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Extraction and Characterization of Essential Oil Ginger from Ginger Rhizome

Andrew E. Aziza[1], Stanley Okiy[2]*

[1] *Department of Industrial Safety and Environmental Technology, Petroleum Training Institute Effurun, Nigeria*
[2]*Department of Welding Engineering and Offshore Technology, Petroleum Training Institute Effurun, Nigeria*
Corresponding author: Andrew E. Aziza

ABSTRACT: This work is aimed at extracting and characterizing the essential oil of ginger from ginger rhizome (zingiberofficinale), by hydro distillation method and solvent extraction method. The following parameters were analyzed: pH value, Free fatty acid, Moisture content, Acid value, Iodine number, Harmonization, in the oil extract. The results obtained showed that the oil extract had values from hydro-distillation (A) and solvent extraction (B); for free fatty acid: A-2.81, B-2.49; Moisture content: A-12.6, B-12.1; Acid value: A-9.35, B-8.414; Iodine value: A-112.15mg, B-111.26mg; percentage yield: A-4.6%, B-3.2% and other physical parameters including its color which was light yellow, with a pungent flavor. Thus, it can be concluded that its yield can serve as reference for large production scale in food and pharmaceutical industry. Also, the results obtained show that the oil extract will retain its medicinal and therapeutic properties. Its flavor and edibility is not compromised. The oil will not easily undergo deterioration.

KEYWORDS: Ginger rhizome,n-Hexane, pH value,hydro distillation, solvent extraction

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I. INTRODUCTION

The advancement in our present age has made technology to be able to minimize the cost of agricultural products. This has made extraction to be used in the determination of extract yield at a reduced cost. Thus in the process of extraction, many plants have been used as sources of pharmacologically active preparations for antibiotics. There is considerable and growing demand for an even more diverse range of plant extracts of high quality and integrity. Gingerols and shogaols present in ginger are pungent chemical substances. Ginger also contains some amount of essential oils in the root, which is the reason for its fragrance. In addition, it contains other chemical substances like sesquiterpenoids and monoterpernoid in lesser quantities. Generally, the more pungent versions of ginger are more effective for therapeutic or medicinal uses, while the milder versions would suffice for culinary purposes [1](Charalambous, G. 1994). Ginger had been thought to adversely affect platelet aggregation. Ginger's platelet inhibition is like that of aspirin and the anticoagulation effect of warfarin is potentiated by acetaminophen [2]. It is notable that only two reported cases of bleeding in humans have been associated with the combined anticoagulation. In this work, extraction and characterization process ofginger oil from ginger rhizome (zingiberofficinale) was carried out.

II. MATERIALS AND METHODS

2.1Sample and Solvents Used

The samples were ginger oil extracted from rhizome of ginger plants (scientifically known as zingiberofficinale). These samples werepurchased from a local market at Effurun, Delta state, Nigeria. The gingers were properly washed to get the dirt off. And the solvents were n-Hexane anddistilled water.

2.2 Methods

2.2.1 Method I: Extraction Process Using N-Hexane as Solvent Extraction.

The extraction of the essential oil present in ginger, dried sample was done in a soxhlet extractor (quickfit). 10g of dried grinded ginger was weighed into the thimble. The weighed sample in the thimble was wetted with about

5ml of the n-hexane solvent before fixing the thimble into the soxhlet apparatus, and the application of heating. On setting up the apparatus, the heating mantle was regulated to 60^0c which is the boiling point of n-hexane. 100ml of n-hexane was measured into the round bottom flask of the soxhlet extractor. The setup was heated for about 30min. During the boiling of the n-hexane solvent, and the condensation of the gas, the gas at the reflux condenser dropped into the sample in the thimble, thereby initiating the extraction of the oil in the sample. Then the color of the liquid from the thimble turned light yellow. The light yellow liquid became darker due to more extraction of oil through the capillary tube of the thimble into the round bottom flask. This reaction was observed until there was no more colored liquid coming from the thimble. This shows that all the oil from the dry sample has been extracted. The heating mantle was turned off, and the apparatus was left to cool. The extracted oil was collected into the solvent, so that the solvent had to be evaporated by distilling the mixture of the two liquids. A distillation apparatus was setup, and the n-hexane solvent was collected in a beaker over the mixture. The mixture of the two liquids was distilled at about 60^0c, leaving a higher concentration of the extracted ginger oil in the round bottom flask. The oil extract from the dry ginger sample using n-hexane solvent, was very small due to the laboratory condition of using a small thimble [3] .

