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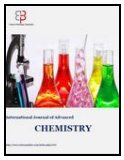

Extraction and physicochemical analysis of some selected seed oils

Afolayan Michael*, Akanji Fausat, Idowu Doyinsola

Chemistry Advanced Laboratory, Sheda Science & Technology Complex, PMB 186 Garki – Abuja, Nigeria
**Corresponding author E-mail: afolayanmic@yahoo.com*

Abstract

Oil was extracted from the seeds of groundnut, melon and Moringa oleifera. The physicochemical properties of groundnut oil, melon oil and moringa oil were determined. The acid value obtained was 9.76 mgKOH/g, 7.85 mgKOH/g and 1.91 mgKOH/g for moringa, melon and groundnut oil respectively. The Iodine value was found to be 35.85 mg/g, 83.75 mg/g and 59.64 mg/g for moringa, melon and groundnut oil respectively. The Peroxide values were moringa oil - 13.80 meq/kg, melon oil - 5.60 meq/kg and groundnut oil - 10.80 meq/kg. Unsaponifiable matter values were moringa oil - 8.59 g/kg, melon oil - 2.18 g/kg, groundnut oil - 5.77 g/kg while the saponification values were moringa oil - 155.68 mgKOH/g, melon oil - 180.92 mgKOH/g and groundnut oil - 168.30 mgKOH/g. The volatile matter in the oils was found to be 0.06. 0.07 And 0.04 in groundnut, melon and moringa oil respectively. All the oils were pale yellow in colour and liquids at room temperature. The results obtained from the physicochemical characterization of the oils shows that moringa oleifera seed oil compares favourably with the other oils and has high potentials for use both as domestic oil and as industrial oil.

Keywords: *Groundnut, Melon, Moringa Oleifera, Oil, Physicochemical.*

1. Introduction

Nuts and seeds are good sources of oil and they are commercially available. These oils are usually sold in drums, tins, glass bottles and plastic containers in the market. The method of processing, storing and handling them affect their shelf life (Amoo et al. 2006). Seed oils are important sources of nutritional oils, industrial raw materials and nutraceuticals. The characteristics of oils from different sources depend mainly on their compositions; no oil from a single source can be suitable for all purposes thus the study of their constituents is important. Many consumers are looking for variety in their diets and aware of the health benefits of fresh fruits and vegetables and of special interest are food sources rich in antioxidants (Aberoumand et al. 2008). There are numerous vegetable oils derived from various sources. These include the popular vegetable oils: the foremost oilseed oils - soybean, cottonseed, peanuts and sunflower oils; and others such as palm oil,palm kernel oil, coconut oil, castor oil, rapeseed oil and others. They also include the less commonly known oils such as rice bran oil, tiger nut oil, patua oil, kome oil, niger seed oil, piririma oil and numerous others (Warra et al. 2011). Melon seed oil and moringa oil are less commonly known. Their yields, different compositions and by extension their physical and chemical properties determine their usefulness in various applications aside edible uses (Aluyor et al. 2011). the characteristics of oils from different sources depend mainly on their compositions

Groundnut or peanut (*Arachis hypogaea* Linn.) is commonly called the poor man's nut. It is an important oilseed and food crop. It is native to South America (Weiss 1993), It is grown annually principally for its edible oil and protein rich kernels seeds, borne in pods which develop and mature below the soil surface. It is generally distributed in the tropical, sub-tropical and warm temperate zones and widely grown in Nigeria.

Melon (citrullslanatu) belongs to the family Cucurbitaceae, this has a great genetic diversity (Ng 1993). Melon is an annual herbaceous plant and they tend to survive in tropical, subtropical and temperate region. This is commonly found in the West African region and used as soup thickener and as a major soup ingredient.

Moringa oleifera Lam belongs to the family Moringaceae (Morton 1991), it is commonly called ben oil tree; it is known as Zogeli in the northern part of Nigeria where it is widely grown and cultivated. (Anjorin et al. 2010). The mature seeds yield about 38 – 40% edible oil from its high concentration of behenic acid. The Moringa seed oil is clear and odorless, and remarkably the oil does not become rancid for several years after it is produced. The seeds oil can be used as a natural source of behenic acid, which has been used as an oil structuring and solidifying agent in margarine, shortening, and foods containing semisolid and solid fats, eliminating the need to hydrogenate the oil (Foidl et al. 2001).

