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Comparative Evaluation Of Quality Characteristics Of Oils Extracted From Some Selected Legumes And A Cereal.

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Abstract: *The quality properties of crude oils of Treculia africana (breadfruit), Artocarpus communis (breadnut), Glycine max (soybean) and Zea mays (maize) were evaluated. The results indicated that crude maize oil had the highest (6.7mgKOH/g oil) acid value and breadfruit was the lowest (2.63mgKOH/g oil) in acid value. Breadfruit had the highest (83.18% and 41.28MJ/L) values in terms of unsaponifiables. The value of biofuel potentials of crude soybean oil was the lowest (39.81MJ/L). The analysis also revealed that crude soybean oil was significantly different (P<0.05) from the crude breadfruit and maize oils in density. Crude soybean oil also differed significantly (P<0.05) from crude breadfruit, breadfruit and maize in melting point, acid value, saponification value, iodine value, unsaponifiables and biofuel potentials but compared well (P>0.05) in density and specific gravity with breadnut. There was no significant difference (P>0.05) in specific gravity between crude soybean and maize oils but difference existed significantly (P<0.05) in specific gravity between it and crude breadfruit oil.*
Keywords: *Quality characteristics, Legumes, Crude oil.*

I. Introduction

"Vegetable oil" generally refers to a liquid fat at ambient temperature that is derived from plant products. Oil can be categorized in many different ways: type of plant it was extracted from, the level of refinement, the method of extraction and the temperature at which it can be cooked (Walnut, 1971). The sources of these oils are reflected in their names such as palm oil, palm kernel oil, etc (Zulbert, 1988). Oil that has both industrial and edible purposes includes palm, palm kernel, soybean, coconut and maize (Igwe, 2003).

Oils are an essential part of our diet, supplying nutrients, improving flavor, aiding in the absorption of vitamins and providing concentrated sources of energy for our bodies (Fellows et al., 1998). They increase palatability of food and satiety value. Vegetable oils are the major source of vitamin E which can be seen as an anti-oxidant in the oil. Other ingredients identified in the oil are very impressive; most contribute effectively in the nutritional utilization of vegetable oil while others are partially or wholly removed during refining processes. The choice of vegetable oil is often of taste preference or cost, although with the exception of olive-oil, these products are quite bland if fresh. Many oils have anti-bacterial properties, thus helping to reduce infections in sensitive or damaged cells.

In order to obtain high quality edible oil, various techniques are used in the processing (Fellows and Hampton, 1992). The processes of obtaining oil from seeds such as maize involve the separation of oil from oil-bearing materials by mechanical means such as distillation and expression (Jack, 1996) and chemical means such as solvent extraction (Potter and Hotchkiss, 1998; Weiss, 1963).

Vegetable oil is composed of glycerides and is an ester of glycerol. Oils which contain more than 2% linolenic acid cannot be used for frying as these oxidize readily, yielding suspect products (irritants and carcinogen). Oils may be used for dressing (rapseed, soybean, saff flower, maize)(Alia and Linden, 1999). Triglycerides are the most important from the standpoint of nutrition (Onimawo and Egbekun, 1998).

The objective of this investigation is to assess and compare some vegetable oils from selected legumes and a cereal.

II. Materials And Methods.

Raw Material Collection

Treculia africana (breadfruit), Artocarpus communis (breadnut), Glycine max (soybean) and Zea mays (maize) seeds were bought from Oil mill market in Port Harcourt city LGA, Rivers State of Nigeria.

Crude Oil Extraction Using Solvent Extraction Method

The method of crude oil extraction as described by the standard methods of AOAC (2005) was used. The dried seeds of breadfruit, breadnut, soybeans and seeds were cleaned, sorted and ground separately into fine particle sizes using attrition mill for most intimate contact with the solvent.

Eight kilograms (8kg) of each of the ground dried legumes and a cereal were respectively fed into an extraction thimble, which in turn was placed in a soxhlet extraction flask. The tube was attached to a weighed flask. The flask was half-filled with hexane. This was refluxed for about 4hs to extract the mixture, warming the weighed flask gently on a heated mantle. The apparatus was rearranged for distillation and hexane was evaporated to dryness while the oil was recovered.

Determination of the Physicochemical Properties of Crude Vegetable Oil

Acid value and peroxide value were determined according to the method described by Pearson (1976). Iodine value, saponification value and unsaponifiable matters were determined using the standard method described by AOAC (2005) while Biofuel potential was estimated according to the method described by Aigodion et al. (2004). Density and specific gravity were determined using the ratio of the density the bottle and the equal volume of distilled water respectively. Melting point was determined by melting samples which were solidified by refrigeration. All determinations were done in triplicates.

