IJAAR PUBLISHING®

International Journal of Advanced Academic Research | ISSN: 2488-9849
Vol. 10, Issue 2 (February, 2024) | www.ijaar.org

EXTRACTION AND COMPARISON OF PROPERTIES OF ESSENTIAL OILS FROM GINGER AND TUMERIC

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ABSTRACT

This study extracted and compared properties of oils from ginger and turmeric rhizomes. The rhizomes of turmeric and ginger were purchased from Eke Oko market in Anambra State. Soxhlet extraction method was used in extracting the oils. The result showed that turmeric (14.8%) has a higher yield than ginger (9.58%). The physical parameters tested showed that specific gravity (0.94 g/l), viscosity (1.59 Pa.s), density (0.96 g/cm^3) and refractive index (1.44) were higher in ginger than Tumeric while Tumeric has a higher flash point value (121^{0}C) than ginger (102.2^{0}C). The results of chemical composition showed that ginger has higher saponification value (263.67 mg/KOH), Acid value (16.97 mg/KOH), Iodine value (50.13 g/gI_2/100g), and Ester value (73.43) than Tumeric. Tumeric has higher peroxide value (11 meq/kg) than ginger. The results showed that these oils are stable and will stand oxidation. It is therefore recommended that these oils will be good for paints industries as they are non-drying.

Keywords: Essential oil, Antimicrobial, Chemical Composition, Solvent, Extraction, Antioxidants.

1.0 INTRODUCTION

Natural plant products have been used as spices and herbs in aromatherapy throughout history. The world production of spices increased from 424.30 tonnes in 1961 to 2,413,28 tonnes in 2016.Herbs and spices offer a wide range of flavour that increase sensory variety in food and beverages without additional energy (Carney et al., 2018)

Ginger and turmeric are two powerful spices which have been widely used as spices for pickles, candies and as preservatives (Aggarwal, et al., 2006) while turmeric, popularly called "Indian saffron" (Tayyem, et al., 2006) is also a dried rhizome of a herbaceous plant that impart a distinctive flavour and orange colour to food.

Both ginger and turmeric belong to the same zingiberacea family, ginger was used as flavouring agent long before history was recorded and was an important article of trade and export from India.

Ginger rhizomes contain 70% water, 18% carbohydrate, 2% protein and 1% fat.Its spicey aroma is mainly due to the presence of ketones especially the ginger oil (Ravindra,et al., 2016). It's typical fragnance and medicinal properties are due to its valotile oil composition 1-3%(Bhatt, et al.,2013).

Turmeric is used as medicine, condiment and cosmetics worldwide and valued as a functional food because of its health promoting potentials (Tilak, et al., 2004). Turmeric contains violatile oil (tumerone, altantone and zingiberone)as well as sugars, proteins and resins. Studies have shown that essential oils from turmeric have significant biological activities including anti-mutagenic, anticarcinogenic, antioxidant, anti-inflammatory and antinociceptive properties (Huang etal., 2007 and Dohara, et al., 2008).

Furthermore rhizomes are rich sources of two remarkable attributes, essential oil and curcuminoids. Essential oils are complex mixtures that may contain over 300 different components (Sell, 2006). They consist of organic violatile compounds, generally of low molecular weight. Their vapour pressure at atmospheric pressure and at room temperature is sufficiently high so that they are found partly in the vapour state (Vainstien, et al., 2001), (Pophot, et al., 2005). These volatile compounds belong to various chemical class such as alcohols, ethers, oxides, aldehydes, ketones, esters, amines, amides, phenols, heterocycles and mainly terpenes. Many thousands of compounds belonging to the family of terpenes have so far been identified in essential oils (Modzelowska, et al., 2005).The essential oils have various functions such as treatment for diseases, flavours or preservatives in food and cosmetics. It can be used for production of shower bath, lotion, shampoo and colgne (Stoyanova, et al., 2005). Oils extracted from rhizomes are classed as Basenote essential oils. They have long lasting effects and are also among the most expensive oils

