EXTRACTION AND PHYSICOCHEMICAL CHARACTERISATION OF THE OIL EXTRACT FROM THE SEED OF UMBRELLA TREE (TERMINALIA MENTALIS).

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ABSTRACT: The increase in demand and different applications of oils foster the search for vegetable and seed oils that are of high quality to meet up with the increasing rate of its demand worldwide. Oils are known to have important biological activities. In this study, the extraction and physicochemical characterization of the oil from the seed of Terminalia mentalis (umbrella tree) was carried out. The physical properties of the oil compares favorably with those of the conventional vegetable and seed oils like cotton seed oil, soybean oil and groundnut oil among others. The results obtained for the chemical properties showed 38% oil yield, 1.5 refractive index, 0.871 g/ml density, 0.052 mgKOH/g acid value, 2.600 mEq/Kg peroxide value, 140.223 mgKOH/g ester value, 54.567 gI2/100g iodine value and 140.275 mgKOH/g saponification value. These make the oil suitable for use in the industry except in the ink and paint industries because of its non drying property which is due to its low iodine value content.

1 INTRODUCTION

Vegetable oils are widely consumed domestically in Nigeria (Nkafamiya *et al*, 2010). A lot of work has been done in the past and many are still been carried out by lipid analysts to explore the potential applications of vegetable oil. The importance of analyzing vegetable oils cannot be over emphasized. In analyzing vegetable oils, the major features that determine the application of such oils are obtained. (Aluyor, *et al*, 2009). The worldwide application of vegetable and seed oils for both domestic use (cooking oil) and as industrial raw materials is on the increase. Pharmaceutical industries use oils as either additive or as raw material in drug production. Oils are used as raw materials in paint production while the cosmetic industries use oils as raw materials for different products.

These different applications of oils foster the search for vegetable and seed oils that are of high quality to meet up with the increasing rate of its demand worldwide.

Oil seed crops are major sources of lipids for human nutrition as well as for several industrial purposes. They are defined as those seeds that contain considerably large amounts of oil. The most commonly known oil seeds (conventional oil seed) are; groundnut, soybean, palm kernel, cotton seed, olive, sunflower seed, rape seed, sesame seed, linseed and safflower seed among others (Ajala and Adeleke, 2014; Aremu *et al*, 2015).

Nut and seed oils are receiving growing interest due to their high concentration of bioactive lipid components which have shown various health benefits. Fats, oils and other lipid components can extensively be used in food, cosmetics, pharmaceutical, biodiesel and paint industries. Oils from most edible oil seeds are used in the food industry, though there is growing emphasis on industrial utilization as feedstock for several industries with about 80% of the world production of vegetable oils left for human consumption. The remaining 20% utilization is for animals, and chemical industries. The ability of a particular oil seed to serve as feedstock for industries depends on its utilization potential, rate of production, availability and ease of the processing technology (Aremu, *et al*, 2015).

2 MATERIALS AND METHODS

2.1 Materials and reagents

Smooth stones, stainless steel container, mortar & pestle, soxhlet extractor set-up, retort stand, water bath, heating mantle, beaker, *Terminalia mentalis* seed, petroleum ether (MW = 88.11, BP = 40-60^{0}C).

2.2 *Methods*

2.2.1 Collection, identification and drying of plant material

The seeds of the *Terminalia mentalis* were collected under the *Terminalia mentalis* tree from Isanlu, Yagba East Local Government Area, Kogi State, Nigeria. The seed was identified by a botanist in the department of Biological sciences, KSU, Kogi State, Nigeria. The seed was de-shelled and further dried for some days. The seeds were grounded using pestle and mortar in preparation for extraction.

2.2.2 Extraction procedure

Dried *Terminalia mentalis* seeds were grounded in a mortar with pestle. 54.5 g of grounded seeds were placed in a cellulose paper cone and extracted using petroleum

ether in a soxhlet extractor for 6 hours. A rotary evaporator was used in recovering some of the solvent and the residual solvent was removed by placing the oil/solvent mixture on a waterbath at 100ºC for about 2 hours.

2.2.3 *Colour*

The colour of the oil is yellow

2.2.4 *Density*

Density determines mass of the sample per cm^3 of the solvent.

