GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES, VOL. 12 NO 1, JANUARY, 2006: 65-67
COPYRIGHT (C) BACHUDO SCIENCE CO. LTD. PRINTED IN NIGERIA. ISSN 1118-0579

COMPARATIVE STUDIES OF THE LIPID CHARACTERISTICS AND INDUSTRIAL POTENTIAL OF *COULA EDULIS* (AFRICAN WALNUT) AND *TERMINALIA CATAPPA* (INDIAN ALMOND) SEEDS

A. S. EKOP and N. O. EDDY

(Received 27 April, 2005; Revision Accepted 22 August, 2005)

ABSTRACT

Characterization of oil from African walnut seed and Indian almond seeds was studied by analysing the lipid extracted from the seeds for their saponification value, iodine value, free fatty acid and acid value. The result of the analysis shows that the saponification value, free fatty acid value, acid value and iodine value of Indiana almond seed oil were 217.38mgKOH, 17.108mgKOH, 0.561mgKOH and 2.6649gI$_2$. The corresponding values for the African walnut seed oil were 169.7025mgKOH, 17.484mgKOH, 0.403mgKOH and 2.6645gI$_2$ respectively. There was no significant difference between the lipid content of the two seeds. The values obtained in this study were compared with values reported for other plant seed oil and the oil was found as a suitable for use in paint production.

KEYWORD: Oil, African walnut & Indian almond seeds, characterization and industrial potentials

INTRODUCTION

Fat and oil are esters of trihydric alcohol and are soluble in organic solvents Aurand and Woods, 1973: Lee, 1983). They belong to a class of compounds called lipids accounting for about 1/3 to ½ of the food energy value (Eneobong, 2001)

Seeds form a major part of the diet of most Nigerians and the extraction and commercial uses of some seeds have not been given serious attention (Achinewhu, 1998).

Fat and oil are vehicles for fat-soluble vitamins, carotene, tocopherol and quinones. The recommended daily intake of lipid is 80 – 100g. Out of this value, plant lipids containing unsaturated fatty acids should not be less than 20 – 25g per day (Stoed, 1989).

Industrial potential of fat and oil has been found to be closely related to the chemical characteristics of the fat and oil under investigation.. Aigbodion et al,. (2004) have stated that the biofuel potentials of any oil is dependent on its iodine and saponification value, Shaw also (1980) stated that the index for the use of some plant oil for the production of paint depends on the iodine value of the oil. Again, the quality of any soap is strongly influenced by the saponification value, free fatty acid value and the acid value of the oil (Wollatt, 1985).

Apart from it food uses, fat and oil have found great for use in the surface coating, soaps, detergents, cosmetics, pharmaceuticals, lubricants, surfactants and polymer industries (Ibemesi, 1992, Morrison and Boyd, 2001, Shaw, 1991, Wollat, 1985).

The characterization of oil involves the determination of both the chemical and physical constants that are unique for a particular oil (Bailey, 1956; Earp and Newall, 1976; Ekpa et al,.2000; Finar 2000; Mahlenbachs, 1960; Offem et al, 2000; Soni, 1981).These chemical parameters include saponification value, iodine value, acid value and free fatty acid value (Lee, 1983).

Several studies have been carried out on the characterization of plant and animal lipids. However, little literature on the characterization of Indian almond (*Terminalia catappa*) and African walnut (*Coula edulis*) seed oil are available. Perhaps the most extensive work reported on the seed of the Indian almond seed is on its proximate composition (Adewole and Olowookere, 1986; Kochlar, 1981). Similar reports are also available for the seeds of African walnut (Ifon et al., 1983). The present study is aimed at extracting and characterizing the oil from these seeds in order to predict their possible utilization for industrial purposes.

MATERIALS AND METHODS

Samples of Indian almond fruits were collected from three different locations within University of Uyo while the African walnut fruits were collected from three different locations in Abak local government area, Akwa Ibom State, Nigeria.. The plants samples were identified by a botanist employed by the department of Botany, University of Uyo, Nigeria.

Each set of samples was dried in the sun for three days and the seeds were removed from the exosperm by cracking the shells.

