Extraction and Characterization of Essential Oil from Ginger Rhizome Collected From Arba Minch Market

Tesfaye Seifu Lemma & Tsegaye Fekadu Egza

Department of Chemistry, Arbaminch University, Arbaminch, Ethiopia.

ABSTRACT

Essential oil has a very high commercial value due its therapeutic properties. It is widely used in aromatherapy, medicine and as well as flavoring food and drink. Ginger (Zingiberofficinalis, Roscoe) is one of the most widely used species of the ginger family and is a common condiment for various foods and beverages. The objective of this project is to extract ginger oil by usingSoxhletExtraction, to evaluate the effect of different solvent on the extraction and toinvestigate the effect of extraction time. The oil was characterized for itspH value, Moisture content, Acid value, saponification value, percentage yield and ester value in the oil extract. N-hexane solvent gave highest yield of the ZingiberOfficinaloilat 6 hours extraction timewhich is 29.145 % of mass yield.

Keywords: *Essential Oil, Ginger, soxhlet extraction*

I. INTRODUCTION

Essential oils are found in diverse plant parts including leaves, seeds, flowers, roots and barks. For the plant, essential oils are thought to be vital for the life of the plant, containing compounds that help to fight parasites and infections; many essential oils have anti- bacterial, antifungal, and anti- parasitic properties. For people, essential oils are used in perfumes, cosmetics and bath products, for flavoring food and drink, for scenting incense and household cleaning products and also for medicinal purposes. Interest in essential oils has revived in recent decades, with the popularity of aromatherapy, a branch of alternative medicine which claims that the specific aromas carried by essential oils have curative effects [1]. ` Essential oils are one of the demanded natural products in the local or international market and are extracted from many different plant parts. Essential oils as a group do not have any specific chemical or pharmaceutical properties in common. Instead they are defined by the fact that they convey characteristic fragrances. It follows that the common tendency to speak of essential oils as a category, as if that implied anything in particular about their medical, pharmacological, or culinary properties, is highly unreliable and often actually dangerous [2].

Currently, there is a growing interest to use plant extracts of herb and spices for the preservation of foods, flavor characteristic[1]. Ginger (Zingiberofficinale Roscoe) is a monocotyledonous plant belonging to the family Zingiberacea and is one of the world's best known spices, cultivated in several countries and has been used since antiquity for its health benefits. It is generally consumed as fresh paste, dried powder, slices preserved in syrup, candy (crystallized ginger) for flavouringtea [3]. It is grown throughout the tropical areas of the world and also commonly found in South East Asia especially in Indo-Malaysia. Ginger is the topmost spice crop both in terms of area of cultivation and production volume, traditionally grown in the mid-hill areas of Nepal [4,5].

Ginger is known botanically as ZingiberOfficinale. It is used as a spice because it has a distinctive flavour and aroma, thus they are used to season foods. The characteristic odour and flavour of ginger is caused by a mixture of Zingerone, shogaols and gingerols[6].Ginger (*Zingiberofficinale*) is a widely used herb and a food - flavouring agent. Its neutraceutical properties have long been an interest to the food processing and pharmaceutical industries. The rhizome of ginger is used as a food ingredient, as well as a traditional medicinal herb to treat many diseases, including gastrointestinal, stomachic, rheumatic disorders and muscular discomfort [7].

Ginger (Zingier officinale) has been used for medicinal purposes since antiquity. Medicinal uses of ginger are also diverse and include the treatment of dyspepsia, colic, diarrhea, colds and flu, and poor appetite. Ginger is also recommended as an anti-inflammatory agent in rheumatic and muscular disorders and to increase longevity. Clinical trials support the use of ginger preparations to prevent motion sickness and vomiting in pregnancy, whereas the evidence is more ambiguous in the case of musculoskeletal disorders [8, 9,10, 11]