Procedure:

50ml measuring cylinder was washed thoroughly, dried and weighed. The volume of the oil sample was determined. The measuring cylinder was filled with 15ml of the oil sample and weighed

Density = Weight of the oil / volume of the oil

2.2.5 *Refractive index*

This is the ratio of the velocity of light in a vacuum compare to its velocity in the oil. This was determined by placing a concave mirror on the base of a retort stand and the pin (which was held by clamp) adjusted in position until it coincides with its image at C. sufficient liquid was then poured in the mirror. The position of the pin was again adjusted until another position C' was found were it coincides with its image. The distances were measured using a meter rule as CA and C'A.

CA = Distance between the pin and the empty mirror, and

C'A = Distance between the pin and mirror + oil.

Refractive index = CA / C'A

2.2.7 *Oil yield (%)*

The % yield of the oil sample is determined as follows :

$$\% \text{ yield} = \frac{\text{weight of a new sample} \times 100}{\text{weight of original sample}}$$

2.2.8 Acid value

Acid value of an oil or fat is defined as the number of mg potassium hydroxide required to neutralize the free acid in gram of the sample. The acid value measures the extent to which the glycerides in the oil have been decomposed by lipase action. The decomposition is accelerated by heat and light. As rancidity is usually accompanied by free fatty acid formation, the determination is often used as a general indication of the condition and edibility of the oils.

Procedure:

25ml diethyl ether with 25ml alcohol (methanol) and 1ml phenolphthalein solution were mixed. 1.5g of the oil was dissolved in the mixed neutral solvent and titrated with aqueous0.1M NaOH with constant shaking until a pink colour which persisted for 15 second obtained.

$$\text{Acid value} = \frac{\text{Titre value } (cm^3) \times 56.1}{\text{weight of the sample}}$$

2.2.9 *Peroxide value*

Fats or oils undergo changes during storage which result in the production of an unpleasant taste and odour, which is commonly referred to as rancidity. Rancidity is caused by the action of air (oxidative rancidity) or by microorganisms (ketonic rancidity). This is essentially used as a basis for studying the stability of vegetable fats.

In actual fact peroxide value is used to monitor the development of rancidity through the evaluation of the quantity of peroxide generated in the product (initiation product of oxidation). The peroxide value is usually less than 10 per gram of a fat sample when the sample is fresh. During storage of most fats, the peroxide value shows little increase in the early stages, known as induction period, after which there is then a marked increase.

Peroxide value is also a measure of its content of oxygen. Fresh oils usually have peroxide values below 10mEq/kg. A rancid taste begins to show up when the peroxide value is between 20 and 40mEq/kg.

Procedure:

1g of the oil sample was weighed into a clean dry boiling tube and 1g powdered potassium iodide was added and 20ml of solvent mixture (13ml glacial acetic + 7ml chloroform) was added also. 5% of iodide solution and 0.002M sodium thiosulphate were prepared. The tube was placed in boiling water so that the liquid boils within 30 seconds and was allowed to boil vigorously. The contents was quickly poured into a flask containing 20ml of potassium iodide solution, the tube was washed out twice with 25ml water and was titrated with 0.002M sodium thiosulphate solution using starch. Blank titration was also performed.

$$\text{Peroxide value} = \frac{(\text{Blank} - \text{titre value}) \text{ ml} \times 0.002 \times 10^3}{\text{weight of oil}}$$

2.2.10 *Ester value*

Ester value of an oil is the number of milligram required to saponify the ester contained in 1g of oil. The ester value was determined by using the procedure described by Pearson (1991).

Ester value = saponification value – Acid value

2.2.11 *Iodine value*

Iodine value measures the degree of unsaturation in vegetable oils. This value for oil or fat is defined as the number of gram of iodine absorbed by 100g of fats. The glycerides of the unsaturated fatty acids present (more specifically as oleic acid series) with a definite amount of halogen and the iodine value is therefore a measure of the extent of unsaturation.

Iodine value is constant for a particular oil or fat, but the exact figure obtained depends on the particular technique employed. The iodine value is mostly used for identification of oil or to assign a particular group to the oil. The common method of determining iodine value is Wijis' method.

