Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 10, October-2020

Extraction and Physicochemical Analysis of Essential Oils in Lemongrass leaves grown in Arbaminch, Ethiopia

Atitegeb Abera
Department of Chemistry,
Arba Minch University,
Arba Minch, Ethiopia;

Abstract:- **Essential oils are highly concentrated substances extracted from plant parts which can be flowers, leaves, stems, roots, seeds, barks, resins, or fruits. These oils are often used for their flavor and their therapeutic or odoriferous properties, in a wide variety of products such as foods, medicines, and cosmetics. The aim of this research is to extract and characterize essential oils obtained from lemongrass, cymbopogoncitratus leaves. Solvent extraction method was used for extraction of essential oils. After extraction, some of physicochemical properties of the extract were determined and the following result is obtained. The moisture content, percentage yield, pH, boiling temperature, acid value and saponification values are 20.7%, 6.27%, 5.6, 212^{0}C, 2.805 mg KOH/g, 140.25mg KOH/g respectively. The higher the acid value of oil, the lower storage quality and vice-versa so that the lemongrasses oil has an excellent storage quality as well as it can be used for manufacturing cosmetics. The saponification value also indicates that the lemongrass essential oil has a potential to be an input for soap production.**

Keywords: Cymbopogon citratus, Solvent extraction, essential oil, physicochemical properties

INTRODUCTION

Essential oils are one of secondary metabolites extracted from different parts of aromatic plants and are highly concentrated volatile organic compounds. These oils are often used for various human necessities like food, medicine and cosmetics because of their strong characteristic flavor and odour. Essential oils (EOs) extracted from aromatic plants are valuable natural products which are most commonly involved in the traditional pharmacopeia and in pharmaceutical industries as an important feedstock for synthesis of modern medicines. Scientific reports showed that most of the EOs and their single constituents have been used to treat several phytopathogens, human pathogens, and insects as well as their effective uses in food and pharmaceutical industries [1, 2].

Recently, the antimicrobial activity and pharmaceutical use of essential oils has attracted considerable interest on the researchers. The principal and important bioactive phytochemicals in plant essential oils are mono- and sesquiterpene hydrocarbons and their oxygenated derivatives, along with aliphatic aldehydes, alcohols, and esters [3].

Lemongrass (cymbopogoncitratus)is one type of essential oil source that grows in most tropical countries. It belongs to the genus Cymbopogon of aromatic grasses (Aldehyde family) and contains essential oil with fine lemon flavor. It is used in the perfume, soap, cosmetics industries and to treat fevers and infections**[**4**].**Since essential oils have been utilized in different domestic aspects such as in perfumery, cosmetics, food, beverages and drugs, recently, there has been great interest in the use of EOs for their curative effects in aromatherapy [5][6**]**.

Research findings showed that lemongrass essential oils are widely used as a traditional folkloric remedy in different parts of the world[7]. In Ethiopia, societies have used the plant especially as an additive in some beverages like coffee and as a source for pleasant aroma by putting it with their cloths and also by boiling with butter to have a pleasant odor for the purpose of hair food. Moreover, lemongrass in Ethiopia has been also used as killing lice and mosquito, Hypertension, abortifacient, bronchitis, cold, fever, malaria, hemorrhoids, tooth ache washing and aromatizing milk bottles [8-12]. Even though, such types of traditional practices are common in Ethiopia, scientific findings which can engulf community problems related with health and food concerns are limited. To the best of my knowledge, there is no published report on the physicochemical analysis of essential oils extracted from lemongrass grown in Ethiopia. Therefore, the present study was conducted to look in to the physicochemical properties of lemongrass essential oil extract to give a direction for further investigations on the constituents of the extracted essential oil.

MATERIALS AND METHODS

The whole experimental works of this study was carried out in the laboratory of chemistry department at Abaya Campus, Arbaminch University, Ethiopia.

Chemicals: n-hexane, ethanol, KOH, methanol, oxalic acid, phenolphthalein indicator and thiosulphate. All chemicals are analytical grade and distilled water was used throughout the experiment.

Materials: Knife, plastic bags, mortar and pestle, 1000ml Round bottomed flask, Funnel, 25ml, 50ml, 120ml and 500ml beakers, Centrifuge, freeze, Thermometer, Borosilicate glass, Electronic weighing balance, pH meter, Water bath, Distillation stills, Hot plate, water bath, Mantel heater.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 10, October-2020

Sample collection: The sample was collected from Arba Minch University agricultural garden. Fresh lemongrass (Cymbopogon citratus) leaves were cut with 5cm height from the root in the morning due to the volatility of the aromatic compound in the lemongrass leaves [7].