The lipid content of the sample was determined by, extracting the oil from the ground sample. The method described by James (1984) was adopted for the extraction.

The saponification value of the extracted oil was determined by titrating 2g of the sample with 0.5M HCl after treating it with 0.5M ethanedioc potash in water bath for 30minutes (A.O.A.C, 1973).

The free fatty acid content of the oil was determined by titrating the mixture of 1.5g of the oil with ethanol to phenolphthalein end point using NaOH (A.O.A.C, 1973).

In the determination of the iodine value of the oil, 10ml of chloroform, 25ml of hanus solution, 15ml of 10% KI and 10ml of distilled water were added to the oil and the resulting solution was titrated with sodium thiosulphate using 2ml of starch indicator (James, 1984).

The acid value of the oil was determined by titrating a mixture of 2g of the oil and ethanol/ether (in the ratio of 1:1) with ethanolic KOH .

The fuel potential of the oil was calculated by using the relationship given by Batel et al,. (1980). Thus, biofuel potential in KJ/kg, $H_u = 47.645 - 4.187I - 38.31S$. where I and S are the iodine value and the saponification value of the oil.

The data obtained for each sample were compared with each other by using t-test statistics (Basset et, .1989).

A. S. EKOP, Department of Chemistry, University of Uyo, Nigeria
N. O. EDDY, Department of Chemistry, University of Uyo, Nigeria

RESULTS AND DISCUSSION

The mean values and standard deviation for the saponification value, iodine value, acid value and free fatty acid value of the Indian almond seed oil and the African walnut seed oil are as shown in table 1. The saponification value for the Indian almond seed oil and the African walnut seed oil are 217.38mg and 169.7025mh respectively. The corresponding values for the free fatty acid were 17.108% and 17.484% respectively while their acid values are 0.561 and 0.1403mgKOH/g respectively. The iodine value for the two oil samples are 2.6649gI_2 and 2.6645gI_2 respectively. The percentage lipid content of the Indian almond seed was 9.20% while that of African walnut seed was 9.02%.

There was no significant difference between the lipid content of Indian almond seeds (9.20% ± 0.3) and the lipid content of African walnut seeds (8.90± 8.90). Adewole and Olowookere (1986) have reported the lipid content of Indian almond seed to be 31.00% while Itam et al., (1983) have reported the lipid content of African walnut seed to be 9.00%. Kochlar (1986) also reported the lipid content of Indian almond seed to be 58.9g%. The reported values for the lipid content of the Indian almond seed are high when compared to the value obtained during the study. This may be due to lipolysis during shortage before extraction. Geographical location may also account for the differences as soil type and other environmental factor affects oil yield in plants (Adewole and Olowoolere, 1986; Agbodion et al., 2004). On the other hand, the mean value for the lipid content of African walnut reported by Essien et al., (1984) is comparable to the value obtained in this work. The observed lipid content of the two samples were low when compared with the lipid content of other oil seeds such as melon – 51.10% (Ige et al,.1984), African bush mango – 55% (Oke and Umoh, 1978), cashew nut – 48.10% (Fetuga et al,. 1974) and African oil beans – 34.90% (Osagie et al, 1986).

The saponification value of Indian almond seed oil was significantly higher than that of the African walnut seed oil. The observed values for the saponification value of the two oil samples were high when compare to saponification value of other plant seeds. Kalu (1988), reported the saponification value for calabash seed oil to be163.69mgKOH while Hilali et al,. (2005) reported the range of values for the saponification value of algan oil to be 180 – 199mgKOH while Agbodion et al,.(2004) had earlier reported the saponification value of Avocado pear seed oil, African pear seed oil, African oil beans and pumpkin oil to be 246.84mgKOH, 143.76mgKOH, 171.11mgKOH and 187.23mgKOH. The lower the saponification value, the better is the quality of the oil in producing soaps and detergents (Woollatt, 1985). This implies that the Indian almond seed oil and the African walnut seed oil are not good for soap production.