2.2.2 Method II: Extraction Process Using Water as Hydro Distillation.

The extraction of the essential oil present in fresh ginger sample was done in a distillation apparatus. The fresh ginger sample was grinded into mash using a manual blender. The 500ml round bottom flask of the distillation apparatus was filled with about 200ml water, then 30grams of the grinded fresh ginger was added into the flask. The quick fit distillation apparatus was set on a thermostatic heating mantle. The temperature was set to 100^0c.The extraction process was set for about 20-25mins. A beaker was used to collect the extract which was the distillate. Then the extract was further distilled to remove excess water, and get a more concentration of the ginger oil extract.The volume of final distillate was 85mls. This contain oil and water mixture and was separated by running off the water and reading the oil in the inbuilt calibrated tube. The oil was then weighed.

III. RESULT AND DISCUSSION

3.1 Result of the ph Value

From the table 1 and figure 1, show the equal volume of the different solvents used. The n-hexane solvent is more volatile than the water solvent. Therefore, the pH value of the oil extract with water solvent was higher than the pH value of the oil extract with n-hexane solvent. This result shows that ginger oil extract with water solvent is more basic than ginger oil extract with n-hexane solvent.

Table 1: Result of the ph Value

Sample	Solvent	Volume of solvent with extract	pH	ATC (^{0}C)
Ginger oil	Water	25	7.25	27.6
Ginger oil	n-hexane	20	7.08	27.2

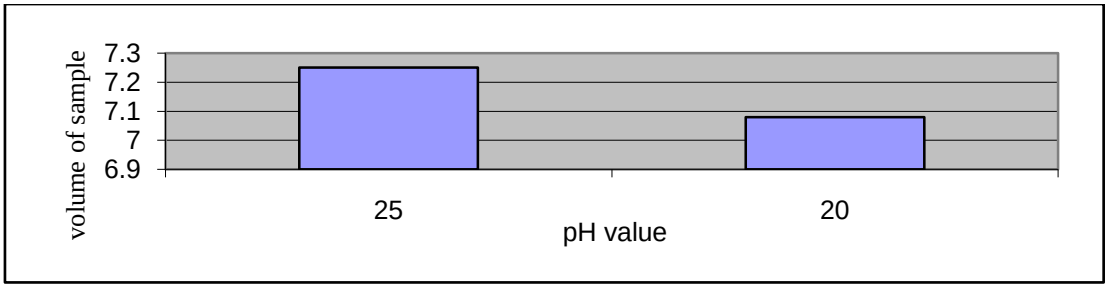

Fig.1. Graph of volume sample against pH value

3.2Result of Acid Value Determination.

The result in table 2 and figure 2 show the acid value present in the oil. It was observed that the acid value present in the oil extract is high, as compared to the standard acid value of 5.5. This is an indication that this particular ginger oil extract is not very good for consumption purpose, although it is edible.

Table 2: Acid Value Determination.

Sample	Solvent	Volume of sample used	Acid value
Ginger oil	Water	3	9.35
Ginger oil	n-hexane	2	8.415

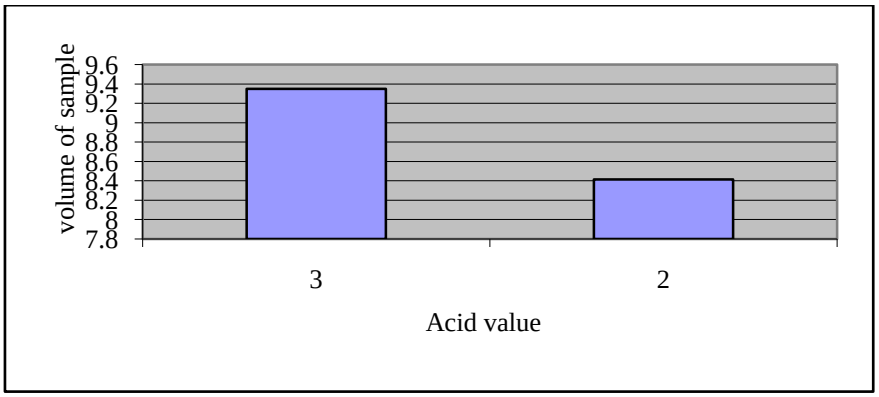

Fig. 2.Graph of volume sample against acid value

3.3 Result of Free Fatty Acid Determination.

After the titration of the reagents, observation and calculations were made. The results for free acid were tabulated in table 3 and plotted in figure 3.

Table 3: Result of Free Fatty Acid Determination.