Statistical Analysis

All the data generated were subjected to one-way analysis of variance (ANOVA) and statistical significant differences among the means were separated using the Duncaric multiple range test (McDonald et al., 1998) using Steel and Torrie (1980).

III. Results And Discussion

Acid Value, Peroxide Value, Saponification Value, Iodine Value, Unsaponifiable and Biofuel Potential

The values obtained for crude T. africana (breadfruit) (2.63mgKOH/g), A. comminus (breadnut)(2.66mgKOH/g), Glycine max(soybean) (4.05mgKOH/g) and Zea mays(maize) (6.7mgKOH/g) are shown in Table 1.

The acid value of crude maize oil differed significantly (P<0.05) from the soybean and breadfruit oils. Adebayo (1979) reported that the occurrence of free fatty acids determines acid value of oil. The quality of oil is determined by the free fatty content or the acid value of the oil. The higher the values, the lower the quality of the oil. Fats and oil regulation under the Food and Drug Act of 1974 (FRN, 1980), recommended that the acid values of a refined oil should not exceed 0.6mgNaOH/g oil.

Peroxide value of the crude soybean oil differed significantly (P<0.05) from the breadfruit and maize oils. Ihekoronye and Ngoddy (1999) stated that peroxide value is usually used as an indicator of deterioration of oil and also used to estimate oxidation. The International Oil Standard, EPIC (2004) reported that the peroxide value of crude oils should be less than 25meq/Kg oil. This agreed with the values of crude oils of Zea mays (2.07meq/Kg), T. africana (2.17meq/Kg)and Glycine max (2.42meq/Kg).

The saponification value of the crude soybean oil differed significantly (P<0.05) from the breadfruit oils and maize oil. Minife (1970) stated that saponifaction value is inversely proportional to the molecular weight of the fatty acids present. This implies that saponification value above 200 indicate the presence of low or fairly low molecular weight fatty acids while values below 190 indicate the presence of high molecular weight fatty acids. Invariably, the results obtained for crude oils of Zea mays (155.29mgKOH/g), Glycine max (190.54mgKOH/g), T. africana (152.90mgKOH/g) andA. comminus (181.76mgKOH/g) agreed with the results of Minife (1970).

The unsaponifiable matter of T. africana oil differed significantly (P<0.05) from the crude oils of A. comminus, Zea mays and Glycine max. Ihekoronye and Ngoddy (1985) stated that the unsaponifiable matter is a measurement of water- insoluble components produced after heating the oil with potassium hydroxide. The amount of unsaponifiable matter found in edible oils is usually small, and high figures may indicate contamination or adulteration (Ihekoronye and Ngoddy, 1999). The result obtained for A. comminus oil (0.63%) agreed with the statement above and higher values of T. africanaoil (83.18%), Glycine max (15.96%) and Zea mays (34.31%) might be as a result of contamination.

The iodine values of Zea mays oil (138g/Kg) differed significantly (P<0.05) from the crude oils of T.africana, A. comminus, and Glycine max. The iodine value is constant for a particular oil or fat, but the exact figure obtained depends on the particular technique employed (Pearson, 1976). The result obtained from crude oils of Zea mays (138.28g/Kg), Glycine max (124.16g/Kg), T.africana (120.41g/Kg)and A. comminus(97.31g/Kg) conformed with the recommended International Codex Standard for edible oils of Zea maysand Glycine max which are 103 - 128 and 120 –143 Wiji's respectively. The lower value (97.31g/Kg) obtained for A. comminus could be a result of the unsaturation of the fatty acids involved. Less saturated fats with iodine values are solids at room temperature, or conversely oil that are more highly unsaturated are liquids (showing there is a relationship between the melting point and iodine values) Pearson (1976).

The biofuel potentials of T. africana oil differed significantly (P<0.05) from the values obtained for Zea mays oil, A. comminus oiland Glycine max oil. The values for crude oils of A. comminus (41.28MJ/L), A. comminus (40.2728MJ/L), Glycine max(39.8128MJ/L) and Zea mays (39.8428MJ/L) did not differ much from that of commercial grade diesel which was (44.9528MJ/L) (Aigodion et al., 2004). Furthermore, Aigodion et al. (2004) reported that the biofuel potential of Glycine max oil was found to be 39.71MJ/L.