According to Merv, (2011), the following are the physical properties of oil, viscosity, density, specific gravity, flash point and refractive index.

i. Viscosity is the resistance to flow in a liquid. The lower the viscosity, the more readily the liquid flows. As with other properties, viscosity is affected by temperature.
ii. Density is the mass (weight) of given volume of oil and is typically expressed in grams per cubic centimeter (g/cm^3). Density is also important as it indicates whether or not particular oil will float on water. Most oils will float on water.
iii. Specific Gravity is the oil's relative density compared to that of water. If the oil's specific gravity is greater than 1, it sinks in water. If less than 1, it floats on water.

iv. Specific Gravity is expressed as expressed as density of sample divided by the density of water. Flash point of oil is the temperature at which the liquid gives off sufficient vapour to ignite upon exposure to open flame. A liquid is considered flammable if its flash point is less than 60^0C. There is a broad range of flash points for oils and petroleum products which are considered flammable.
v. The refractive index is the degree of a beam of light that can occur when it passes from one transport medium to another. This is one of the measures used to accurately determine and identify oils and test their purity.
vi. The chemical properties of oil are as follows:-Saponification value, Iodine value, Acid value, Peroxide value and Ester value.
vii. Saponification Value indicates the average molecular weight of oil. Saponification value is defined as the number of milligram of potassium hudroxide (KOH) that is required to neutralize the fatty acid obtained by complete hydrolysis of one gram of oil or fat (Hoffman 2005).
viii. Iodine Value is expressed as the gram of iodine required to react with 100g of oil. High iodine value of oil is related to polymerization of oil which leads to infection or fouling.
ix. Acid value is the number of potassium hydroxide (KOH) that is required to titrate 1g of oil to a specified acid point. It is the measure of the mineral acid content or free fatty acid content in an oil sample (Okolebo, et al., 2002).
x. Peroxide value of fat and oil is used as a measurement of the extent to which rancidity reaction has occurred during storage. As oxidation takes place, the double bonds in the unsaturated fatty acid are attached forming peroxide. When the peroxide value is between 20 and 40 milli-equivalent, the rancid taste is noticeable (Idigo, 2006).
xi. Ester value is the number of milligrams of Potassium hydroxide required to saponify the esters present in 1g of the substance. Ester value equals saponification value minus Acid value.

2.0 METHODOLOGY

Fresh rhizomes of ginger and tumeric were purchased at Eke Oko market, washed and cut in pieces. They were dried and grinded with a mechanical grinder. The powder were preserved in air-sealed polythene bag and labeled.

The essential oils present in ginger and turmeric were extracted using Soxhlet extractor. The yields were determined and compared.

The following parameters were tested:-

Viscosity:-10% of the sample (oil) was suspended in distilled water and was mechanically stirred for 2 hours at room temperature. Oswald type viscometer was then used to measure the viscosity and the value was recorded.

Density:-50ml pycometer bottle was thoroughly washed with detergent, water and petroleum ether and weighed. The bottle was filled with water and weighed and dried. The bottle was then filled with the oil sample and weighed and calculated.

Specific Gravity:-50ml container was thoroughly washed, dried and weighed. The container was filled with the sample (oil) and weighed and the result was recorded.

Flash Point:-10ml volume of oil was poured into an evaporating dish. A thermometer was suspended at the centre of the evaporating dish ensuring the bulb dips inside the oil. The

temperature of the oil was risen using a water bath. The temperature at which the oil sample gives off thin bluish smoke is the smoke point. Similarly, the temperature at which the oil sample started flashing (when flame was applied) without supporting combustion is noted as the flash point and the value was recorded.

Abbes refractometer was used in the determination of the refractive index of the oil sample. The refractometer was rinsed with distilled water and with the aid of cotton wool, the oil was smeared on the refractometer prism and was viewed with the eye through sunlight to determine its reading and the reading was recorded.

