EFFECT OF STORAGE ON THE YIELD AND THE ELEMENTAL COMPOSITION OF THE VOLATILE OILS OF EUCALYPTUS CITRODORA AND LEMON GRASS

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ABSTRRACT

The yield of the volatile oils of Eucalyptus citrodora and lemon grass obtained from a locally constructed apparatus is presented. Hydro distillation of the fresh and dried leaves at room temperature (25°C) gave a better yield with dried leaves.

Elemental composition of the crude and rectified volatile oils of the predominant metallic impurities such as iron, zinc, lead, and chromium revealed lemon grass oil to contain the highest concentration level of iron (21.31mg/L and 17.12mg/L) in crude and rectified oils respectively. The implication of these findings of the essential oil in pharmaceutical application and cosmetics is discussed.

INTRODUCTION

Essential oils are the volatile odiferous ethereal principles found in some plants part which are usually separated out by some physical methods like hydro distillation, steam distillation among others. Essential oils obtained from plants are used extensively in the cosmetic and pharmaceutical industries (Gbolade, 1992). The volatile odiferous fractions which are primarily responsible for the various usages are morphologically stored in different parts of the plant (Lawrence *et al.*, 1993). The volatile oils from these plants can be isolated by different methods depending on the part of the plant they are found.

The essential oils are not single compounds but mixture of a number of chemical compounds belonging to a wide variety of classes of saturated and unsaturated aliphatic, cyclic, alicylic, aromatic, and heterocyclic substances (Eiserle, 1971). The economic aspect of the essential oils is tied to their individual characteristic volatile components. The main constituents of the oils obtained from eucalyptus and lemon grass species are 1, 8- cineole and citral respectively. During the production process, a lot of metallic impurities affect the quality and some applications of these oils. Also, moisture contents of the harvested plant leave affect their yields.

This study aims at studying the effect of storage on yields and also elemental composition of the volatile oils of eucalyptus and lemon grass leaves.

MATERIALS AND METHODS

Materials:

The lemon grass leaves were harvested at the premises of National Research Institute for Chemical Technology (NARICT), Basawa, Zaria. While the Eucalyptus citrodora leaves were collected from the Layin Zomo Forestry Plantation, Zaria, all in Kaduna State, Nigeria.

Methods:

Extraction of Essential Oils

The Eucalyptus citrodora and lemon grass oils were extracted by steam distillation method using a locally constructed distillation unit at NARICT – Zaria. The drum was filled with about 22.5 Litres of water before introducing a known weight of the leaves. This was allowed to boil for 45 minutes. When substantial amount of oil has distilled off, heating was stopped and the contents of the drum allowed to cool before evacuation in preparation for the next batch of extraction. The crude oil was further rectified in the laboratory using simple distillation set up. The percentage yield of both crude and rectified oils were calculated and recorded as a mean of three determinations.

Moisture Content Determination

The moisture content of both fresh and dry leaves which have been stored in the sun for six (6) hours were determined using the AOAC, 1980 methods of analysis. Mean of triplicate values were recorded.

Specific Gravity of the Oils

Specific gravity (S.G) values for the crude and rectified oils of Eucalyptus citrodora and lemon grass were determined based on the AOAC, (1980) methods of analysis. The mean of three values were reported.

Elemental Composition Analysis

Dry ashing technique of sample preparation based on Whiteside (1979) was used. About 10g of the oil sample was heated inside a clean crucible on a hot box Gallenkamp oven in order to remove the carbonaceous materials. The residue was then taken into a muffle furnace and ashed at 600°C for five (5) hours. This was removed and allowed to cool in a dissector. The ash was dissolved in few drops of conc. HCl and finally diluted with distilled water in a 100ml volumetric flask. Elemental analysis was carried out using a Unicam 969 – atomic absorption spectrophotometer. Five elements such as iron, lead, zinc, copper, and chromium were analysed in order to find the level of metallic impurity in the crude and rectified oils respectively.

RESULTS

Table I: Percentage Yield of Crude Oils

Plant	Nature of Oil/Leaves	% Yield (w/w)	Specific Gravity
E. Citrodora	Crude oil/fresh leaves	0.78	0.8526
E. Citrodora	Crude oil/dried leaves	0.98	0.8526
Lemon Grass	Crude oil/fresh leaves	0.30	0.8762
Lemon Grass	Crude oil/dried leaves	0.36	0.8762

Table II: Percentage Yield of Rectified Oils

Plant	Nature of Oil/Leaves	% Yield (w/w)	Specific Gravity
E. Citrodora	Rectified oil/fresh leaves	0.60	0.8648
E. Citrodora	Rectified oil/dried leaves	0.93	0.8648
Lemon Grass	Rectified oil/fresh leaves	0.26	0.8821
Lemon Grass	Rectified oil/dried leaves	0.36	0.8821

Table III: Moisture Content of Fresh/Dried Eucalyptus Citrodo and Lemon Grass Leaves