Sample Preparation

The lemongrass leaves were cut freshly with 5cm height from the root. After collecting, the plant material, it was partially dried at room temperature for maximum of 4 days, then kept in a seal plastic bag at ambient temperature and protected from sun light. The lemongrass leaves (Cymbopogoncitratus) were reduced in size by using a knife and crushed using mortar for size reduction since extraction yield increases as the particle size decreased [13].

Moisture Content determination

The moisture content of lemongrass was determined from 2g fresh sample which was dried at 105 ^{0}C in oven for four hours till the sample becomes gray in color. Then it was cooled in dessicator and measured in a digital balance. Moisture content of the lemongrasses sample was measured in the following equation. [14]

$$Moisture\ \% = \frac{W1-W2}{W1} X100 \qquad (1)$$

Where: W1 is the original weight of the sample before drying andW2 is weight of the sample after drying

Procedure for solvent extraction of essential oils

300g of lemongrass (Cymbopogoncitratus) powder was weighted and was placed in a clean round bottomed flask and 700ml of N-hexane solvent was poured in to the flask. Then it was allowed to stand for 48hours with continuous shaking with electrical shaker. After the limited time was completed, the extract containing the solvent was decanted into another beaker.

This includes highly volatile aroma molecules as well as non-aroma waxes and other lipids. The solvent was removed from the extract using rotary evaporator at 40 ^{0}C. The waxy mass that remains is known as the concrete. The concentrate is further processed to remove the waxy materials which dilute the pure essential oil. To prepare the essential oil the waxy concentrated extract was stirred with alcohol (ethanol). During the stirring process only essential oils were dissolved in ethanol but not the waxy substances. As a result two layers were formed and separated easily using separatory funnel.. Ethanol was then evaporated at 78 ^{0}C and the yield of oil was determined as the different between the final weight of the beaker with extract and the initial weight of the empty beaker.

Determination of the yield of lemongrass oil

The yield of extracted essential oil was calculated using the following equation.

$$percentageyield = \frac{weightof\ oil}{weightoflemongrass} x\ 100\% \qquad (2)$$

Physicochemical parameters of Lemongrass Oil

Physicochemical characterization determines the physical and chemical properties of the extracted oil. Some of these properties are viscosity, pH, solubility, boiling temperature etc which all these are physical properties. Chemical properties of the oil are acidic value, iodine value, saponification value etc. Physicochemical properties are also used to determine the quality of oil extracted [**15**].

pH

2g of the lemongrass oil was poured into a clean dry 25ml beaker; and then, 13ml of distilled water was added in to the beaker and heated on hot plate till boiling with slow stirring and left to cool down. Then it was filtered into 25 ml volumetric flask and filled with distilled water to the mark and was determined by using a calibrated pH meter.[16]

Boiling temperature

25ml of lemongrass oil was placed into borosilicate glass and a thermometer was inserted and placed on the heating mantel, and the oil in the borosilicate was started to be circulated which leads the boiling of oil and the temperature on the thermometer was recorded.

Solubility

The solubility of lemongrass oil was analyzed by adding 1g of lemongrass oil sample into 10 ml of 70% ethanol and water respectively and the solubility was observed.

Saponification value

1g of lemongrass oil was accurately weighed and dissolved in 50ml of 2.5 Normality of potassium hydroxide solution. This procedure was performed together with blank experiment which was without the oil. The mixture was refluxed for two hours and cooled. The unreacted KOH was titrated with standard 0.5 Normality of oxalic acid by adding 2-3 drops of phenolphthalein indicator until it became colorless. After that, the saponification value was determined using the following equation [17].

$$Saponificationvalue = \frac{56(V1-V2)}{2xW} \qquad (3)$$

Where: W is the weight of oil, V1 is the volume of 0.5 normality of oxalic acid for blank V2isthe volume of 0.5 normality of the oxalic acid for sample

Acid value

50ml of neutral ethyl alcohol was heated with 5g of oil sample in a 250ml beaker until the mixture began to boil. The heat was removed and was titrated with 0.1M KOH solution, using two drops of phenolphthalein indicator with continuous shaking and finally a permanent pink colour was obtained at the end point.

$$\frac{Acid\ value = 56.1\left(\begin{matrix}Number\ of\\ ml\ consumed\\ x\ 0.1M\ NaOH\end{matrix}\right)}{W} \qquad (4)$$

Where**:** 56.1 molecular weight of KOH, M Morality of KOH and V volume of KOH used, W weight of the sample

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 10, October-2020

RESULT AND DISCUSION

Physicochemical analysis for plant extracts is very essential to decide the validity and way of using extract in appropriate manner. According to this logic, the n-hexane extract of lemongrass essential oil has characterized with different physicochemical parameters.