Chemical properties of the oils were determined thus:-

i. **Saponification**:- 2g of the oil was weighed into a conical flask and exactly 25ml of alcoholic Potassium solution was added. A reflux condenser was attached and heat was applied to the flask in boiling water for 1 hour, and was shaken frequently. 1ml of phenolphthaleien (1%) was added to the solution and was titrated against excess alkali with 0.5M hydrochloric acid.

ii. **Iodine Value**:- The sample was poured into a small beaker, a spatula was used to weigh out a suitable quantity of the sample into a dry glass-stopper bottle of about 250ml capacity. 10ml of carbon tetrachloride was added to the oil and was dissolved. 20ml of Wiji's solution was added and a stopper (previously moistened with potassium iodine solution) was added and allowed to stand in the dark for 30minutes. 15ml of potassium iodine solution and water was added, mixed and titrated with 0.1M thiosulphate solution, using starch as an indicator just before the end point.(a ml)

   A blank was carried out at the same time commencing with 10ml of carbon tetrachloride (b ml) and the result was recorded.

iii. **Peroxide Value**:- 1g of oil (sample) was weighed into a clean dry boiling tube and while still in the liquid form, 1g of potassium iodide powder and 20 ml of solvent mixture (2 vol glacial acetic acid + 1 vol chloroform) was added.

   The tube was placed in boiling water so that the liquid boils within 30 seconds and was allowed to boil vigorously for not more than 30 seconds.

   The content was poured quickly into a flask containing 20ml of potassium iodide solution (5%), the tube was washed out twice with 25ml water and titrated with 0.002M sodium thiosiulphate solution using starch as indicator.

   A blank was performed at the same time and the result was recorded

iv. **Acid value**:-25ml of diethylether was mixed with 25ml of alcohol and 1M phenoltphlthalein solution and was carefully neutralized with 0.1M Na0H. 1-10g of the oil was dissolved in the mixed neutral solvent and titrated with aqueous 0.1MNa0H with constant shaking until a pink colour which persisted for 15 seconds was obtained

3.0 RESULTS AND DISCUSSION

Results of the percentage yield of ginger and turmeric oils are presented in the Table 1.

Table 1: Percentage of oil yields of Ginger and Tumeric

Parameters	Weights (g)	Yields %	Colour
Ginger	112	9.58	Dark brown
Tumeric	112	14.8	Light brown

The Table above shows that turmeric has higher yield of oil 14.8% than ginger which has 9.58%.

Table 2: Results of the physical properties of ginger and turmeric oils are presented on the table below.

Parameter	Ginger value	Standard value (SON)	Turmeric value	Standard value (SON)
Specific Gravity	0.94	0.87 – 0.89	0.82	0.93-0.94
Flash point	102.20	121.00	141.00	99.00
Viscosity (Pa.s)	1.59	1.47 – 1.60	1.417	1.43 – 1.50
Density (g/cm^3)	0.96	0.87.88	0.84	0.83-0.85
Refractive Index	1.44	1.48-1.48	1.40	1.50 -1.58

It was observed that most of the parameter values fall within the SON standard range but the specific gravity of ginger oil (0.94) is greater than the SON range of (0.87 – 0.89) and also the density of ginger (0.96) is above the standard range of SON (0.87 – 0.88). The flash point of tumeric oil (141^0c) is greater than the SON value of (99^0C).