Plant	Nature of Leaves	% Moisture
E. Citrodora	Fresh	52.8
E. Citrodora	Dried	23.5
Lemon Grass	Fresh	72.9
Lemon Grass	Dried	33.4

Table IV: Elemental Compositions in mg/L of Crude Oils

Plant	Nature of Oil	Element	Conc. (mg/L)
E. Citrodora	Crude	Chromium	0.089
E. Citrodora	Crude	Copper	0.0920
E. Citrodora	Crude	Iron	0.2410
E. Citrodora	Crude	Zinc	0.191
Lemon Grass	Crude	Chromium	0.036
Lemon Grass	Crude	Copper	ND
Lemon Grass	Crude	Iron	21.31
Lemon Grass	Crude	Zinc	1.747
Lemon Grass	Crude	Lead	0.152

Detection limit of AAS =

Table V: Elemental Compositions in mg/L of Rectified Oils

Plant	Nature of Oil	Element	Conc. (mg/L)
E. Citrodora	Rectified	Chromium	0.068
E. Citrodora	Rectified	Copper	0.0240

E. Citrodora	Rectified	Iron	0.1740
E. Citrodora	Rectified	Zinc	0.182
Lemon Grass	Rectified	Chromium	0.015
Lemon Grass	Rectified	Copper	0.0000
Lemon Grass	Rectified	Iron	17.21
Lemon Grass	Rectified	Zinc	0.407
Lemon Grass	Rectified	Lead	0.105

DISCUSSION

The results of various determinations are presented in Table I-V. Values in Table I and II showed dried leaves of both Eucalyptus citrodora and lemon grass to have a higher yield of oil and low moisture content (Table III). This could be attributed to the fact that essential oil producing plants record high oil concentration when they are grown or kept in the sun (Fluck, 1963). One would have expected the fresh leaves with higher moisture content to give a better yield of the oil. However, investigations have shown that essential oils are not responsible for the entire moisture content of leaves since they are secreted in special glandular/internal parts of the plants producing them. Moisture content of leaves is due to atmospheric and morphological conditions mainly and not the oils stored in them. Also in Table I and II, it's seen that Eucalyptus citrodora leaves gave an overall higher yield than lemon grass leaves. This may be attributed to the fact that Eucalyptus citrodora leaves are short and thinner than those of lemon grass and also the fact that the former is high from the ground than the latter. This therefore, may enable it to receive some appreciable amount of sunlight which keeps the leaves in a continuous state of evaporation thereby exposing the essential oil glands more for the expression of the oil – hence the higher yield recorded (FAO, 1963). Specific gravity (S.G) values are also used in identifying the quality and purity of essential oils (Tables I and II) Eiserle, 1971). The recorded disparity between the specific gravity values in crudes and rectified oils is an indication of the presence of impurities in the crude oils.

Results of elemental analysis are shown in Table IV and V. The results showed the effect of the walls of the drum (apparatus) on the overall quality and purity of the oils. The predominant elements analysed here is as a result of the suspected materials used in the construction of the apparatus such as iron, steel, and other alloys. In the presence of water, these metallic substances enter into solution and become metallic impurities due to rust or corrosion. Generally, the presence of heavy metals in essential oils contaminates or impart unwanted colour to the oils. This explains the colour difference between crude and rectified oils respectively. Tables IV and V also showed crude oils having higher concentration of metals in all cases. All this is attributed to the presence of impurities in the crudes. However, there was an unprecedented high value of iron concentration for both crude and rectified lemon grass oil. It is known that both iron (II) and iron (III) complexes are stable in aqueous solutions (King, 1978). For example, compounds like citral (which gives β- ionone) form complexes with iron giving a tricarbonyl iron complex. These types of reactions have been found to shift off carbon – carbon double bond along a carbon chain leading to an analogous formation of 1, 3-butadiene tricarbonyl iron. Furthermore, compounds containing iron – carbon bonds are sensitive to hemolytic cleavage producing free organic radicals and lower oxidation state of the metal.

Our investigations have therefore revealed that there is a good economic prospect in the field of essential oils. In order to achieve the maximum economic dividends, there is need for improvement in the design and construction of the distillation unit. It is also therefore pertinent for industrialists wishing to invest in this venture to explore ways of maximizing yield and quality of the oils. The intended cosmetic or pharmaceutical application of these types of oils must take into cognizance the importance of using extraction units that have minimum effect of causing impurities for example, the use of stainless materials in constructing the hydro distillation set. The oils should also be subjected to other analysis in order to meet International standards. The presence of high concentration levels of metallic impurities could be harmful if not removed before being used for pharmaceutical and cosmetic applications. Further purification using rectification as carried out in this work reduce or remove the concentrations of these metals to an acceptable limit.

CONCLUSION

The findings from this study suggest that dried leaves yield more of the volatile oils than the fresh ones. Since this simple technology is targeted to be exploited in the rural areas for economic empowerment of our rural dwellers, fresh leaves harvested may be kept for use at intervals of days so as to reduce water content in the leaves.

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