In this present study, we extracted and analyzed the seed oils of moringa and melon and compared with the seed oil of groundnut which is very common and popular as against the other two seed oils which are less common with not much work done on their physicochemical characterization.

2. Materials and methods

Groundnut seeds and melon seeds were purchased from Kwali market in Kwali LGA, FCT, and Abuja – Nigeria while the seeds of moringa oleifera were obtained from the farm located in Sheda Science and Technology Complex (SHESTCO), Sheda, Abuja. All other analytical grade reagents were obtained from Chemistry Advanced Laboratory, Sheda Science and Technology Complex, Abuja, Nigeria.

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2.1. Extraction of oil from the seeds of groundnut, melon and Moringa

The seeds were picked and pulverized using an electric blender. The oil was then extracted from each of the seeds using hexane by adopting the method described by Association of Official Analytical Chemist (AOAC, 1998). 200 g of the pulverized seeds were packed in a muslin cloth and inserted into the soxhlet extractor and hexane was used as the extraction solvent for a period of eight hours. At the end of the extraction period, the solvent was recovered by rotary evaporator and residual oil was oven dried at 75 ^{O}C for one hour. The extract was transferred to desiccators and then stored in air tight container until needed for further analysis.

2.2. Determination of the physicochemical properties of the oils

2.2.1. Acid Value

The acid value was determined using the method described by Ronald (1991). Equal volumes (25 ml) of diethyl ether and ethanol were mixed together and 1 ml of 1% phenolphthalein indicator solution was added and was then neutralized with 0.1 M potassium hydroxide solution. The oil sample (between 1 to 10 g) was dissolved in the neutralized solvent mixture and titrated with 0.1 M potassium hydroxide solution with constant shaking until a pink colour which persists for 15 seconds is obtained. The acid value is given as:

$$\text{Acid Value} = \frac{\text{titre value (ml) X 5.61}}{\text{Weight of sample used (g)}}$$

2.2.2. Peroxide value

Determination of peroxide value was carried out using the method described by Pearson (1981) and Ranken (1988) with slight modifications. The test which was carried out in subdued daylight involved weighing 1 g of the oil into a clean dry boiling tube and adding 1 g powdered potassium iodide and 10 ml of a solvent mixture consisting of 2 volumes glacial acetic acid and one volume chloroform. The boiling tube was placed in a boiling water bath so that the liquid boils within 30 seconds and allowed to boil for more than 30 seconds. The whole content was then poured into a titration flask containing 20 ml freshly prepared 5% potassium iodide solution and the tube washed twice with 25 ml portions of water with the washings added to the titration flask. It was then titrated with 0.002 M sodium thiosulphate solution using starch as indicator. A blank titration omitting the oil was also carried out. The peroxide value is calculated from the equation:

$$\text{Peroxide value} = \frac{2\,(a - b)}{\text{Weight of sample used (g)}}$$

Where a = sample titre value
b = blank titre value

2.2.3. Iodine value

The determination iodine value was carried out according to the IUPAC method (IUPAC 1979). With the aid of a dropping pipette, about 0.2 – 0.5 g of the oil was accurately weighed into a glass stoppered flat bottom flask and 10 ml carbon tetrachloride added to the oil to dissolve. Exactly 20 ml Wijs' solution was added and the stopper which had been moistened with potassium iodide solution inserted. The mixture was mixed and allowed to stand in a dark cupboard for 30 minutes. 15 ml of freshly prepared 10% potassium iodide solution and 100 ml water was added and mixed. The mixture was titrated with 0.1 M standard sodium thiosulphate solution and using starch as an indicator just before the end point. A blank titration was also carried out. The iodine value is given as:

$$\text{Iodine Value} = \frac{(b - a)\text{ X } 1.269}{\text{Weight of sample used (g)}}$$

Where a = sample titre value
b = blank titre value

2.2.4. Saponification value

This was carried out using the method described by AOAC (1998). 2 g of the oil sample was added to a flask with 30 cm^3 of ethanolic potassium hydroxide solution and was then attached to a reflux condenser and heated on a water bath for 1 hour with occasional shaking to ensure the sample was fully dissolved. After the sample had cooled, 1cm^3 of phenolphthalein indicator was added and titrated with 0.5M hydrochloric acid until a pink endpoint was reached. A blank determination was also carried out omitting the oil and saponification value was calculated using the equation:

$$\text{Saponification Value} = \frac{(b - a)\text{ X M X } 56.1}{\text{Sample weight (g)}}$$

