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Partial Characterization of Red Oil from Three Varieties of Palm Oil Trees (*Elaeis Guineensis*)

Ezenwaka, C. J.and Ezeonu, F. C.
Biochemistry Department, Faculty of Natural Science, NnamdiAzikiwe University, Awka, Nigeria.

Abstract:- Partial characterisation of palm oil from the three varieties of Elaeisguineensis namely E.guineensisvariety 'dura', E.guineensisvariety 'tenera' and E.guineensisvariety 'pisifera' were carried out. Physicochemical properties and vitamin A and E were evaluated using standard methods. The physicochemical properties were largely similar except for the acid values, peroxide values and the free fatty acid that differed significantly ($p<0.05$) in 'pisifera' variety. The Nigeria Industrial Standard (NIS) limits of 0.60 mg KOH/g acid value, 0.20% moisture and 0.05% impurities were exceeded in all the sample varieties while the peroxide values of all the sample varieties were within the NIS limit of 10 meq/L maximum. The results showed that the unsaponifiable matter differed significantly ($p< 0.05$) in the 'dura' variety. The vitamin A and E and kernel content were highest in 'dura' variety and least in 'pisifera variety. The 'pisifera' variety had the highest oil yield with the value 55.24%±2.64 while 'dura' variety had the least oil yield of 23.57%±1.0. These results could imply that E.guineensisvariety 'dura' could be a more potent antidote than E.guineensisvariety 'tenera' and E.guineensisvariety 'pisifera'.

Keywords:- *Unsaponifiable matter, Physicochemical, Acid value, Elaeisguineensis, 'tenera' 'pisifera', 'dura'.*

I. INTRODUCTION

The genus Elaeis (palm oil) comprises of two species, Elaeisguineensisand Elaeisoleifera. Elaeisguineensis originated from West Africa while Elaeisoleifera is a stumpy plant of South American origin. African oil palm (Elaeisguineensis) has three different varieties namely 'pisifera', 'dura' and 'tenera' distinguished on the basis of relative thickness of the shells and the ratio of mesocarp to fruit (Hartwell, 1967). Dura (locally called 'akwu-ojukwu' by the Ibos) is the thick-shelled variety with low to medium mesocarp content and greenish colour tinge, 'pisifera'' locally called 'akwu-osukwu' by the Ibos) usually has little or no kernel and 'tenera' type has thin-shell kernel and thick mesocarp.

Significant differences were observed in the composition of the lipid classes of oil palm fruit from the three varieties. 'Dura' contains high concentration of unsaturated fatty acid (George and Arumughan, 1991).

Palm oil fruit is made up of three parts, the exocarp, mesocarp and endocarp. The compositions of these parts differ. Extremely high contents of phospholipids and glycolipids were noticed in the exocarp (outer skin) of the fruit compared with the fleshlymesocarp (George and Arumughan, 1991).

Palm oil obtained from fruit of palm tree is the most widely produced edible vegetable oil in the world and its nutritional health attributes have been documented (Chandrasekharan*et al.,* 2000). It is rich in carotenoids (especially vitamin A) from which it derives it deep red colour and no other vegetable oil has as much vitamin E as compared to palm oil (Chow, 2002; Khosla, 2006). Palm oil contains palmitic acid and linoleic acid which is an essential unsaturated omega-6 fatty acid (Basiron, 2005). Fruit bunch yield, size of the kernel in fruit and oil content of fruits are used as criteria for selecting individual palms for breeding.

II. SAMPLE COLLECTION AND OIL EXTRACTION

Palm fruits were extracted from freshly harvested bunches of the three different varieties of *Elaeisguineensis* trees at Ozubulu, Ekwusigo Local Government Area, Anambra State Nigeria. Palm fruits were boiled with hot water and were pounded in a wooden mortar and mashed with water. The oil was separated using a sieve. The oil was further scooped, placed in a separate pot and heated to dry the water while other impurities in the oil settled at the bottom of the pot. The oil was collected and stored in sample bottles for analysis.