The result shows that moisture content of lemongrass leaves was 20.7% and yield of the essential oil obtained was 6.27%. M.A.Suryanshi, V.B.Mane , G.B.Kumbhar (2016) reported that the percentage yield of essential oil obtained from lemongrass leaves was 1.85% and 0.86% via solvent extraction and steam distillation methods respectively.[18] In the other hand Alhassan,M. et.al.,(2018) reported also the essential oil extracted from lemongrass leaves was 4.5% through solvent extraction method and 3.8% for soxhlet extraction method. [19] These variations could be attributed to a change in environmental factors, geographical location, methods used for extraction etc.

The boiling point of organic compounds can give important information about their physical properties and structural characteristics. The normal boiling point of a compound is also an indicator of the volatility of that compound. The higher the boiling point, the less volatile is the compound. Conversely, the lower the boiling point, the more highly volatile is the compound.[20] From the result obtained, the boiling point of lemongrass oil is 112 ^{0}C

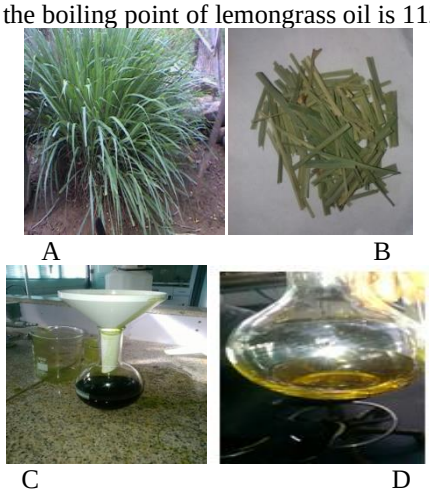
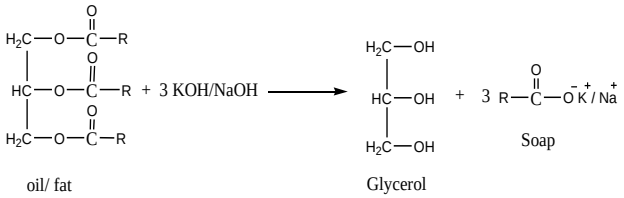


Fig. 1: *A) fresh lemongrass leaves; B) dried lemongrass leaves; C) crude extract; D) essential oil obtained.*

The colour of the lemongrass oil (**fig. 1: D**) was yellow in color and dissolved by 70% ethanol. The pH of extracted essential oil was also recorded as 5.6.

As it has been also described in **table 1**, the acid value of the extracted lemongrass oil is 2.805 mg KOH/g. There is also a result for lemongrass oil obtained from soxhilet extraction method done by Abbas Mustapha, 2018 [20] which was an acid value of 4.09mg KOH/g. The higher the acid value of oil, the lower storage quality and vice-versa, this ensures that the extracted lemongrasses oil has an excellent storage quality. Since the acceptable acid value limited for edible oil is less than 10 [21], the essential oil from lemongrass can be used in food manufacturing industries as an additive.

The saponification value is the amount (mg) of KOH required to saponify 1g of an oil/fat. It is a measure of the average molecular weight of all the fatty acids present in the oil/fat. In saponification, triglycerides of fatty acids are hydrolyzed with alkali produce glycerol and alkali salts of fatty acids. This process is highly significant in the making of soap as described in the following reaction.



The saponification value (**table 1**) of the lemongrass oil was found to be 140.25mg KOH/g, which means that it has potential value for soap production. There is also a result for lemongrass oil extracted from sun died lemongrass leaves by hydro-distillation with a value of 142.59mg KOH/g which was determined by A. Nath, et al., 2014[22].The difference between values may be caused by drying methods of the sample as well as environmental factors.

TABLE 1: Experimental results obtained from chemical and physical Parameters for extracted lemongrass essential oils

Parameter	Value
Acid value (mg KOH/g)	2.805
Saponification (mg KOH/g)	140.25
pH	5.6
Boiling point	212 ^{0}C
Solubility	dissolved in 70 % of ethanol but not in water
Moisture content (%)	20.7

CONCLUSION AND RECOMMENDATION

Based on the experimental facts obtained from this work, it can be concluded that essential oils extracted from lemongrass leaves have promising acid and saponification value which ensures that the extract can be used for manufacturing soap, cosmetics and perfumery products. Besides, its acid value which is one of the quality pararameters also proves the extracted lemongrass essential oil can be used as an additive in food manufacturing industries.

In basis with this work, it is recommended that care must be taken during extraction time and selection of extraction techniques since essential oils are sensitive to high temperature to be decomposed in to smaller fractions and there may be also hydrolysis of ester components of essential oils as a result the original molecule cannot be found within the extract. Besides to this, further study must be carried out to isolate and identify essential oil constituents.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 10, October-2020

ACKNOWLEDGMENT

The author is thankful to department of chemistry, college of natural science, Arbaminch University for granting laboratory chemicals, equipments and working laboratory room as well.