The observed values for the acid values of the two oil are low when compare to values reported by Aigbodion et al, .(2004) for Avocardo pear oil (0.80mgKOH), African pear seed oil (3.25mgKOH), African oil beans (3.25mg/KOH), and pumpkin seed oil (10.45mgKOH). However, the values were comparable to range of values reported by Chaelow (1964) for cotton seed oil (0.6-0.9mgKOH), olive oil(0.3-1.0mgKOH) and rape seed oil (0.4-1.0mgKOH) as well as for camphor seed reported by Osagie et al,.(1986) for camphor seed oil. According to the British standard for paint, an acid value of not more than 8 should be recommended (Devine and Williams, 1961). From the results the oil could be suitable for paint making.

The free fatty acid value of African Walnut seed oil (17.484%) was not significantly higher than the free fatty acid content of Indian almond seed oil (17.10^{8}mg). The observed values for the FFA of the two oil samples were high when compared to values reported by Aigbodion et al (2004) for oil from avocado pear seed (1.37%). African pear seed (1.10%), African oil bean (3.25%) and pumpkin seed oil (5.25%). These values are also high when compared to values reported by Kalu (1991) for melon seed oil (3.45n%).The high level could be as a result of lipilysis during shortage before extraction. For soap making, it is required that the %free fatty acid should be between 2% and 5% (Woollatt, 1985). The oil from African walnut and Indian almond tree are therefore not suitable for soap making. The iodine value of African walnut seed oil (2.6645mg) was not significantly different from the iodine value of oil from Indian almond tree (2.6649m). These values are low when compared with values reported by Aigbodion et al for oil from avocado pear seed 942.66gI_2/100g), African pear seed (44.08g/100g), African oil beans (57.60gI_2) and pumpkin seed (118.00gI_2/100g). According to Hilditch (1950), oil with iodine value less than 130 are non-drying oil and are suitable for paint making. Therefore the two oil samples are suitable for paint making.

The biofuel potential of the African walnut oil is – 6464.814KJ/kg while that of Indian almond seed is – 8291.343KJ/kg. This implies that the biofuel potential of African walnut seed oil is relatively greater than that of almond seed oil. However, the biofuel potential of the two oil is very low when compared with values reported by Aigbodion et al, . (2004) for avocado pear seed oil (38.01MJ/l), African pear seed oil (41.95MJ/l), African oil beans seed oil (40.85MJ/l) and pumpkin seed oil (39.99MJ/l).

Table 1: Chemical constant of oil from African walnut and Indian almond seeds

Chemical constants	Indian almond seeed	African walnut seed
Saponification value(mgKOH/g)	217.38 ± 2.38	169.7025 ± 1.50
Free fatty acid(%)	17.108 ± 1.00	17.484 ± 0.90
Acid value (mgKOH/g)	0.561 ± 0.10	0.1403 ± 0.01
Iodine value (gI_2/100g)	2.6649 ± 0.12	2.6645 ± 0.10

* Mean of three ± Standard deviation

ACKNOWLEDGEMENT

The authors of this papers are grateful to Mrs. A. Ekop, Edikan Eddy, Nsentip Eddy, Abasidiong and Abasiada Eddy for their respective roles in the production of this paper.

REFERENCES

A.O.A.C., 1975. Official methods of analysis. 12th ed. William Horwiti (ed). Washington D. C: USA. Pp 203-204

Achinewhu, S.C., 1998. Nuts and seeds. In Nutritional quality of plant foods. Eka, O.U and osagie, A.U (edt). Post harvest research Unit. University of Benin. Benin. Pp134-159

Adewole, A. and Olowookere, J. O., 1986. Nutritional potentialities of Irvingia gabonensis and Terminalia catappa fruit. Nutr. Repts. 2: 10-13

Agbodion, A. I., Ikjiloria, E. U. and Okiemen, F. E., 2004. Extraction and characteristic of vegetable oils from indigenous sources. Proceedings of the 27th International Conference of the Chemical Society of Nigeria. Supplement to the journal of the chemical society of Nigeria. Pp. 208-210.

Aurand, L. W. and Woods, A. E., 1973. Food Chemistry. Westport, Connecticut. The Avi Pub. Comp, inc PP. 104-142

Bailey, A. E., 1956. Industrial oil and fat products. 2nd ed. Interscience Publishers, New York: pg. 216.