- *Preparation of sample for vitamin a and e assay*

One gram of the extracted oil from three different species of palm fruit were refluxed with 90% methanolic 0.3N NaOH for 1-2 hours. After, the reaction mixture (soap) was diluted with methanol and the non saponifiable matter was extracted with hexane. This was used for vitamin A & E assay (Panfili*et al.,* 2003).

*Chemicals***:** All chemicals used were of analytical grade.

III. METHODS

Standard curve for vitamin E was prepared according to the titration method described by Kayden *et al.,* 1973.

Vitamin A standard curve was prepared according to the spectrophotometry method described by Plummer, 1978.

Free fatty acid was determined according to American Oil Chemist Society, AOCS (1972).

Moisture/volatile matter and specific gravity were determined according to the method described by Association of Official Analytical Chemist, AOAC (2000).

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Iodine value was determined according to IUPAC (1982) method.

Peroxide value was determined according to the method described by American Oil Chemist Society, AOCS (2006).

Colour determination was done according to American Oil Chemist Society, AOCS (1993) method.

Insoluble impurity was assayed using Nigeria Industrial Standard Test method (2000).

Oil content was determined using the method described by Association of Official Analytical Chemist, AOAC (1984).

Viscosity index (VI), kinematic viscosity at 40^{o}C and 100^{o}C were done using ASTM standard method (2003).

Determination of saponification value was done using standard method for analysis of oil, fat and soap (IUPAC, 1982).

Determination of unsaponified matter was done using diethyl ether method of Nigeria Industrial Standard Test method (2000).

Acid value was determined using the method described by American Oil Chemist Society, AOCS method (1989).

IV. STATISTICAL ANALYSIS

The mean values of different parameters from different sample varieties were analysed using one way analysis of variance (ANOVA) using Statistical Packages for Social Sciences (SPSS) version 15 to test for significance across the sample varieties. Data were reported as means ±S. D, where appropriate. Correlation analysis was also conducted to find out if there is a relationship between the vitamin A and E across the sample varieties. Differences were considered significant when $p< 0.05$ and $p< 0.01$.

V. DISCUSSION AND RESULTS

Partial characterisation using standard methodologies was carried out on the three varieties of Elaeisguineensis namely E.guineensisvariety ‘dura’, E.guineensisvariety ’tenera’ and E.guineensisvariety ‘pisifera’. The result showed a significant difference ($p<0.05$) in the oil yield between ‘pisifera’ variety and other varieties. Also, there exists a significant difference ($p<0.05$) in the kernel content between ‘dura’ variety and others. These were as the result of high mesocarp to fruit ratio in ‘pisifera’ variety and high kernel to fruit ratio in ‘dura’ variety (Basiron, 2005). The high free fatty acid/acid value of the three varieties could imply the need to refine the oil to a better food grade and to improve the stability. The low peroxide value could be an indication of the ability of the three oil varieties to resist lipolytic hydrolysis and oxidative deterioration (Akanniet al., 2005). The result showed a significant difference ($p<0.05$) between the red pigment in ‘pisifera’ variety and ‘dura’ variety, though this could not be related to the low vitamin A content in ‘pisifera’ variety when compared with ‘dura’ variety since palm oil is rich in carotenoids (especially vitamin A) from which it derives it deep red colour (Chow, 2002). The high specific gravity in the three oil varieties could be due to high moisture and impurity contents. The significantly ($p<0.05$) low unsaponifiable matter in ‘dura’ variety when compared with ‘tenera’ and ‘pisifera’ varieties might explain the low cholesterol level and could satisfy the consumption need of atherosclerosis patients (Akanniet al., 2005). In the other hand, cooking with oil from ‘dura’ variety may be encouraged to maintain a population with low cholesterol level. The high saponification values of ‘dura’ variety could imply that the oil could be suitable in soap making and cosmetic industries (Akanniet al., 2005; Asuquoet al., 2010). ‘Dura’ had the highest iodine value which could indicate higher degree of unsaturation. This is in line with (Ekwenye, 2006; Njokuet al., 2010). The ‘dura’ variety also had the highest vitamin A (Njokuet al., 2010) and vitamin E content. This might explain the preference of oil and miscella (mixtures of oil and water) from ‘dura’ specie as a better antidote when compared with other varieties.