REFERENCE

[1] Hazem, S. and Ippolito, C. An Overview of the biological effects of some mediterranean essential oils on human health. BioMed Res Int. 2017, 1-14 (2017).
[2] Bakkali, F., Averbeck, S., Averbeck, D., Idaomar, M. Biological effects of essential oils. FoodChemToxicol. 46 (2), 446–75 (2008).
[3] Baser, C. and Buchbauer, G. Handbook of Essential oils. Science, technology and applications. (ed. Baser, C. and Buchbauer, G.) 85 (CRCPress, 2010).
[4] Price, S. Aromatherapy workbook: A complete guide to understanding and using essential oils. 320 (Thorsons, 1993).
[5] Ali, B., Al-Wabel, N., Shams, S., Ahamad, A., Khan, A. and Anwar, F. Essential oils used in aromatherapy. Asian Pac J Trop Biomed. 5(8), 601–611 (2015).
[6] Orafidiya, O., Agbani, O., Oyedele, O., Babalola, O. and Onayemi, O. Preliminary clinical tests on topical preparations of ocimumgratissimum linn leaf essential oil for the treatment of Acne vulgaris, CLIN DRUG INVESTIG. 22(5), 313–319 (2002).
[7] Adeola, S., Folorunso, O., Raimi, G. and Sowunmi, A. Antioxidant activity of the volatile oil of Cymbopogon citratus and its inhibition of the partially purified and characterized extracellular protease of Shigellasonnei. Am. J. Res. Commun. 1 (1), 31-45 (2013).
[8] Letebo, A. Ethnobotanical survey of common medicinal plants used by Alfacho Kebele, Amaro Wereda Area, southern Ethiopia. J. Pharm. Chem. 5(2), 100-109 (2018).
[9] Kassahun, M., et al. Performance of lemongrass (Cymbopogon citratus L. (DC) Stapf) for agronomic and chemical traits in different agro-ecologies of Ethiopia. Med Aromat Plant Sci Biotechnol. 5, 133-138 (2011).
[10] Hailemariam, G. and Emire, S. Antioxidant activity and preservative effect of thyme (Thymus schimperi R.). J Appl Sci Technol. 3, 1311-1326 (2013).
[11] Aman, B. Metsehafe Fewus (in Amharic), Addis Ababa, Ethiopia. (ed. Aman, B.) 185-382 ((Eleni Printing house Share Company, 2015).
[12] Maryo, M., Nemomissa, S. and Bekele, T. An ethno botanical study of medicinal plants of the Kembatta ethnic group in Enset-based agricultural landscape of Kembatta Tembaro (KT) Zone, Southern Ethiopia. Asian J Plant Sci Res. 5, 42-61 (2015).
[13] Onyinyechi, O. Extraction and formulation of perfume from lemongrass leaves. IRJET. 3, 1775-1780 (2012).
[14] General, D., Health, O. F., Health, M. O. F., Welfare, F., & Delhi, N. E. W. (2005). manual of methods of analysis of foods.
[15] Pandey, D. Extraction of essential oil from eucalyptus leaves (B Tech project). NIT Rourkela, 44, 2006-7 (2007).
[16] Moses A. G. Maobe, Leonard Gitu, Erastus Gatebe and Henry Rotich. Physical Evaluation of Selected Eight Medicinal Herbs Used for the Treatment of Diabetes, Malaria and Pneumonia in Kisii Region, Southwest Kenya. European Journal of Applied Sciences, 5(2), 43-46 (2013).
[17] Panda, H. Essential Oils Handbook. (1st edition) Chap. 110 (National Institute of Industrial Research, (2003).
[18] M.A.Suryanshi, V.B.Mane , G.B.Kumbhar . Methodology to extract essential oils from lemongrass leaves: solvent extraction approach. IRJET. 3 (8), 1775-80 (2016)
[19] Alhassan et al. Extraction and Formulation of Perfume from Locally Available Lemon Grass Leaves. ChemSearch Journal. 9(2): 40 – 44 (2018).
[20] Abba, M. Comparative Analysis on the Extraction of Essential Oil from Lemongrass and Basil Leaves. Int J Innov Res Sci Eng Technol. 5(11), p 114-118 (2018).
[21] Sampson, W. Studying herbal remedies. N Engl J Med. 353(4), 337- 339 (2005).
[22] Debashis, D., Pawan, K., Nath, A., Verma, N. and Gangwar, B. Qualities of lemongrass (Cymbopogan citratus) essential oil at different drying conditions. IJAEB. 7(4): 903-909 (2014).