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ABSTRACT

The yield, phytochemicals, and vitamin A and E content of various traditional ways of processing palm oil were evaluated. Samples A, B, C, D, and E were created using four typical methods and one control method. Fresh fruit was pounded; fermentation, frying, and manual pressing were used to obtain Sample A. (Eketeke). The control sample B was extracted by boiling and pressing (Mill technique). Boiling, pounding with red mud, and manual pressing were used to extract Sample C. (Mbaise Method I). Boiling, smashing with earth sand, washing, and distilling produced Sample D (Mbaise Method II). Finally, sample E was obtained through boiling, pounding, washing, and distillation (Enugu method). All of the methods required 8.9kg of fresh fruits. With a volume of 130cl, Sample D came out on top, followed by Sample E with 125cl, Sample C with 120cl, Sample B with 118cl, and Sample A with 108cl. Tannins, phenols, oxalates, alkaloids, and flavonoids were among the phytochemicals found in the samples. Sample E had the most tanins (0.06g), followed by Sample A (0.05g), and Sample D had the least (0.02g). Sample B (0.62g) has the most phenols, followed by Sample A (0.49g), Sample D (0.39g), Sample E (0.18g), and Sample C (0.18g). Sample E had the highest oxalates value (0.11g), followed by Sample B (0.09g), Sample C (0.6g), and Sample D and C (0.5g). In alkaloids, the highest value was in Sample E (10.93g), Sample B (6.55g); Sample D (6.02g), and the lowest in Sample C (2.44g) and lastly flavonoids yielded the highest in Sample C (8.31g), Sample E (7.77g) and Sample A the lowest with (0.10g). The estimation of vitamin A and E was also determined. Sample D yielded the most vitamin A (18.732mg); Sample B (18.459mg); and Sample A yielded the least (14.879mg). Sample D produced the most vitamin E (789.094mg), followed by Sample B (787.512mg), and Sample A (694.303mg). As a result, Sample D and E are considered the best methods of processing palm oil, and these methods of processing palm oil should be adopted and further analysis conducted on them to elucidate their efficiency in order to ensure a continuous supply of essential phytochemicals and Vitamin A and E required for good vision and adequate blood clotting whenever a cut on the human body occurs.

Keywords: *Palm oil, Traditional, Nutrition, Processing.*

INTRODUCTION

Palm oil is a liquid extract made from the fresh fruit bunches of the oil palm (Elaeis guineensis) plant and is one of Nigeria's most important exports [1,2]. Oil palm cultivation and oil extraction are not only an agricultural culture for millions of people in the country, but also a source of income for many rural families [3]. The fronds, leaves, trunk, and roots of the oil palm are all key components that are used for a variety of applications [4].

The red palm oil (from the mesocarp) and palm kernel oil (from the seeds) are the two main products of the oil palm crop [5]. Cooking, soap and detergent production, margarines, candles, confectioneries, epoxy resins, lubricants, pomades, and cosmetics all use these oils as raw materials [6]. Kernel cakes, which are made by crushing palm kernels to extract oil, are used as animal feed additives [7]. Palm wine is also made from the plant's immature inflorescences. Carotene, a precursor to vitamin A, fatty acids, and glycerol enzymes are among the phytochemical components in palm oil [8].

The establishment of plantations, which provided the opportunity for large-scale fully mechanized processing, and research and development of the Red oil processing work in many disciplines - biochemistry, chemical, and mechanical engineering - resulted in the evolution of the traditional processing steps designed to extract red oil from harvested oil palm bunches. In essence, the traditional oil extraction method entails receiving fresh fruit bunches from plantations, sterilizing and threshing the bunches to release the palm fruit, mashing the fruit, and pressing the crude palm oil out. The crude oil is purified before being stored and exported [9].

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Research organizations, development agencies, and private sector engineering firms have all attempted to mechanize and improve old manual methods, but their efforts have been fragmented and uncoordinated. They've mostly focused on reducing the tedium and drudgery from the mashing or pounding stage (digestion) and increasing oil extraction efficiency. In most oil-palm-growing African countries, small mechanical, motorized digesters have been constructed [10].