Where a = sample titre value
b = blank titre value
M = molarity of the HCl
56.1 = molecular weight of KOH

2.2.5. Unsaponifiable matter

This was determined using the neutralized liquid after the titration for the determination of saponification value. The neutralized liquid was transferred quantitatively into a separating funnel using 50 ml of water for washing the flask. This was extracted 3 times while still warm with 50 ml diethyl ether, all the ether extracts combined into another separating funnel and washed vigorously with 20 ml portions of water and the water discarded. The ether extract was also washed with 20 ml portion of aqueous 0.5 M potassium hydroxide. The extract was poured into weighed 150 ml clean dry beaker and evaporated on a boiling water bath, 2 – 3 cm^3 acetone added and heated on a water bath. It was further dried to constant weight and then dissolved in 2 ml of diethyl ether. 10 ml neutralized ethanol was added and titrated with 0.1 M alcoholic potassium hydroxide. The Unsaponifiable matter was gotten from the equation:

$$\text{Unsaponifiable Matter} = \frac{M_2 - 0.028v\text{ X } 1000}{M_1}$$

Where v = volume of potassium hydroxide used
M_1 = mass of oil used for saponification value
M_2 = mass of Unsaponifiable matter.

2.2.6. Volatile matter

A clean flat petri dish was dried in an oven, cooled in a desiccator and then weighed. 2 g of the oil was accurately weighed into the petri dish using a dropping pipette and the dish and contents weighed and recorded. The dish was then transferred into an air oven set at 105 ^{O}C to dry for about 3 hours. The dish was transferred into a desiccator to cooled and then weighed. The drying process was repeated until constant weight was gotten, the final constant weight was recorded. The percentage volatile matter was calculated as:

$$\%\text{ Volatile matter} = \frac{W_2 - W_3\text{ X } 100}{W_2 - W_1}$$

Where W_1 = Weight of empty dish
W_2 = Weight of dish with contents
W_3 = Final weight of dish with contents

All physicochemical properties determinations were carried out in triplicates.

Table 1: Physicochemical Properties of the Oils.

Oils/Parameters	Acid value (mgKOH/g)	Peroxide value (mEq/kg)	Iodine value (wijs)	Saponification value (mgKOH/g)	Unsaponifiable matter (g/kg)	Volatile matter (%)
Moringa oil	9.76	13.80	35.85	155.68	8.59	0.04
Melon oil	7.85	5.60	83.75	180.92	2.18	0.07
Groundnut oil	1.91	10.80	59.64	168.30	5.77	0.06

3. Results and discussion

The physicochemical properties of oils are presented in the table below. The oils were all pale yellow in color and liquid at room temperature.

In this study, the quality of the oil from the seeds of melon, groundnut and moringa were assessed using parameters such as acid, peroxide, iodine and saponification values as well as Unsaponifiable and volatile matters.

The iodine value is a measure of the degree of unsaturation of the fatty acids in an oil and could be used to quantify the amount ofdouble bonds present in the oil which reflects the susceptibility of oil to oxidation. The iodine value for melon oil is the highest and this reflected the presence of high percentage of unsaturated fatty acids in the melon seed oil while moringa oil has the least percentage of unsaturated fatty acids as indicated in its iodine value which is the lowest for the 3 oils. The Iodine values generally indicate that the oils have low degree of unsaturation and according to Pearson, (1981) for most edible oil; they are classified as non-drying oils (80-100g/100g).

Acid value is an important index of physicochemical property of oil which is used to indicate the quality, age, edibility and suitability of oil for use in industries such as paint (Akubugwo et al. 2008). The presence of free fatty acids (FFA) in an oil or fat is an indication of previous lipase activity, other hydrolytic action or oxidation. According to Demian (1990), acid values are used to measure the extent to which glycerides in the oil has been decomposed by lipase and other physical factors such as light and heat. Thus, the higher acid value of the moringa oil and melon oil when compared with that of groundnut oil suggests that the moringa and melon oils are more susceptible to lipase action. Moreover, the acid values for Moringa and Melon oil were higher than the Codex standard for virgin vegetable oils while that of groundnut oil falls within the range recommended for cooking oil which is 0.00-3.00 mgKOH/g (Oderinde et al. 2009).

