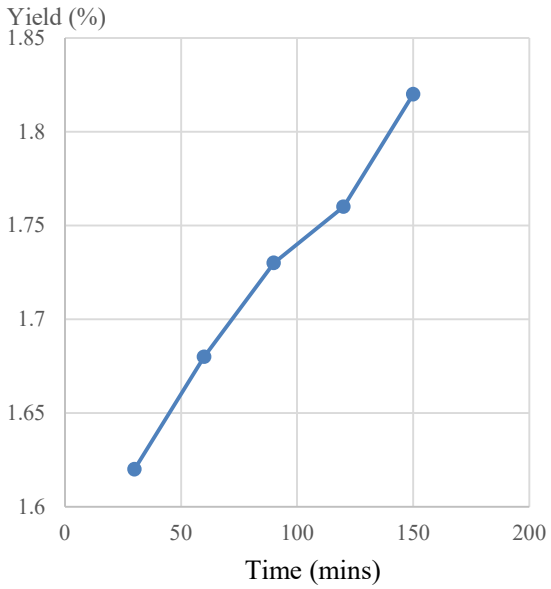

Fig. 2: Graph of yield against Time

density of less than one (ρ = 0.8865) at room temperature, indicating that the essential oil was lighter than water. Comparatively with Table 3, some physicochemical properties from lemongrass extract as determined by Atitegeb Abera 2020 gives the following result such as moisture content, percentage yield, pH, boiling temperature, acid value and saponification values are 20.7%, 6.27%, 5.6, 212ºC, 2.805 mg KOH/g, 140.25mg KOH/g respectively. Precisely, both results shows that the higher the acid value of oil, the lower storage quality and vice versa, though with varying saponification value, but was exactly 21.04 mg KOH/g as reported by Alhazan *et al*, 2018, which all values indicates that saponification value also has the potential to be an input for soap production The boiling temperatures was similar to the former at 212ºC, though higher than the later at 85ºC, though with varying yields percentage to both at 3.8% as shown Table 1.

In the same vain, on the particle analysis of the dried powdered lemongrass**,** Table 4 shows the sieving analysis performances carried out at the Chemical Engineering Department of the Federal University Otuoke (FOU).

Table 3: Physicochemical Properties of Lemongrass Oil

Physio-chemical properties	Lemongrass oil (C. citratus essential oil)
Acid Value	2.948 mg KOH/g
Saponification Value	21.04mgKOH/g
Specific Gravity	0.890 @ 20°C
Viscosity	0.887 kg/L
API	27.488
Colour	Yellow-Green
Odour	Specific
Density	0.8865
Ester Index	6.402
Boiling Point	224°C

Table 4: Results for Particle Analysis for the Powdered Lemongrass Sample

Sieve Number	Pore Diameter (mm)	Initial Weight of Dry Sample (g)	Final Weight of Dry Sample (g)
8	2.36	1200	28.0
10	2.00	1172	51.2
12	1.70	1120	74.4
20	0.85	1046.4	260.4
30	0.60	786	278.8
40	0.425	507.2	279.8
60	0.25	227.4	97.2
Pan		130.20	0.4

The process was by stacking and vibrating the sieve on a sieve shaker for 20 minutes with a test sieve (size 250 m) at amplitude of 60. The samples were then sieved and the final weight was recorded. The particle analysis of the powdered lemongrass sample was placed on a stack of seven sieves with sieve numbering 8, 10, 12, 20, 30, 40, 50 and 60 respectively. The total weight of 1200g dried powdered lemongrass sampled was weighed and poured to the topmost sieve on the stack which is sieve number 8, then the timer and the electronic sieve shaker was turned on at the same time. After 20 minutes the shaker was turned off and each sieve was separated and the sample on each sieve was weighed and recorded. A small brush was used to clean each sieve properly before the sample on each sieve was weighed to prevent losses. From the results on table 4, the sieve with the sieve number 30 and opening size of 0.6 had the highest amount of sample at 278.8g while the sieve with sieve number 8 with an opening size of 2.36 had the least amount of sample at 28.0g.

Similarly, on the formulation of perfume, 15ml carrier oil (Olive oil) was placed in a beaker containing 25ml of 42%vol vodka. 15 drops of lavender were added as the base note, 25 drops of lemongrass oil as the middle note and 10 drops of sandalwood as top note. To improve the longevity of the perfume, 5ml of benzyl salicylate which is a fixative was added to the solution. The beaker containing the solution was covered and placed in a cool dark place to allow the individual scents interact, mix and become stronger.

The sample product was then placed in a bottle with a funnel, covered and placed in a cool dark place then left to age for three weeks for future use. Under the ranges of the quality and strength as provided by www.sensoriam.com, the product obtained falls in the range of Eau de Parfum which has a fragrance concentration between 15% and 20% which can lasts for about four to five hours on an average, though below Parfum known as extrait de parfum or pure perfume having the highest fragrance concentration between 15% to 40% fragrance that last up to six to eight hours. However, it has higher lasting concentration fragrance above Eau de Toilette (EDT) which has a fragrance concentration of between 5% and 15% which can only last between two to three hours. It was also higher in fragrance concentration above Eau de cologne (EAU) which serves between 2% and 4% of fragrance and contains a very high concentration of alcohol

V. CONCLUSION

An essential oil was produced from lemongrass (Cymbopogon citratus) using solvent extraction (soxhlet extraction method which is one of the best techniques that increases oil output, separating the solvent from the oil at 60^{o}C and regulate the oil's composition which enable fragile plants in achieving better yield of essential oil with a smaller amount of harvesting. The extract was further employed for the production of perfume which result falls under the range of Eau de Parfum having a fragrance concentration between 15% and 20% that can lasts for about four to five hours on an average. The extraction method is one specialized separation processes used for heating sensitive materials such as essential oils, resins, hydrocarbons that are insoluble in water and may decompose at their boiling point. The temperature of the steam was high enough to vaporize the essential oils present while not destroying or burning them. Furthermore, in varying temperature and time, yield increases with both time and temperature respectively. And to be precise every necessary application and methods were used of chemical engineering unit operations such as leaching, liquid-liquid extraction, and evaporation.

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