Palm oil has a distinct flavor, color, and nutritional profile, making it appropriate for a wide range of cooking applications and boasting a long list of possible health advantages [11]. Palm fruit, which is harvested from palm trees, is the primary source of palm oil. Processing this palm fruit in a variety of ways (methods) has a detrimental or beneficial impact on it. Some processing methods degrade the nutritional value of palm oil by failing to remove all contaminants and residual waters in red palm oil during processing, resulting in a foul odor, taste, and color change [12].

Vitamin A deficiency, also known as retinol deficiency, is a public health issue that is the most common dietary deficit worldwide [13]. Vitamin A shortage can be caused by liver problems, fat malabsorption, or a lack of vitamin A in the diet. Retinaldehyde, and hence retino and retinoic acid, can be produced by cleaving provitamin A. [14]. While the vitamin E in red palm oil may help the heart, improper processing might lead to heart problems. Red palm oil is the least effective in lowering cholesterol and may potentially enhance "bad" LDL cholesterol levels when compared to other liquid vegetable oils. When compared to olive oil, palm oil raises cholesterol in healthy people [6].

As a result, the goal of this study is to evaluate different conventional techniques of processing palm oil and their impact on certain of its phytochemical features, as well as vitamin A and E attributes.

MATERIALS AND METHODS

2.1. Study Area

This study was carried out in Umuchima Village, Ihiagwa Community in Owerri-West Local Government Area of Imo state. This location was chosen as an appropriate site for this study because of the existence of different oil palm plantations..

2.2. Sample Collection and Processing

The palm fruits were collected from a plantation in Umuchima village, Owerri and not from the wild type. Other materials used for the experiment include: water, red mud, earth sand, mercury thermometer, mortar and pestle, measuring scale, gas cylinder (5.5kg), iron pot, basin, 10 litres paint container, plastic container/glass bottle container, paper tape and filter.

Palm fruits were collected from already harvested bunches. The harvested fruit bunches were manually threshed by cutting the fruit-laden spikelet from the bunch stems with a machete and were allowed to ferment for two days for easy removal of the egg-shaped fruits from the spikelet. Then separation of the fruits from the spikelets was done by hand. The harvested fruits were weighed and shared into five different places (Samples) and labeled A – E. Each of the Samples weighed (8.9kg) and subjected to different extraction methods. The red mud and earth sand were equally weighed (1kg) each.

There are different ways by which palm oil is produced. But for the purposes of this study, the five different samples were subjected to extraction processes of four traditional methods and one mechanized method.

2.2.1. Sample A (Extraction by raw pounding, fermentation, and frying otherwise known as Eketeke)

Exactly 8.9kg of the raw fruits was poured into a wooden mortar and pounded until it looked even. It was then transferred to a container and covered for 3 days to allow fermentation to occur. On the third day, kernels were selected out and the fiber fried using the metal frying pot. The initial temperature of the fiber before frying was 29^0C. The temperature at which the fiber loosened out and the oil started coming out was 38^0C. It was then allowed to cool a little to a temperature of 30^0C. Bare hands were then used to press out the oil. The extract was measured and transferred to container.

2.2.2. Sample B: (Extraction by boiling, pounding and Mill Processed {Control})

Briefly 8.9kg of the palm fruit was subjected to boiling for 1hour 10 minutes. The initial temperature of the water before boiling was 23^{o}C and surrounding temperature at 28^{o}C. The boiled palm fruits were removed from the pot with a metal sieve and transferred to the machine for pounding until it becomes even. Hydraulic press was done with the machine. The extract was also measured and stored in a container.

