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Extraction and Characterization of Cashew Nut (*Anacardium Occidentale*) Oil and Cashew Shell Liquid Oil

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ABSTRACT

This study was carried out to extract oils from cashew shell and its kernel and to characterize the oils; with the view to ascertain their suitability for consumption and other uses. Soxhlet apparatus was used for the extraction using hexane as solvent. The physical and chemical properties of the extracted oil were analyzed. The percentage oil extracted from the shell of the cashew was found to be 25.5% while that extracted from the kernel was 11.8% oil. The results of the physical analysis showed that the cashew kernel oil (CKO) is light yellow while the Cashew Nut Shell Liquid (CNSL) is dark brown. The boiling points for shell and kernel oil were 92^0c and 95^0c respectively. The cashew kernel oil is non-toxic and the properties of CNSL conformed, to a greater extent, to that exhibited by linseed oil. This suggests its application in the processing and manufacturing industries. The kernel oil conformed both in its physical and chemical properties to those of groundnut and melon oil and thus could be used in the food and pharmaceutical industries.

Keywords: Cashew, oils, characterization, shell, kernel oil, seed nut

INTRODUCTION

The cashew industry ranks third in the world production of edible nuts with world production in 2000 put at about 2 million tones of nuts-in-shell and an estimated value of US$2billion, the world cashew nuts production comes from both wild and cultivated trees. The four major cashew producing regions are India, Brazil, Nigeria and Tanzania. During the last decades, the production of cashew nuts in Nigeria has increased from 30,000 tons in 1990 to 176,000 tons in 2000 (FAO, 2000).

Cashew apples are sometimes made locally into fruit drinks, wines and pickles. In some countries they are also Osmo-Sol dried to produce a date like caramel (Akinhami and Akintokun, 2008). The cashew apple is very sour and astringent until fully ripe, when it becomes edible. In contrast to the nut, the apple was neglected until recently, although it is available in far greater tonnage. A number of processes have now been developed for converting the cashew apple into various products such as juice, jam, syrup, chutney and beverage (Akinhami and Akintokun, 2008). In addition, the cashew apple is consumed locally and rich in vitamin A and C. The shell of the nut yields phenol-containing oils which are used for preserving and waterproofing and, after distillation; it can be used for oil proof brake lining (Idowu and Abdulhamid, 2013).

The most important product of the cashew tree is the nut, which is used as confectionery. Cashew shell nut liquid (CNSL), which is of great industrial importance is obtained from the seed pericarp by steam distillation or extraction with solvents. When unprocessed or improperly roasted, the cashew nut is very astringent (Abitogun and Borokini, 2009); the complete roasting makes all the allergens inactive. Cashew nut is a high value edible nut which yields two "Oils" one of these found, between the seed coat or pericarp and the nuts, is called the Cashew Nut Shell Liquid (CNSL). It is not a triglyceride and contains a high

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proportion of phenolic compound. It is used in industry as a raw material for brake lining compounds, as a water proofing agent, a preservative and in the manufacturing of paints and plastics (Dosunmu et al., 1995). It is toxic and corrosive to the skin (Hall and Banks, 1988). The second type of oil is found in the kernel of the cashew nut. This is called the cashew kernel oil (CKO). It contains high proportion of unsaturated fatty acids. It finds uses in medicine and cosmetics industries (Akpan et al., 2004).

According to Abitogun and Borokini (2009), Cashew nut oil is completely neutral when is unprocessed and is the best for human health. It is especially rich in unsaturated fatty acids and is least damaging to heart and arteries. In fact, it constitutes about 47% of the total weight of the nut. Nut often produces oil half their weight, the oil is referred to as 'good fat' and the ratio of saturated to monounsaturated to polyunsaturated fatty acid is 1:2:1 which is ideal for human consumption. According to Achal (2002), the relative abundance of monounsaturated fatty acids in cashew nut oil is conducive to promotion of good health and poses no nutritional risk.

Edible oil can be extracted from cashew nuts but hitherto, there is no evidence of it being carried out commercially. Despite the fact that Nigeria is one of the major cashew producers in the world, it is worthy of note that the utilization of the fruit is still very low. The nut, most times, is discarded, after the consumption of the edible cashew apple, despite its richness in oil. Again, even though it has been discovered that edible oil can be extracted from cashew nut, a thorough characterization of the oil has not be carried out. Cashew nut contains oil of economic importance and due to the efforts of Nigerian government to improve the production of the crop; it is of economic interest to characterize and to improve the oil extracted from the abundant cashew nuts for possible consumption as vegetable oil.

The aim of this work is to characterize the oils extracted from the shell and kernel of cashew fruit, using their physical and chemical analysis, and to compare the properties of Cashew Kernel Oil (CKO) with the properties of other edible vegetable oils.

MATERIALS AND METHODS

The cashew nuts obtained from a farm located at Barnawa, Kaduna state of Nigeria, were sun dried for two weeks. They were decorticated and processed by cleaning, soaked in water to avoid scorching. They were dried again and shelled to separate and obtain the kernels free of cracks. This was done manually by placing them on a flat stone and cracked with a wooden mallet. The resulted products are the kernels and the shell. 250g of both the dried kernel (AFR species) and the shell were crushed in a mortar and screened for homogeneity in size ranges.