Table 3: Chemical Properties of Ginger and Tumeric

Parameter	Ginger value	Turmeric value	Standard value (SON)
Saponification value (mg,/KOH)	263.67	206.17	245.00-270.00
Peroxide Value (meq/kg)	3.60	11.00	10.00-15.00
Acid Value (mg/KOH/g)	16.77	4.21	Ginger (15.00-17.00) Tumeric (2.00-5.00)
Iodine value	50.13	45.63	45.00-70.00
Ester value	73.43	71.95	70.50-79.50

The acid value is a measure of the amount of free fatty acid (FFA) present in the oils (Okalebo, et al., 2002). It is often an ideal measure of the breakdown of tricylglycerols into free fatty acids, which reflects on the essential property or quality of many lipids. Generally, it points to the degree of edibility of the oil. These were found to be in permissible limit of 10.00-17.00 mg/KOH/g of ginger and 2.00-5.00mg/KOH/g of turmeric oils recorded in Essein and Amadi (2009). High acid value is an indicator of oxidation of the oil which may lead to gumming and sludge formation besides corrosion. Oil with very high acid values are not edible.

The Iodine value of ginger oil was found to be 50.13 while that of turmeric oil was 45.67. The iodine value is a marker for the extent of unsaturation of the oil. The low value of both

oils show that the oil contains appreciable level of unsaturated fatty acid and this indicates that the oil are considered stable (Prakash et al, 2001). These are the same as those reported in Adeleja (2006). Iodine value helps to classify oils according to the degree of unsaturaion into drying oils (IV> 150), Semi drying oils (125< IV<150) and non-drying oils (IV<125). Non-Drying oils (IV<125) are good for the paint industries while oils with high iodine value (IV<150) are more suitable for 500P mateing.

The saponification value is a measure of the proportion of low molecular weight tricylglycerols in oils (Oladeji, et al., 2010). Saponification values obtained were 263.67 mg /KOH and 206.17 mg/KOH for ginger and turmericoils respectively. Saponification value indicates the average molecular mass of fatty acid or high number of ester bond. The higher the saponification value, the lower the fatty acids average length and the lighter the mean molecular weight of triglycerides. The high saponification value recorded for the oil samples in this study are indication of their possible use in the industries and this agrees with the report of Adolf,et al. (2018), Ardabili, et al. (2011)and Amao, et al. (2004).

The peroxide values found for ginger and turmeric oils were 3.60 meq/kg and 11.00meq/kg respectively. Peroxide value is used to measure the extent to which rancidity reaction has occurred during storage of the oil. Lower peroxiode value indicates good preservation status. It could be used to show the quality and stability of fats and oils (Stoilova, et al., 2007), (Idigo, 2006). These oils are thus stable and would not undergo rancidity early.

The ester value of ginger and turmeric oils was found to be 73.43 mg/KOH and 71.95mg/KOH respectively.

The specific gravity of both ginger and of turmeric oil was found to be 0.94 and 0.82. These values are within the specific gravity values range of 0.82 – 0.92.Specific gravity is used to access the purity of the oil (Ogbonna, et al., 2015)

The density of ginger and turmeric oil was found to be 0.96 g/cm^3 and 0.84 g/cm^3respectively. This indicates that the oils will float on water because of their low densities which are well below that of water.

Retractive index of ginger and turmeric oils were found to be 1.44 and 1.40 for ginger and turmeric respectively. When oils have high number of carbon atoms in their fatty acids, it indicates that the retractive index recorded in this study for the essential oils were lower than the value of most drying oils whose refractive index are between 1.48 and 1.49 (Oluba, et al., 2008).

The flash point of ginger was 102.2^0C and that of turmeric oil was 141^0C. This means that ginger oil will flash when ignited with flame at a lower temperature while that of turmeric oil will occur at a higher temperature.

Viscosity of both oils were found to be 1.59 Pa.s and 1.41 Pa.s for ginger and turmeric respectively and this shows that ginger oil is more viscous than turmeric oil. This implies that the oils posses a relative amount of heavier saturate which make the oil moderately viscous.

4.0 CONCLUSION AND RECOMMENDATIONS

In conclusion, this study reveals that turmeric has higher oil yield (14.80%) while ginger oil yield is lower (9.58%). The saponification values and iodine values of the samples reveal that the oils will be good for the paint industry.

It is recommended that the aromatherapy of these oils can also be investigated.

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