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2.2.3. Sample C (Extraction by cooking, pounding with red mud and hand pressing without washing {Mbaise Method I})

Palm fruits weighing 8.9kg was poured into an metal pot that can contain it and 10 litres of water was poured. The initial temperature of the water before boiling was recorded at 23^0C with the surrounding temperature at 26^0C. The pot contents (palm fruits and water was set on fire to boil for about 1 hour to a temperature of 100^0C – final temperature). This softens and sterilizes the palm fruit. It was then transferred into the wooden mortar, pounded for a few minutes then red earth was added. The mixture of red mud and the palm fruits was pounded together until it mixed properly. Then the kernels were separated from the fibre by hand picking and then the fibre was pressed with bare hands to bring out the oil which was stored in a container labeled C.

Fig. 2.1: Oil extraction from fibre by hand pressing

2.2.4. Sample D (Extraction by cooking, pounding with earth sand and washing ({Mbaise Method II})

Extraction for this sample was the same with the procedure for sample C except that in place of red mud, earth sand was used to mix with the boiled fruits during pounding. Then the mixture was transferred into a basin containing water. The kernels and fibre were removed, leaving the oil and water in the basin. The oil was then skimmed out with bare hands into a pot for boiling. The skimmed oil was boiled for about 1 hour to remove water contents from the oil.

Fig. 2.2: Washing pounded fruits mixed with Earth sand (Sample D).

2.2.5. Sample E (Extraction by cooking, pounding and washing {Enugu Method})

The same amount of palm fruit (8.9kg) was poured into a metal pot followed by 10 litres of water. The initial temperature of the water before boiling and the surrounding temperature were noted. The iron pot containing the palm fruit and water was set on the fire and allowed to boil for 1 hour to soften and sterilize the fruit. It was then sieved out and poured into the wooden mortar for pounding. After pounding, the pounded fruit was transferred into a basin containing water for washing. The kernels and fiber were removed, leaving the oil and water in the basin. The oil was skimmed out with bare hands into a pot for boiling. The skimmed oil was boiled for about an hour to remove the water content from oil.

Fig. 2.3: Skimming floating oil with hand into a pot.

Fig. 2.4: Oil and water boiling in a pot until water evaporates

2.3. Percentage (%) Yield

The oil percentage yield was recovered once the extraction of the oil was done after each method of processing. After extraction of the oil from each sample, the yield was measured with a measuring cylinder.

2.4. Phytochemical Analysis

2.4.1. Test for tannins

Exactly 1.0g of the sample was weighed and dispersed in 10ml of distilled water and agitated and left for 30 minutes at room temperature. The mixture was centrifuged and 2.5ml of the supernatant (extract) was dispersed in 50ml of volumetric flask. 2.5ml of standard tannic solution was dispersed into a separate 50ml flask. 1.0ml Folin-Denis reagent was added

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followed by 2.5ml of saturated NH_4OH solution. The mixture was diluted to mark in the flask (50ml) and incubated for 90 minutes at room temperature. The absorbance was measured at 250nm in a Genway model 6090 electric spectrophotometer. The same procedure was carried out on samples B, C, D and E.

2.4.2. Test for Alkaloids

To 5.0g of the sample was added 50ml of 10% acetic acid solution ethanol and dispersed. The mixture was vortexed and allowed to stand for 4hrs before filtering. The filtrate was evaporated to (1/4) of its original volume. Drops of concentrated NH_4OH solution were added and the precipitate filtered with a weighed filter paper and washed with 1% NH_4OH solution. The precipitate was dried in the filter paper in an oven at 60^0C weighed for 30 minutes and reweighed. Same procedure was carried out in sample B, C, D and E.

2.4.3. Test for phenol (using Folin-Ciocalteu reagent method)

Briefly 1mg of the sample A was dissolved in methanol (1ml). A total of 10% Folin-Ciocalteu reagent was prepared by adding Folin-Ciocalteu reagent (10ml) in water (90ml). Then, 5% Na_2Co_3 (3g) was prepared by dissolving Na_2Co_3 in water (50ml). Oil sample was taken in a test tube followed by 10% Folin-Ciocalteu reagent (1.5ml). All the test tubes were kept in a dark place for 5mintues. Finally, 5% Na_2CO_3 (1.5ml) was added to the solution and mixed well. Again all the test tube was kept in the dark for 2 hours The absorbance was measured for all solution using UV-spectrophotometer at constant wave length 750nm. The same procedure was repeated for sample B, C, D and E.

