PROXIMATE ANALYSIS OF CRUDE PALM OIL SAMPLES COLLECTED FROM KOGI EAST, NIGERIA

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Abstract

This research work was carried out to ascertain whether the local palm oil met the required standard. The analytical test carried out includes the free fatty acid, peroxide value, carotene content. The specific gravity of the sample and that of water, while its moisture content was analyzed by oven drying the sample for a particular period of time. The procedure were the same except different indicator that was used for some test e.g. starch solution was for peroxide while free fatty acid used phenolphthalein as their titration process. The results show that the palm oil sample under consideration has a value of specific gravity -0.915g, free fatty acid of -23.97%, peroxide value -26mg, therefore, the results obtained showed that the oil sample meets the required standard but needed a little purification process on the moisture content as compared with the international requirements.

1.0 Introduction

Palm tree (*Elaeis guineensis*) is one plant which grows best in tropical regions. Palm oil fruit is a drupe consisting of a hard seed surrounded by a soft semi fibrous and semi fleshy pulp. In the center of this stone or nut lies the seed. The fleshy part of the fruit (the pulp) is at first black in color, but as it ripens becomes bright red. Palm fruit common name for member is palm a large fairly of chiefly tropic all trees shrubs and vines, most spies are traces characterized by a crown of compound teases called fronds terminal tall woody, unbranched stem (Aletor *et al*., 2012). Also oil palm being a nature of equatorial west Africa and preferring high rainfall and a more open kind a long river banks grow in bunches weighing up to ten kilograms and containing hundreds of fruitless like small plums. The flesh is oily and the oil ran be recovered by very simple means so that it is probable that palm oil has been recovered and used for human food for tens of thousands of years. The primitive extraction procedure are still in use in the village today. A typical method consists of cutting the bunches, usually after climbing the tree and allowing them to ferment in a heap for six to seven days then production takes place. Vegetable as it is generally called is an important product and raw material for most agro allied industries. More emphasis had been placed on vegetable oil from groundnut source in recent time, this had been attained to its local usages most especially in domestic activities like cooking and as well as its cheap and local method of production but with the new trend in technology, vegetable oil is how being produced from both palm oil and palm kernel fruit (Broadbent and Kuku, 2015).

The African oil palm is native to tropical Africa, from Sierra Leone in the west through the Democratic Republic of Congo in the east. It was domesticated in its native range, probably in

Nigeria, and moved throughout tropical Africa by humans who practiced shifting agriculture at least 5000 years ago. European explorers discovered the oil palm tree in the late 1400′s, and distributed it throughout the world during the slave trade period. In the early 1800s, the slave trade ended but British began trading with West Africans in ivory, lumber, and palm oil. The oil palm was introduced to the Americas hundreds of years ago, where it became naturalized and associated with slave plantations, but did not become and industry of its own until the 1960s. The first plantations were established on Sumatra in 1911, and in 1917 in Malaysia (Coursey, 2016).

Oil palm plantations were established in tropical America and West Africa about this time, and in 2003, palm oil production equaled that of soybean, which had been the number one oil crop for many years. *Elaeis guineensis* is a species of palm commonly called African oil palm or macaw-fat. It is the principal source of palm oil. It is native to west and southwest Africa, specifically the area between Angola and the Gambia; the species name *guineensis* refers to the name for the area, Guinea, and not the modern country which now bears that name. The species is also now naturalized in Madagascar, Sri Lanka, Malaysia, Indonesia, Central America, the West Indies and several islands in the Indian and Pacific Oceans. The closely related American oil palm *Elaeis oleifera* and a more distantly related palm, *Attalea maripa*, are also used to produce palm oil (Desassis, 2014).

Human use of oil palms may date as far back as 5,000 years in West Africa; in the late 1800s, archaeologists discovered palm oil in a tomb at Abydos dating back to 3,000 BCE. It is thought that Arab traders brought the oil palm to Egypt. The first western person to describe it and bring back seeds was the French naturalist Michel Adanson. For each hectare of oil palm, which is harvested year-round, the annual production averages 20 tonnes of fruit yielding 4,000 kg of palm oil and 750 kg of seed kernels yielding 500 kg of high-quality palm kernel oil, as well as 600 kg of kernel meal. Kernel meal is processed for use as livestock feed. All modern, commercial planting material consists of tenera palms or DxP hybrids, which are obtained by crossing thickshelled dura with shell-less pisifera. Although common commercial germinated seed is as thick-shelled as the dura mother palm, the resulting palm will produce thin-shelled tenera fruit. An alternative to germinated seed, once constraints to mass production are overcome, are tissue-cultured or "clonal" palms, which provide "true copies" of high-yielding DxP palms (Henderson and Osborne, 2009).