Sample	Solvent	Volume of sample used	Free fatty acid value%
Ginger oil (A)	Water	2.2387	2.81
Ginger oil (B)	n-hexane	2.15	2.49

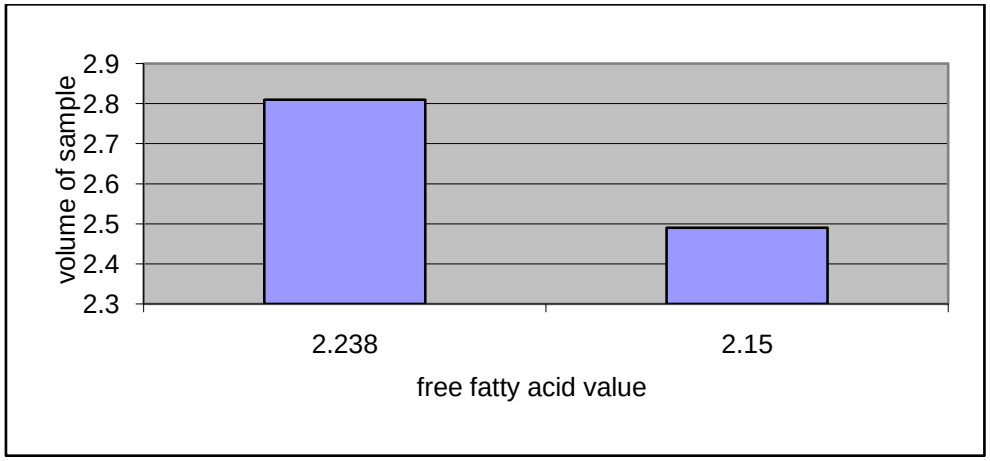

Fig. 3.Graph of volume of sample against free fatty acid value

3.4Result of Moisture Content Determination

After the titration of the reagents, observation and calculations were made. The results for volume of moisture content were tabulated in table 4.

Table 4: Result of Moisture Content Determination

Sample	Solvent	Volume of sample used	Moisturecontent value%
Ginger oil (A)	Water	2.8016	12.60
Ginger oil (B)	n-hexane	1.3525	12.10

3.5Result of Percentage Yield

From the measurement of 300ml of water, with 50grams of wet grinded ginger, the quantity of the oil and solvent extracted was about 203ml, while on further distillation; the actual yield gave about 9.3ml. The results for percent yield were tabulated in table 5 and plotted in figure 5.

Table 5: Result of Percentage Yield

Sample	Solvent	Volume of sample used	Percentage yield value%
Ginger oil (A)	Water	203	4.6
Ginger oil (B)	n-hexane	183.2	3.2

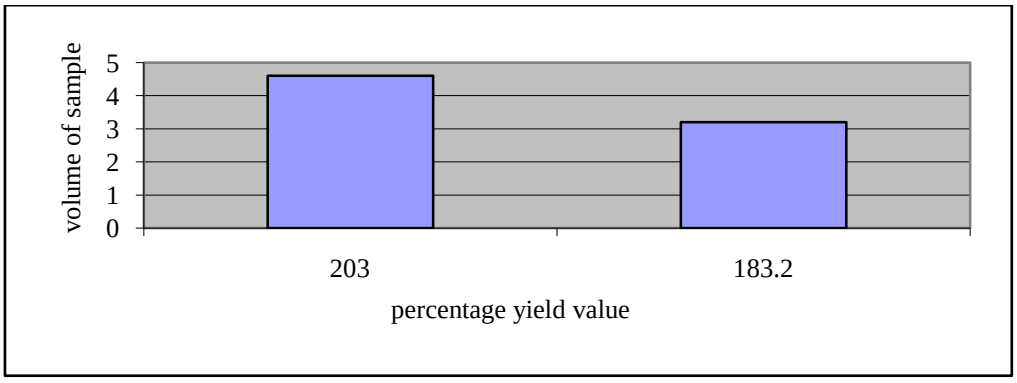

Fig.5. Graph of volume of sample against percentage yield value

3.6 Result of Harmonization

It was observed that when 2ml of the ginger oil extract gotten from hydro distillation, was added to 5grams of soluble edible starch, and was mixed thoroughly to enhance even distribution. The oil had sharp pungent and aromatic smell initially, from day one. After leaving the mixture for seven days, the strong odor of the ginger oil mixture began to decrease as the days increased. The oil extract from solvent extraction lost its flavor faster than the oil extract from hydro distillation. The flavor was left for 36days. A graph of the effect/quality of oil extract against the number of days was plotted.

Table. 7 RESULT OF IODINE VALUE/NUMBER.