Extraction of Oil and Analysis

Complete extraction of the oil content of *Anacardium occidentale* seeds and shells was carried out using the Soxhlet extractor (Konte, USA). Digital weighing balance was used to weigh samples of 5g, 10g, 15g and 20g. Each sample was introduced into the Soxhlet apparatus containing 250ml of hexane at 90^0c for complete oil extraction. Characterization of the oil was undertaken by analyzing the properties. For the physical analysis, standard tests as described by AOAC (1990) were adopted to determine the specific gravity, boiling point, refractive index, density and the viscosity of the oils. Standard chemical analysis were also carried out to determine the free fatty acid (FFA), acid value, saponification value, iodine value, peroxide value and the PH of the cashew nut oils as follows: the free fatty acids was determined using the method as described by Devine and Williams (1961), the iodine value was determined using the method as described by Williams (1950), and PH value was determined by the method as described by Atofaranti (2004), acid value was determined by

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the method as described by Akpan et al., (2004), the iodine value was determined using the method as described by Williams (1950) while the saponification value was determined using the method as described by Strong and Cock (1974).

RESULTS AND DISCUSSION

The summary of the results for all the properties measured are presented in Table1 and 2 for physical and chemical properties respectively.

Table 1. Results of the physical properties of the characterized oils

S. No	*Properties*	*CNSL*	*CKO*
1	Color	Dark brown	Light yellow
2	Odor	Choke	Sweet
3	Specific Gravity	0.500	0.512
4	Boiling Point (^{0}C)	92	95
5	Refractive Index	1.423	1.411
6	Density At 290C	0.903	0.812
7	Viscosity at 290C(Kg/ms)	3.60x10-3	3.59x10-3

Table 2. Results of the chemical properties of the characterization

S. No	*Properties*	*CNSL*	*CKO*
1	Free Fatty Acid (%)	58	77
2	Acid Value	1.94	2.48
3	Saponification value (mgKOH)	161	161
4	Iodine Value (mgKOH/g)	177.7	86.5
5	pH	6.28	6.68

The free fatty acid of the oils were found to be 58% and 77% for the CNSL and CKO respectively, which are higher than the previously reported value of 36.09 ± 1.12 % by Idowu and Abdulhamid (2013).This is an indication that when the CKO oil is refined it can be edible; and it also implies that the oil may stimulate oxidative deterioration which can result in the formation of off–flavour component, as earlier reported by Abitogun and Borokini (2009). The acid value of the CNSL was found to be 1.94 mgKOH/g and that of CKO was found to be 2.48 mgKOH/g which is in line with the value of 2.24 ± 0.56 reported by Idowu and Abdulhamid (2013). These values are however higher than the value of 0.82mgKOH/g reported by Aremu *et al* (2006), but lower than the value 10.7 mgKOH/g reported by Akinhanmi and akintokun (2008), for CNSL and the value of 5.99 mgKOH/g reported by Ataise et al (2009) for groundnut oil. The low acid values obtained for both oils shows that their lipids are in good non-degraded state and the values are within limits for oils used in the manufacture of paints and varnishes (Idowu and Adulhamid, 2013), (Cock and Rede 1996).

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The saponification value which is a measure of the molecular weight of fatty acid present in the oil was found to be 161mgKOH/g for both oils which is slightly lower than the value 187-196mgKOH/g reported by Pearson (1981), for groundnut oil. This low value is an indication that the oil may not be suitable in soap making. The iodine value was 177.70 for CNSL. It is a measure of the properties of unsaturated organic components and indicates the reactivity of the double bond. The iodine value 85.5g/100g for CKO indicates low degree of unsaturation and classified the oil as non-drying oil (80-100g/100g) as recorded for most edible oil, (Ataise et al., 2009), Pearson (1981). The PH values of the oils were found to be 6.28 and 6.68 for the CNSL and CKO respectively. Some of the properties obtained here show a slight deviation from those reported by Akinhanmi and Akintokun, (2008); this may be due to differences in the species of the cashew nut, the environment in which they are grown and the methods of extraction of oils before characterization. Results used for this analysis are from the raw unrefined state of the oils.

Generally, the physical and chemical properties of the characterized Cashew kernel oil show to a greater extent conformity with the properties exhibited by melon oil and groundnut oil as reported by Bertha (1992) and Weiss (2000). This shows that it could be used in the food and pharmaceutical industries. The CNSL, on the other hand, comprises both the acidic and non acidic substances called the anacardic and the cardol respectively. Its properties compare favorably with the physical and chemical properties of the castor oil (Aldo, *et al*, 2012) and linseed oil (Viorica-Mirela et al., 2012). This suggests its application in the processing and manufacturing industries.

CONCLUSION

The results of this study showed that the chemical properties of cashew kernel oil are within specification for vegetable oils. This suggests its possible use as vegetable oil when refined. The oils extracted by Soxhlet apparatus using hexane as solvent has percentage yield of 25.85% of cashew nut shell liquid (CNSL) and 11.87% cashew kernel oil (CKO). The CNSL is dark brown with a choke odor while the CKO is light yellow liquid with a sweet odor. The physical and chemical properties of the CKO oil show that it is within specification for vegetable oils while the properties of the CNSL shows that it only finds application in the processing and manufacturing industries but not suitable for consumption. The PH value of the CKO is also a clear indication that the oil is non toxic.

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