Table 1: Values For The Chemical Properties Of Crude Breadfruits, Soybean And Maize Oils

SAMPLE OILS	ACID VALUE (mgKOH/g oil)	PEROXIDE VALUE (MEq/Kg oil)	SAP. VALUE (mgKOH/g oil)	IODINE VALUE (g/Kg)	UNSAP. MATTER (%)	BIOFUEL POTENTIAL(MJ/L)
Treculia africana (Breadfruit)	2.63±0.14[c]	2.17±0.028[b]	152.90±0.58[d]	120.41±0.13[c]	83.18±0.15[a]	41.28±0.021[a]
Artocarpus communis (Breadnut)	2.66±0.0081[c]	1.48±0.012[c]	181.76±0.26[b]	97.31±0.24[d]	0.63±0.016[d]	40.27±0.009[b]
Glycine max (Soybean)	4.05±0.024[b]	2.42±0.06[a]	190.54±0.19[a]	124.16±0.071[b]	15.96±0.012[c]	39.81±0.045[c]
Zea mays (Maize)	6.7±0.025[a]	2.07±0.057[b]	155.29±0.28[c]	138.28±0.13[a]	34.31±0.26[b]	39.84±0.029[c]

Means ± SD with same alphabets in the same vertical row are not significantly different (P<0.05).

IV. Physicochemical Properties Of Crude Maize, Breadfruit And Soybean Oils.

The result of some quality properties of the crude oils Treculia africana (breadfruit), Artocarpus communis (breadnut), Glycine max (soybean) and Zea mays (maize) are shown in Table 2. The densities of A. communis (0.916g/cm^3) and Glycine max(0.926g/cm^3) were not significantly different (P>0.05) but they significantly differed (P<0.050) from the densities of crude Zea mays oil (0.903g/cm^3) and crude T. africana oil (0.846g/cm^3) (Table 2).

The density Artocarpus communisoil significantly differed (P<0.05) from the density of Treculia africanaoil (0.846g/cm^3) but does not differ from that of Zea mays oil at 95% confidence level.

Density is often defined as the specific gravity or relative density (David et al., 1978) and as such has the same value as the specific gravity in this study. Since the specific gravity of crude oil is about 0.89 (International Oil Standards EPIC, 2004), the densities obtained showed that the values (0.846, 0.916, 0.926 and 0.903g/cm^3) for Treculia africana, Artocarpus communis, Glycine max and Zea maysoils compared very well (P>0.05) with the above standard. The result of the density of crude Zea maysoil (0.903g/cm^3) agreed with that obtained for Zea maysoil (0.920 – 0.928g/cm^3) (Patterson, 1989). Meyer (1978) and Woodbury et al. (1998) has also obtained the specific gravity of crude Zea maysas 0.917- 0.925g/cm^{3}which also compared with the value of 0.903g/cm^{3}for maize in this study.

The melting point of crude Artocarpus communisoil differed significantly (P<0.05) from those of crude Treculia africana,Glycine max and Zea maysoils. The values obtained for crude oils of oils Treculia africana (5.00^{o}C), Artocarpus communis (17.01^{o}C), Glycine max (6.09^{o}C) and Zea mays (6.09^{o}C) agreed with the statement of Woodbury et al. (1998) that the melting range of a compound is one of the characteristic properties of a pure solid and as such melting range of 5^{o}C or more indicate that a compound is impure.

Table 2: Values For The Physical, Properties Of Crude Breadfruits, Soybean And Maize Oils

Sample Oils	Density (g/cm^3)	Specific gravity	Melting point (^oC)
T. africana (Breadfruit)	0.846 ± 0.006^{c}	0.846 ± 0.006^{b}	5.00 ± 0.0047^{c}
A. communis (Breadnut)	0.916 ± 0.0047^{ab}	0.916 ± 0.01^{a}	17.01 ± 0.0081^{a}
Glycine max (Soybean)	0.926 ± 0.0047^{a}	0.926 ± 0.01^{a}	6.09 ± 0.12^{c}
Zea mays (Maize)	0.903 ± 0.0047^{b}	0.903 ± 0.006^{a}	6.90 ± 0.29^{b}

Means ± SD with same alphabets in the same vertical row are not significantly different ($P<0.05$).

V. Conclusion

The investigation revealed that appreciable oil can be extracted from Treculia africana (breadfruit), Artocarpus communis (breadnut), Glycine max (soybean) and Zea mays (maize). Although, breadnut had low iodine value which signified its degree of unsaturation, the quality of oil was comparably high.

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