2.4.4. Test for oxalate

This test involves three major steps digestion, oxalate precipitation and permanganate titration. 2g of sample oil was suspended in 190ml of distilled water in a 250ml volumetric flask. 10ml of 6M HCl was added and the suspension digested at 100^{o}C for 1 hour. Allowed to cool and then made up to 250ml mark before titration. Duplicate portions of 125ml of the filtrate are measured into beakers. Four drops of methyl red indicator was added, followed by conc. NH_4OH solution (dropwise) until the test solution changes from salmon pink colour to a faint yellow colour (pH of 4 – 4.5). Each portion is then heated to 90^{o}C, cooled and filtered to remove precipitate containing ferrous ion. The filtrate is again heated to 90^{o}C and 10ml of 5ml $Cacl_2$ solution is added while being stirred constantly. After heating, it is cooled and left over night at 5^{o}C. The solution is the centrifuged at 250rpm for 5minutes. The supernatant is decanted and the precipitation completely dissolved in 10ml of 20% (v/v) H_2SO_4 solution.

The total filtrate resulting from digestion of 2g of the oil sample is made up of 300ml. Aliquot of 125ml of the filtrate is heated until near boiling. Then titration against 0.05M standardized $KMnO_4$ solution to a faint pink color which persists for 30seconds. Then the calcium oxalate content is calculated.

2.5. Estimation of Vitamin A

Vitamin A was estimated by the method of Bayfield and Cole [15].

The assay is based on the spectrophotometric estimation of the color produced by vitamin A acetate or palmitate with TCA. The procedures were carried out in the dark to avoid the interference of light.

2.6. Estimation of Vitamin E

Vitamin E was estimated in the samples by the Emmerie-Engel reaction as reported by Deldime *et al*., [16]. The Emmerie-Engel reaction is based on the reduction of ferric to ferrous ions by Vitamin E, which, with 2, 2'-dipyridyl, forms a red colour. Vitamin E and carotenes are first sampled with xylene and read at 460nm to measure carotenes. A correction is made for this after adding ferric chloride and read at 520nm.

2.7. Experimental Analysis

Data obtained were analyzed using Chi-Square.

RESULTS AND DISCUSSION

3.1. Quantity Of Samples Used / Yield in The Different Methods

Figure 3.1 shows the quantity of fresh palm fruit used for the different methods and quantity yields. Sample D has the highest yield at (130cl) followed by sample E (125cl), sample C (120cl), sample B (118) and sample A (108cl) as the lowest.

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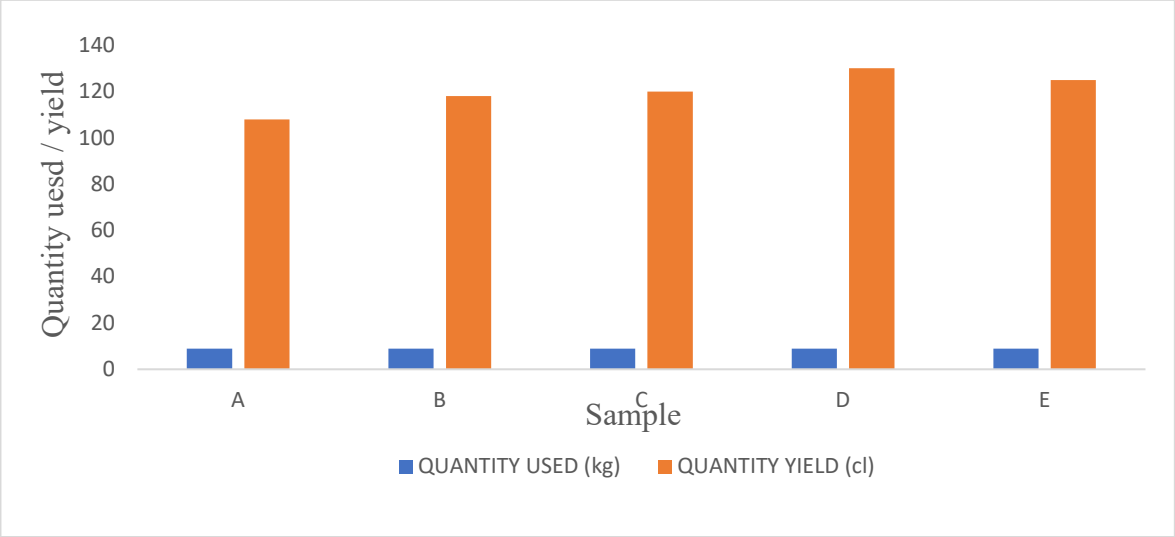