Sample	Solvent	Volume of sample used	Iodine value
Ginger oil (A)	Water	0.162	112.60
Ginger oil (B)	n-hexane	0.167	111.69

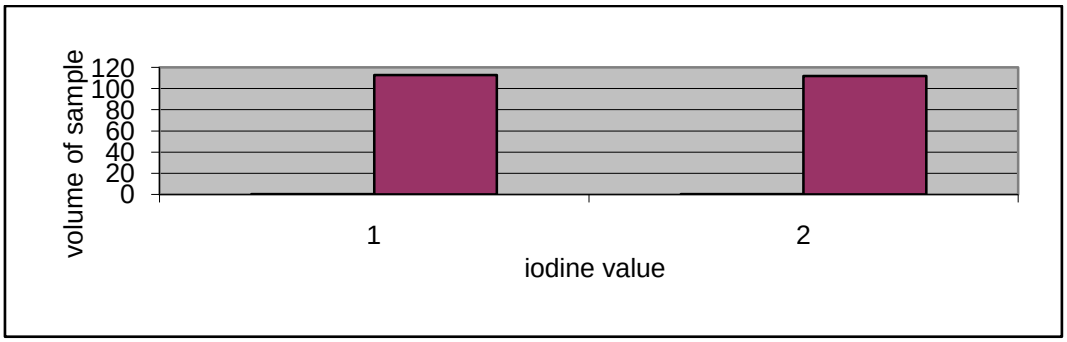

Fig. 7 Graph of volume of sample against iodine value

3.7 Discussion.

Acidity of the oil indicated by its acid value can either be expressed as percent free fatty acid or the number of milligram of potassium hydroxide required to neutralise the free fatty acid in one gram of oil. If the free fatty acid value is high, it means more oleic acid and other acids are present as free acids in the oil and consumption. Such oil is reduced as the percent free fatty acid is an indication of high rate of lipase activity (hydrolytic reaction) and hence oil deterioration.

However, iodine number from hydro distillation was 112.6mg of I_2 per 100g of the oil, while from solvent extraction was 111.696mg of I_2 per 100g of the oil. Moisture content was 12.60% from hydro distillation, and 12.10% from solvent extraction. Acid value was 9.35 from hydro distillation, and 8.415 from solvent extraction. pH value was 7.25 from hydro distillation, and 7.08 from solvent extraction. The percentage yield of the oil from hydro distillation was 4.6%. and 3.2% from solvent extraction. The iodine value is the quantity of iodine in grams absorbed per 100grams of oil. It is an index of the degree of unsaturation of oil. It corresponds to the average number of double bonds in the oil but does not indicate the distribution of the percent fatty acid. A high iodine value is good for direct consumption because more hydrogen will be required to hydrogenate the unsaturated glycerides present in the oil. In the case of the experimented oil the iodine value is high (H_2g/100g). In general, the greater the degree of unsaturated ion (i.e. the higher the value), the greater is the tendency of the oil or fate to become rancid.

According to [1] , oils with iodine value above 150 are having a high degree of unsaturaton while the ones between 100-150 are semi-drying oil and oil with iodine values below 100 are having low degree of unsaturation. The ginger oil have common characteristics with some fats and oils gone through in literatures,

and can therefore be used in prevention and treating high cholesterol and triglyceride levels, alteriosclerosis (hardening of the arteries), and respiratory infections such as cold cough, bronchitis, gastrointestinal problems.

IV. CONCLUSION

Based on the experimental facts obtained from this project work, it can be concluded that the use of ginger essential oil in the pharmaceutical industry, will expand and expose a state-of-the-art, new technology, or digitalized method of extracting the oil, and analyzing it. From the result of the characterization done, the hydro-distillation method generated a more edible essential oil, than the solvent extracted oil. Water being the solvent of hydro-distillation, did not contaminate the extraction process, thereby making the extracted oil suitable for consumptions, to an extent. The solvent extracted oil, using hexane as solvent, is not edible, even though the experimental values were within the standard limits. Hydro-distillation was a valuable technique considering economy, time and quantity. The consequences of volatilization leading to loss of volatile organic matter present in the essential oil, makes the technique not encouraging.It can also be said that since the oil carries some of the characteristics such as taste and smell, the medicinal quality can be much.

The mashed ginger was hydrolyzed immediately because it had an effect on the yield of the essential oils. Ginger oil is an essential oil seen to contain numerous compounds, majority of which are hydrocarbons and oxygenated hydrocarbons. They are generally unsaturated compounds possessing characteristic smell and taste, and they are volatile. The oil can be used in our modern pharmaceutical for preparation of various ointment and cosmetics.

The essential oil extracted from ginger can be used to produce cosmetics, diet supplements, drug additives, therapeutic substances, and even agricultural products. More research should be made in line of edible oils. The government and non-governmental organizations should create assistance for further research in individual plants that produce essential oils. Two or more essential oil can be combined and processed to prospect better result.

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