Procedure:

1g of the oil was weighed into 500ml conical flask and the oil was dissolved with 25ml of carbon tetrachloride. 25ml of Wiji's solution was addede and the flask was stoppered and shaked. The resulting mixture was allowed to stand in the dark for one hour. The liberated iodine was then titrated with 0.1M sodium thiosulphate ($Na_2S_2O_3$) using starch as indicator. A blank titration was also carried out

$$\text{Iodine value} = \frac{(\text{Blank - Titre}) \text{ X } 12.69}{\text{weight of oil}}$$

2.2.12 *Saponification value*

Saponification value of fat or oil can be defined as the number of milligrams of potassium hydroxide needed to neutralize the fatty acids resulting from the complete hydrolysis of 1g of the sample. Saponification values are usually large when compared with the acid values of most edible oils. Saponification value actually does not give a better identification index when compared with iodine value. It is often used to detect saponification value of oils which contain a high proportion of lower fatty acids.

Procedure:

2g of the oil was weighed into a conical flask and 30ml of ethanolic potassium hydroxide solution was added. A reflux condenser was attached and the flask was heated in boiling water for 30 minutes. After sample has cooled, 1ml phenolphthalein was added and titrated with 0.5M hydrochloric acid. A blank titration was carried out at the same time (Abdulhamid, *et al*, 2014).

$$\text{Saponification value} = \frac{(b-a) \times 56.11}{\text{wt of sample}}$$

b = blank titre

a = titre value

3 RESULTS AND DISCUSSION

3.1 Results

Table 1: summary of physical properties of the oil extract

S/N	Parameters	Value
1	Colour	Yellow
2	Specific gravity	0.871
3	Refractive index	1.5

Table 2: Summary of chemical properties of the oil

S/N	Properties	Values
1	Oil yield (%)	38.000
2	Acid value (mg KOH/g)	0.052
3	Peroxide value (meq/kg)	2.600
4	Iodine value (gI_2/100g)	54.567
5	Ester value (mgKOH/g)	140.223
6	Saponification value (mgKOH/g)	140.275

3.2 Discussion

The results for the physicochemical analysis of the extracted seed oil were given in tables 1 and 2. The percentage oil yield of the seed is 38%. The value is closely similar to that of the percentage oil yield of pawpaw and sweet orange seed oil as reported by Abdulhamid *et al*, (2014), and higher than that of some conventional oil seed crops like cotton (15.0-24.0%) and soybean (17.0-21.0%) (Pritchard, 1991). This high percentage oil yield in this study show that the industrial processing of the oil for soap making and edible purposes would be viable

The saponification value (140.275mgKOH/g) is higher than that of beeswax (93.0mgKOH/g) which is commonly used in soap making (Mabrouk, 2005).

The acid value (0.052mgKOH/g), according to Aremu *et al*, (2015), low acid value in oil indicates that the oil will be stable over a long period of time and protect against rancidity and peroxidation. This could be attributed to presence of natural antioxidants in the seeds such as vitamins C and A as well as other possible phytochemicals like flavanoids. Acid value is used as an indicator for edibility of an oil and suitability for use in the paint and soap industries. High acid value in oil (e.g luffa gourd) showed that the oil may not be suitable for use in cooking (edibility), but however, be useful for production of paints, liquid soap and shampoos (Aremu *et al*, 2006a).

The peroxide value (2.60mEq/Kg). Peroxide value (PV) is the most common indicator of lipid oxidation. The unrefined vegetable oils are characterized by greater PV, compared to refined oils. High values of PV are indicative

of high levels of oxidative rancidity of the oils and also suggest absence or low levels of antioxidant (Aremu, *et al*, 2015). The WHO/FAO (1994) stipulated a permitted maximum peroxide level of not more than 10 mequivalent of oxygen/kg of the oils.

The iodine value (54.567 gI_2/100g); The iodine value could be used to quantify the amount of double bond present in the oil which reflects the susceptibility of the oil to oxidation. Oils with iodine value less than 100 gI_2/100g of oil are non-drying oils; correspondingly, Aremu *et al.* (2006a) reported that the lower the iodine value the lesser the number of unsaturated bonds; thus the lower the susceptibility of such oil to oxidative rancidity. Therefore, non-drying oils are not suitable for ink and paint production due to their non-drying characteristics but may be useful in the manufacture of soaps (Kochhar, 1998) and can be regarded as liquid oil. A good drying oil should have iodine value of 130 and above (Aremu, *et al*, 2015).

4.0 CONCLUSION

Findings from this studies shows that the oil extract from the seed of *Terminalia mentalis* is a good source of oil which is capable to meet the increasing need for quality and potent oil in industries and domestic applications.

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