Bassett, G. H., Denney, R. C., Jeffery, G. H. and Mendham, J., 1989. Vogel ' Textbook Of Quantitative Chemical Analysis. (5th Edition). ELBS/Longman. London, PP 17-46

Boyd, R. N. and Morrison, P. T., 2001. Organic Chemistry, 4th ed. Prentice Hall Inc.

Butel, E., Graef, M., Meyer, G. T., Moller, R and Schoedder ., 1980. Grundhayen cher landtechnik 30(2): 40-51.

Chappehow, C. C., 1964. Acid value in the encyclopedia of Chemistry, 3rd ed. Van Nostrand Reinhold Comp. New York: Pp 12-13.

Devine, J. and William, P. N., 1961. The chemistry and Technology of edible oils and fat. 1st ed. London. P. 43

Earp, D. A. and Newall, W., 1976. International Development in Palm Oil. The Incorporated Society of planters, Kuala: Malaysia. Pp. 19-22

Ekpa, O. D., Akpanabiatu, M., Mauro, A. and Renco, R., 2000. Varietal Differences and Polymorphism in Palm Oil: A case study of palm oils blended with coconut oil. Global J. of Pure And Applied Science (2): 27-28.

Eneobong, H. N., 2001. Eating Right: A Nutritional Guide. University of Calabar Press, Calabar-Nigeria. Pp. 14-22

Fetuga, B. L., Botsindo, G. M. and Oyenuga, V. A., 1974. Protein quality of some Nigerian feed crops. Pp. 18-45

Finar, L., 2000. Organic Chemistry. The English Language book society and Longman Group Ltd. 6th ed. London. Pp. 46-97

Hilali, M., Zoubida, C., Abd, E. A. S., larbi, H. and Dominique.G., 2005. Influence of origin and extraction methods on Argan oil physiochemical characteristics and composition.. J. Agric. & Food Chem. American Chemical Society. 53(6): 2081-2087

Hildritch, J. P. and Seavell, R., 1950. The constitution of natural facts. Chapson and Hall, London: 3rd ed. P. 571.

Ibemesi, J. A., 1992. Vegetable Oil as Industrial Raw Material. The Nigerian Perspective; SNAPP Press, Enugu Pp. 10-52

Ige, M. N., Ogunsua, A. O. and Oke, I. O., 1984. Functional properties of some Nigerian oil seeds: Camphor seeds. J.Agric. Food chem. 32:822-825

Itam, E. H., Eka, O. U. and Ifon, E. T., 1983. Chemical evaluation of the nutritive value of African walnut (*coula edulis*). Baill. Nig. J. Sci. 17: 11-19

James, C. S., 1984. Analytical Chemistry of Food. Blackie academic and professional, London. Pp. 23-107

Kalu, N.Y., 1988. Characterisation of calabash seed oil. M.Sc. Thesis, University of Uyo. Pp. 40 -140

Lee, B. A., 1983. Basic food chemistry, 2nd ed. The AVI Publishing Co. Inc. Westport. Pp. 200-306

Mahlenbacher, V. C., 1960. The Analysis of Fat and Oil. 2nd ed. Gurrand Press, Illinois, USA.

Offem, J. O., Moma, E. E., Onuchukwu, A. and Onuoha, N., 2003. AnalyticalIndices for the Identification of Adulterated Vegetable oil – palm kernel oil J. of Chem. Soc. Of Nigeria. 28:87-92.

Oke, O. I. and Umoh, I. S., 1978. Lesser known oil seeds chemical composition. Nutri reports int. 17: 293-297

Osagie, A. U., Okoye, W. I., Oluwayose, B. O and Dauodu, A.O., 1986. Chemical quality parameters and fatty acid composition of oils of some under exploited tropical seeds. Nig. J. Appl. Sc. 4: 151-162

Shaw, D. C., 1980. Introduction to colloid and surface chemistry. Butterworth Heinemann. London. Pp. 1-213

Stoed, E. A., 1989. A Biochemistry Text, 2nd ed. Mir publishers, Moscow. Pp. 25-98

Wollat, E., 1985. The manufacture of soaps, other detergents and glycerin. 2nd ed. Ellis Harwood Publishers, Chichester. Pp. 14-103