Fig. 3.1. Bar chart showing Quantity of Samples Used / Yield in the Different Methods

3.2. QUANTITATIVE PHYTOCHEMICAL ANALYSIS OF PALM OIL SAMPLES PRODUCED BY DIFFERENT METHODS

Table 3.1 below shows the quantity yield for each phytochemical parameter checked, tannin is higher in sample E (0.06), followed by Sample A (0.05), Sample B (0.04), Sample C (0.02) and Sample D (0.02) as the least. For phenols, Sample B (0.62) has the highest quantity yield followed by Sample A (0.49), Sample D (0.39) and Sample C and E (0.18) as the least yield. For oxalate, Sample E (10.93) has the highest quantity yield followed by Sample B (6.55), Sample D (6.02), Sample A (3.83) and Sample C (2.44) as the least yield. For flavonoids Sample C (8.31) has the highest yield followed by Sample E (7.770, Sample B (7.35), Sample D (4.50) and Sample A (0.10) being the least.

Table 3.1: Quantitative Phytochemical Analysis of Palm Oil Samples Produce by Different Methods

		Samples Yield (Gram)				
S/N	**Parameter Checked**	**A**	**B**	**C**	**D**	**E**
1	Tannins	0.05	0.04	0.03	0.02	0.06
2	Phenols	0.49	0.62	0.18	0.39	0.18
3	Oxalate	0.06	0.09	0.05	0.05	0.11
4	Alkaloids	3.83	6.55	2.44	6.02	10.93
5	Flavonoids	0.10	7.35	8.31	4.50	7.77

3.3. VITAMIN A AND E ANALYSIS ON THE DIFFERENT SAMPLES

Table 3.2 reveals that sample D has the highest concentration of vitamins A (18.732 mg/kg) and vitamin E (789.094 mg/kg) followed by sample B with vitamin A (18.459 mg/kg) vitamin E (787.512 mg/kg), sample E with vitamin A (18.245 mg/kg), sample C with vitamin A (16.745 mg/kg) and vitamin E (755.968 mg/kg) and sample A with vitamin A (14.879 mg/kg) and vitamin E (694.303 mg/kg).

Table 3.2. Vitamins A and E Yield from the Different Samples

S/N	**Samples**	**Vitamin Yield (mg/kg)**	
		A	**E**
1	A	14.879	694.303
2	B	18.459	787.512
3	C	16.745	755.968
4	D	18.732	789.094
5	E	18.245	785.306