The peroxide assay is a predominant test for oxidative rancidity in oils and fats; this is a measure of concentration of peroxides and hydro peroxides formed in the initial stage of lipid oxidation. Peroxide value is also used as a measure of the extent to which rancidity reactions have occurred during storage. The higher peroxide value of the moringa oil shows the fact that the moringa oil has less resistance to lipolytic hydrolysis and oxidative deterioration when compared with the other two seed oils (Popoola et al. 2006). The peroxide value of the groundnut oil (10.80 mEq/kg) contrast the findings of Atasie et al (Atasie et al. 2009) who got a value of 5.99 mEq/kg for the oil from Arachis hypogae. This may be due to seasonal and geographical variations. The higher peroxide value of the moringa seed oil indicated a more susceptibility to oxidation than the melon and groundnut oil (Anyasor et al. 2009). Again, the peroxide value of the groundnut and moringa oils are outside the range of 0-10mEq/kg stipulated for freshly prepared oil (Cooks 1966). Therefore, it is likely that storage for a long time may lead to rancidity of the oil. However, peroxide value for Melon oil was lower than the minimum value (10mEq/kg) allowed for refined vegetable oil while that of Moringa and Groundnut oil are quite higher than the minimum value and lower than the maximum value allowed for unrefined olive oil (FAO/WHO, 1993), this indicates that they have a lower degree of rancidity. This shows that both moringa and groundnut oils will be useful as unrefined oils.

The saponification values of the oils are low when compared to Neem seed oil – 213 mgKOH/g (Akpan et al. 1999) and coconut oil - 253.2 mgKOH/g (Osinowo 1987), these low values show that the lauric acid contents of the oils are also low and this is an important determinant of the suitability of the oil in soap making. (Asuquo et al., 2010). However, the saponification values are quite higher than that of Dennettia tripatala fruit oil (Pepper fruit) - 159.33 mgKOH/g (Nwinuka et al. 2009) and African pear oil - 143.76 mgKOH/g which could be good for soap making (Ikhuoria et al. 2007). This indicates that the oils could also be used in soap making since their saponification values falls within the range of these oils. Since higher saponification justifies the usage of fat or oil for soap production, melon seed oil with a saponification value of 180.92 mgKOH/g would be the most suitable of the three for soap making.

The term "Unsaponifiable Matter" in oils or fats, refers to those substances that are not saponifiable by alkali hydroxides but are soluble in the ordinary fat solvents, and to products of saponification that are soluble in such solvents. Melon seed oil which has the highest saponification value also has the lowest Unsaponifiable matter which confirms its best choice for soap making as compared with groundnut oil and moringa oil which have lower saponification value and higher unsaponifiable matters respectively.

4. Conclusion

The physicochemical properties of moringa, melon and groundnut seed oils have been analysed and compared. All the oils gave good yields and were pale yellow in colour. From the physicochemical characterization, all the oils have very low degree of unsaturation and could be classified as non-drying oils, melon seed oil would be very good for soap making while moringa and groundnut oil show a good tendency to be used as unrefined oils.

References

[1] Amoo A. and Asoore F.P. (2006), Effect of processing on the nutrient composition and oil of peanut (*Arachis hypogea*) seed flour, J. Chem. Soc. Nig., 31(12), 1-5.

[2] Aberoumand A., Deokule S. S. (2008), Determination of elements profile of some wild edible plants, Food Anal. Methods. doi: 10, 2008, 1007/s12161-008-9038-z.

[3] Warra, A.A., Wawata, I.G. Gunu, S.Y. and Aujara, K.M. (2011), Extraction and physicochemical analysis of some selected Northern Nigerian industrial oils, Archives of Applied Science Research, 3 (4), 536-541

[4] Aluyor, E.O. and Ori-Jesu, M. (2011), African J. Biotechnol, 7 (25): 4836-4842

[5] Weiss T.J., (1993), Physical and chemical properties of fats and oils and their uses, 2nd Edn. AVI Publishers, Westport, USA, pp: 25-31, 44-84.