Ginger products, such as essential oils and oleoresin, are commercialized foruse in food and pharmaceutical processing [11, 12]. It is a common food additive in a number of foods and beverages and it is valued due to the volatile components especially the aromatic

compounds which give a spicy, pungent and pleasant smell [13] and those volatile compounds responsible for the characteristics of ginger flavor. The characteristic aroma of ginger is due to a volatile oil that is present in 1-3% quantities [14]. There is various extraction methods used in the manufacture and extraction of crude oil and the method used is normally dependent on what type of material is being used. So one of the method is a soxhlet extractions and used for isolation of components in the form of soluble compounds. This method converts the volatile liquid into a vapor and then condenses the vapor back into a liquid and is method of separating mixtures based on differences in their volatilities in a boiling liquid mixture. Therefore, this research aimed to Extraction and characterization of essential oil from Ginger Rhizome by using Soxhlet extractionmethod

II. METHODOLOGY

A. Description of study Area

ArbaminchZuriaworeda is Woreda located in GammoGofa zone around at distance of 275 km and 505 km from the regional city, Hawassa and the country capital city, Addis Ababa respectively. Geographically, the Arbaminchworeda is located between 5°42´ and 6°13´on North latitude and 37°19´ and 37°41´ east longitude.

B. Materials and Methods

The experiments' for the production of Oil from *ZINGIBER OFFICINALE* was carried out in laboratory scale level in Chemistry Department laboratory, College of Natural Sciences, Arba Minch University, Ethiopia.Equipment's used for this experiments were Hot plate, condenser, Boiling round flask, Boiling chips, Iron stand, Receiver round flask, Masher, Water bath.PH meter, test tube, stirrer ,beaker, ice bath, electronic beam balance, dissector ,conical flask, Petri dish. The materials or chemicals used for this experiment were:Ginger, solvents (Acetone, N-hexane, ethanol, and Distilled water), phenolphthalein, 0.1N Sodium hydroxide, 2.5N Potassium hydroxide, 0.5N Oxalic acid.

C. Sample Collection and Preparation for Essential Oil Production

The samples were collected from Arba Minch vegetablemarket.The samples were transported to the laboratory using sterile plastic bags.The rhizome of Ginger samples collected were washed and rinse thoroughly with tab water and the peel was removed and sliced in to small pieces .The pieces of Ginger Rhizome were cited in the oven until it dry; then the dried sample was changed in to fine powder and stored in sample container ready for work.

D. Soxhlet extraction method

From the dried samples 35g of grinded ginger was weighed into the thimble and 350 ml of solvent was added before fixing the thimble into the Soxhlet apparatus, and the application of heating. After fixingthe thimble into the Soxhlet apparatus the setup was heated for about four hour. During the boiling of the solvent, and the condensation of the gas, the gas at the reflux condenser dropped into the sample in the thimble, there by 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 is observing until there is no more colored liquid coming from the thimble [15].

E. Preparation for Essential Oil Production

F. Moisture and volatile matter of Ginger essential oil

4gm of oil was weighted and put in a dish and then dried in an oven at 105 C^0 for 1h. The dish was removed from the oven and cooled in a dissector and weighted. The moisture and volatile matter of the oil was determined [16].

$$\textbf{Moisture and volatile matter of Ginger oil} = \frac{W1}{W0} * 100\%.$$

G. PH value of essential oil

The pH of the samples was measured using GENWAY pH meter

H. Acid Value determination

The acid number is used to quantify the amount of acid present, in ginger essential oil sample. It was determined according to the method of European Pharmacopeia. Ginger essential oil (0.5g) was

accurately weighted and dissolved in 10ml of 95% ethanol and 2-3 drops of phenolphthalein indicator was added. The free acid was then titrated with standard 0.1 N aqueous sodium hydroxide solutions by adding the alkali drop-wise at a uniform rate of about 30 drops per minute. The content of the flask was continuously agitated. The primary manifestation of the red coloration that did not fade within 10 seconds was considered the end point. The arithmetic is done by using:

$$\text{Acid Value} = 5.61 * \frac{\text{number of ml of 0.1N NaOH}}{\text{Weight of sample in gram}}$$

I. Saponification Value

Saponification value represents the number of milligrams of potassium hydroxide or sodium hydroxide required to saponify 1g essential oil under the condition specified. It was determined according to the method of European Pharmacopeia. Ginger essential oil (0.5g) Ginger essential oil (0.5g) was accurately weighted and dissolved in 10ml of 70% ethanol and then 10ml of 2.5N KOH solution was added. That procedure was performedtogether with blank experiment which was also performed omitting the oil. The mixture was refluxed for 30 min,and then cooled. The unreacted KOH was titrated with standard 0.5Noxalic acid by added 2-3 drops of phenolphthalein indicator.