VI. CONCLUSION

The study revealed that the variety ‘dura’ had the highest vitamin A and E content whereas ‘pisifera’ variety had the least. ‘Dura’ variety was also observed to have the highest degree of unsaturation from the result of the iodine value while ‘pisifera’ variety had the lowest. Also, ‘dura’ variety had the least unsaponifiable matter when compared with ‘tenera’ and ‘pisifera’ varieties.

VII. CONTRIBUTION TO KNOWLEDGE

‘Dura’ variety has healthier nutritional component than ‘pisifera’ and ‘tenera’ variety.

VIII. RESULTS

The relative proportion of moisture, fat and kernel in the three varieties of *E. guineensis*is shown in table 1.

Parameters	E.guineensis‘dura’ variety	E.guineensis ‘tenera’ variety	E.guineensis ‘pisifera’ variety
Moisture (%)	0.34±.01	0.76±.04	0.32±.05
Oil yield (%)	23.57±1.00	30.88±1.18	55.24±2.64
Kernel content (%)	65.52±1.45	14.85±1.08	12.44±.26

Table 1. Relative proportion of moisture, fat and kernel in the samples

From the table it is obvious that E.guineensis‘pisifera’ variety had the highest oil yield and the least kernel content. E.guineensis‘dura’ variety on the other hand had the highest kernel content and the least oil yield.

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A. Physicochemical characterisation

Physicochemical characteristics of the three varieties of E.guineensisare reported in table 2.

Parameter	E. guineensis'dura' variety	E.guineensis 'tenera' variety	E.guineensis 'pisifera' variety
2.18±.02%		2.62±.06%	0.64±.04%
16.6±.25 Red		18.8±.34 Red	24±2.33 Red
0.9156±.04		0.9198±.02	0.9180±.03
Impurities	0.12±.01%	0.30±.03%	0.06±.03%
Unsaponifiable matter	4.57±.34 g/kg	7.06±.67 g/kg	7.19±.62 g/kg
Saponification value	199.94± .58 (mg KOH/g oil)	198.21±.13 (mg KOH/g oil)	194.94± 4.98 (mg KOH/g oil)
Acid value	4.46±.07 mg KOH/g oil	5.30±.03 mg KOH/g oil	1.32±.03 mg KOH/g oil
Peroxide value	6.31±.31 meq/kg oil	7.58±.43 meq/kg oil	1.83±.81 meq/kg oil
Viscosity@40^{o}C	41.3±.25 cst	40.7±.53 cst	41.1±.58 cst
Viscosity@100 ^{o}C	8.26±.51 cst	8.14±.52 cst	8.24±.63 cst
Viscosity index	180±.88	179±2.31	181±2.08
Iodine value	53.38±2.42 Wijs	52.09±2.67 Wijs	51.60±3.81 Wijs

Table 2. Physicochemical properties of oil from different varieties of E.guineensis

The table showed great similarities between the physicochemical properties across the sample varieties except for few parameters. The table also showed a significant difference ($p<0.05$) in the free fatty acid, acid value and peroxide value between E.guineensis 'pisifera' variety and other varieties. Also, the table showed a significant difference ($p<0.05$) in the red pigmentation between E.guineensis 'pisifera' variety and other varieties.

B. Vitamin A and E

The vitamin A and E contents of the oil samples are presented in table 3.

	VITAMINS PER GRAMME OF OIL	
SAMPLES	VITAMIN A	VITAMIN E
E. guineensis'dura' variety	485.44 I.U	7.34 I.U
E.guineensis 'tenera' variety	166.67 I.U	2.72 I.U
E.guineensis 'pisifera' variety	324.90 I.U	3.65 I.U

Table 3. Vitamin A and E in the oil samples

The 'dura' variety had the highest values of both vitamin A and E. This was followed by 'tenera' variety and then 'pisifera' variety.

There was a strong positive correlation in the vitamin A and E content across the sample varieties.

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