[6] Ng T.J., (1993), New Opportunities in Cucurbitaceae. In: New Crops. Janick, J. and J.E. Simon (Eds). Wiley, New York, pp: 538-546.

[7] Morton J. F., (1991), the horseradish tree, Moringapterigosperma (Moringaceae). A boon to arid lands.Econ. Bot. 45 (3), 318-333.

[8] Anjorin T.S., P. Ikokoh and S. Okolo, (2010), Mineral composition of Moringa oleifera leaves, pods and seeds from two regions in Abuja, Nigeria. Int. J.Agric. Biol., 12: 431–434.

[9] Foidl, N., Makkar, H.P.S. and Becker, K., (2001). Potential of Moringa oleifera in agriculture and industry. Potential of Moringa products development, pp: 20

[10] AOAC: Official Method of Analysis 13th Ed. (1980), William Horwitz. Ed. Washington, DC, Association of Official Analytical Chemists, 7: 56-132.

[11] Ronald S. K. and Ronald S. (1991), Pearson's composition and analysis of foods 9th edition, Longman New York. Pp 507 – 544

[12] Pearson, D., (1981), the chemical analysis of foods. Churchill Livingstone. Edinburgh UK. Pp 504-530.

[13] Ranken M. D. (1988) Food industries manual, 22nd edition, published by AVI van nostrand Reinhold company, New York.

[14] International Union of Pure and Applied Chemistry, IUPAC, (1979), Standard Methods for the Analysis of Oils, Fats and Derivatives. 6th ed. Oxford: Pergamon Press.
[15] AOAC: Official Methods of analysis of the Association of Official Analytical Chemists,16th Edition, 1998; Gaithersburg, USA.
[16] Akubugwo, I. E, Chinyere, G. C, Ugbogu, A. E. (2008), Comparative studies on oils from some common plant seeds in Nigeria. Pak. J. Nut. 7: 570-573.
[17] Demian, M. J. (1990) Principles of Food Chemistry. 2nd Ed. Van Nostrond Reinhold International Company Limited, London, England, pp: 37-38.
[18] Oderinde, R. A., Ajayi I. A. and Adewuyi. A. (2009), Characterization of seed and seed oil of Hura. crepitans and the kinetics of degradation of the oil during heating. Elect. J. Env. Agr. Food Chem., 8(3): 201-208.
[19] Popoola, T. O. S., Yangomodou, O. D. (2006), Extraction, properties and utilization potentials of cassava seed oil. Biotechnol 5: 38-41.
[20] Atasie, V. N., Akinhanmi , T. F., Ojiodu, C. C., (2009), Proximate Analysis and Physico-Chemical Properties of Groundnut (*Arachis hypogaea* L.). Pak. J. Nutr. 8(2): 194-197.
[21] Anyasor, G. N., Ogunwenmo, K. O., Oyelana, O. A., Ajayi, D., Dangana, J., (2009), Chemical Analyses of Groundnut (*Arachis hypogaea*) Oil. Pak. J. Nutr. 8(3): 269-272.
[22] Cooks, L. V., Reds, B. C., (1966), Laboratory Handout for Oils and Fats Analyst. (U.S Edition). Academy Press Inc. London. 419-421.
[23] FAO/WHO (1993).Fats, oils and related product. Food standard program. Codex Alimentarius Commission. Food and Agriculture Organization of the United Nations. World Health Organization,Rome. 8: 33-35.
[24] Akpan, U. G., Eyo, A. A., Aluko, P. O., Garba, S. A., Ali, U. D., Lamai, S. L. and Olufeagba, S. O. (1999), Proceedings of the 12th Annual Conference of the Biotechnology Society of Nigeria, Pp. 63 - 66.
[25] Oshinowo, T. J., (1987), Nigerian Soc. of Chem. Engineers, 6(1):36-41.
[26] Asuquo, J. E., Anusiem A. C. I. and Etim E. E. (2010). Extraction and characterization of sheabutter oil, World Journal of Applied Science and Technology 2(2): 282 –288.
[27] Nwinuka, N. M. and Nwiloh, B. I. (2009) Nigerian J. Biochem. Mol. Biol., 24 (1): 42 - 46.
[28] Ikhuoria,E.U. and Maliki, M. (2007) African J. Biotechnol. 6(7): 950-952.