$$\text{Saponification value} = 56.1 * \left(\frac{V1 - V2}{2 * M}\right)$$

J. Ester value, content of esters and combined alcohols

The determination of the ester content is of great importance in the evaluation of many essential oils. Most esters, which occur as normal constituents of essential oils, are esters of monobasic acids. The value of ester can be calculated as follow:

$$\text{Ester Value} = \text{Saponification value} - \text{Acid value}$$

K. Percentage Yield

$$\text{Yield of essential oil (\%)} = \frac{amount\ of\ essetial\ oil\ (g) obtained}{amount\ of\ raw\ materials\ (g) used}\ x\ 100$$

III. RESULTS AND DISSCUTION

Characterization of the extract of Ginger (essential oil)

The yields of essential oil, pH value, acid value, moisture content, saponification value and ester value were analyzed using standard procedures.

A. Effect of solvent

Table1:The extracted of Ginger Essential oil using different solvent at the same timeand different temperatures.

Solvent	Time	Volume of solvent(ml)	Extracted amount of oil(ml)	temperature
n-hexane	4 hour	350	5.75	67
Acetone	4 hour	350	3.5	56.1
Ethanol	4 hour	350	2.75	78
Distilled water	4 hour	350	-	100

Effect of Solvents table 1 shows the ginger oil collected using different solvents with the help of soxhlet extraction. The table shows that there was ginger oil collected during 67 degree Celsius temperature in this extraction process. It was also observed that most of the ginger oil distilled out and solvent is recovered for reuse. Soginger oil collected using n-hexane as solvent has more yield % compared to other solvents. So from table n-hexane is good solvent for extraction of ginger oil as compared to other. So for further process n-hexane is used.

B. Effect of Time

Table 2:The extracted of Ginger essential oil using n-hexane at different time interval

Solvent	Time	Volume of solvent(ml)	Extracted amount of essential oil(ml)
n-hexane	1 hour	350	1.5
n- hexane	2 hour	350	2.85
n-hexane	4 hour	350	5.75
n-hexane	6 hour	350	9

Effect of time table 2 shows the ginger oil collected during the 7 hours of soxhlet extraction. It was also observed that most of the ginger oildistilled out in 4 hours. Prolonging the extraction time will achieve a constant value of the ginger oil collected. Therefore, in order to have minimum energy consumption, 4 hours of extraction is enough to do the extraction.

Table 3:Characterization of Moisture content,PH value, Acid value,Saponification value, Ester value and Percentage Yield extract oilfor different solvents.

Solvent	Moisturecontent (%)	Saponification value (ml/g)	Ester value(ml/g)	Percentage yield (%)	Acid Value(ml/g)	P^H value
n-hexane	97.25	36.6	23.136	19.43	13.464	6.8
Acetone	99.75	56.1	40.29	12.29	15.81	6.2
Ethanol	95.05	22.2	12.15	9.71	10.05	7.2
Distilled water	-	-	-	-	-	-

The relatively low saponification value of this oil may imply its poor suitability for the production of soaps and detergents. Ester value represents the number of milligrams of potassium hydroxide required to saponify the esters present in 1g of the oil. It is obtained as the difference between the saponification value and the acid value. Acid value is usually as indicator for edibility of oil. The result this table shows the acidity 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 indicates that this particular ginger oil extract is not very good for consumption purpose.

The pH value of the extracted oil from ginger was measured indicating that the extract ginger oil is slightly acidic

4. CONCLUSIONS

Study on extraction of ginger oil by soxhlet extractor, using different solvents like acetone, ethanol, water, n-hexane were done.From the experimental results it was concluded that n-hexane gives more yield compared to other solvents. From the change in temperature within increasing temperature extraction quantity decreases. Experimental results indicate that the volume of oil extracted increases with the time of heating in all cases. The maximum yield of oil is obtained using n-hexane as a solvent. So many physical and chemical properties like pH value, acid value, moisture content, Saponification value and ester value, of the ginger essential oil was determined and obtained comparable results from literatures.

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Conflict of Interest

The authors declare no conflict of interest.

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