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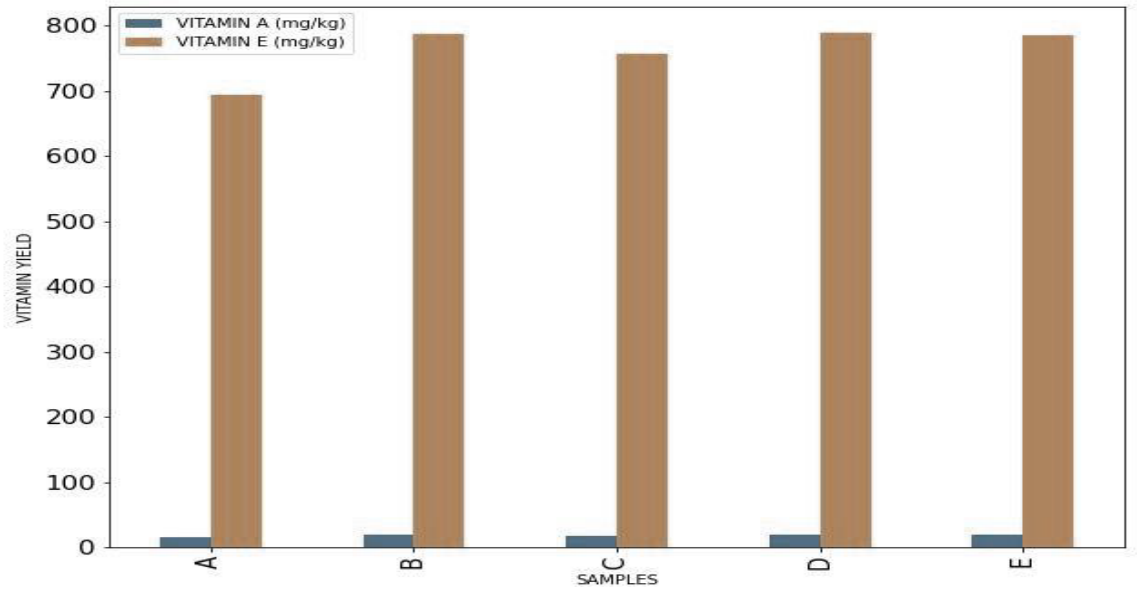

Figure 3.2: Bar Chart showing Vitamin A and E Analysis on the Different Samples.

DISCUSSION

The result on the effects of the different traditional extraction methods on red palm oil yield revealed that sample D extraction method yielded more (130cl) than all the samples while sample A yielded the lowest value. These differences in yield may be attributable to the different processing methods. The low yield in sample A that was fried may be as a result of its temperature during hand pressing. This is because, if too hot the hand may not be able to handle the heat, and if too cold the oil may stick back to the fibre. While high yield in sample D may be due to its extraction as no form of pressing was involved, rather total distillation from water was performed.

Sample E (Enugu method) revealed good levels of the phytochemicals, scoring highest in alkaloids and oxalates (10.98g) and (0.11g) respectively; second highest in flavonoids (7.7g) with relatively good presence of tannins and phenols. The high presence of these phytochemical may be as result of its peculiar extraction method involving boiling, pounding, washing with water and distillation. There were no additions of mould or red earth which may contain some substances that may be reactive to these phytochemicals [17]. Also, the introduction of water by washing in the extraction method may have brought a cushioning effect on the phytochemicals during its distillation [18]. The low presence of most of the phytochemicals in sample A was observed, apart from tannins (0.05g) and phenols (0.49g), other phytochemicals were comparatively low. This may be due to fermentation and frying as most of the chemical nature of this phytochemicals can be affected by enzyme actions as well as being denatured by high heat [19].

Similarly, it was observed from table 2 that Sample D has the highest concentration of Vitamin A (18.732 mg/kg) which is extremely crucial for normal vision, immune system, reproduction and ensure proper functioning of the heart, lungs, kidney and other organs [20; 6], and Vitamin E (789.094 mg/kg) which is essential in boosting of the immune system; it also helps to widen blood vessels and keep blood from clotting within them [20]. This compares favourably with Sample B which has vitamin A (18.459 mg/kg) and vitamin E (787.512 mg/kg); followed by Sample E with vitamin A (18.245 mg/kg) and vitamin E (785.306 mg/kg). Sample C is relatively low in vitamin qualities, with vitamin A (16.745 mg/kg) and vitamin E (755.968 mg/kg) whereas Sample A recorded the lowest in vitamin qualities, with vitamin A (14.879 mg/kg) and vitamin E (694.303 mg/kg).

CONCLUSION

The data generated from red oil yield, phytochemical and vitamin content of the different traditional methods of processing palm oil in this study, the Enugu method and Mbaise method II are the most effective methods of processing palm oil against other methods.

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