An oil palm nursery must have an uninterrupted supply of clean water and topsoil which is both well-structured and sufficiently deep to accommodate three rounds of on-site bag-filling. About 35 ha can grow enough seedlings over a three-year period to plant a 5,000-ha plantation. Prenursery seedlings must be watered daily. Whenever rainfall is less than 10 mm per day, irrigation is required, and the system must be capable of uniformly applying 6.5 mm water per day. Prenursery seedlings in the four-leaf stage of development (10 to 14 weeks after planting) are usually transplanted to the main nursery after their gradual adjustment to full sunlight and a rigid selection process. During culling, seedlings that have grassy, crinkled, twisted, or rolled leaves are discarded (Hirsch, 2011). Weeds growing in the polybags must be carefully pulled out. Herbicides should not be used. Numerous insects (ants, armyworms, bagworms, aphids, thrips, mites, grasshoppers, and mealybugs) and vertebrates (rats, squirrels, porcupines, wild boar, and monkeys) are pests in oil-palm nurseries and must be carefully identified before control measures are implemented. After eight months in the nursery, normal healthy plants should be 0.8–1 m in height and display five to eight functional leaves (Kruger *et al.*, 2007).

2.0 Methodology

2.1 Sample Collection and Preparations

The samples (palm oil) were collected from plantation in Dekina, Idah, Omala and Ankpa of Kogi State. And examined at the department of science laboratory technology (chemistry unit) Kogi State Polytechnic, Lokoja. For each sample free fatty acid (FFA) content, peroxide value and carotene content were analyzed the FFA content was determined by titrating the alcohol solution of the oils within solution of sodium hydroxide using phenolphthalein and alkaline blue as indicators. The FFA content was expressed as a percent of palmitic acid the major fatty acid in palm oil (AFNOR, 1988). The carotene content was determined as a Caroline in milligram per liter using methods described by one and Ng (2013). Peroxide value was determine by titrating chloroform / glacial acetic acid / saturated K, solution of the oil with an aqueous solution of sodium this sulfate using starch as the indicator (AFNDR 1988)

2.2 Procedures

Determination of Free Fatty Acid in Palm Oil

- The sample of palm crude oil was collected and it was boiled for 10 minutes
- Then 2ml of sample was dissolved into 20ml of alcohol (methanol) and it was stirred with help of glass rod. Exactly 0.1 NaOH was added with the mixture of palm crude oil and alcohol, the solution was dropped into 50ml beaker the phenolphthalein was added as indicator. It was stirred thoroughly and was continuously shaken until pale pink color appeared.

2.3 Determination of Peroxide Value in Palm Oil

Exactly 2ml of sample (palm oil) were placed in a 50ml beaker containing 20ml of chloroform/ glacial acetic acid. This followed by mixing and sodium thiosulfate was added to the solution and starch was used as the indicator (AFNOR, 1988)

2.4 Determination of Carotene Content in Palm Oil

The sample was melt at 60.70^{o}c and homogenized sample was weighted to 0.1mg into 250ml volumetric flask a few millet of isooctane was added and it was dissolved at room temperature and the solution was filtered over a paper filter. Carotene content was expressed as ppm of beta-carotene and appropriate mathematical correlation with absorbance at 446nm. Extinction at 446nm was determined and the results were recorded.

2.5 Statistical Analysis

Data collected were subjected to a non-way analysis of various procedures in a completely randomized design, using the IRRISTAT for windows (versions 5.0) computer software duncas multiple range test (2020) was used to separate the means at 5% level of probability.

3.0 Results and Discussion

3.1 Results

Table 1: Effect of method of crude palm oil production on the peroxide value, free fatty acid and carotene contents (NIFOR)

Parameter	Traditional method	Semi-scientific method	Scientific method
Carotene	491.20[a]	887.20[b]	921.8[c]
Free Fatty acid	15.97[a]	13.70[b]	12.14[c]
Peroxide value	13.40[a]	10.67[b]	7.33[c]

[a b] = Means with different superscripts within rows are significantly (P<0.05) different
Source: Survey

Table 2: Comparative evaluation of crude palm oil samples from NIFOR and four LGAs in Kogi East using the scientific method of palm oil production

Source	Carotene	Free Fatty Acid	Peroxide Value
NIFOR	928.47 [a]	11.27[a]	6.67[b]
Idah	918.20[a]	12.20[a]	7.00[b]
Dekina	919.57 [a]	12.20[a]	7.00[b]
Omala	920.87[a]	12.50[a]	7.67[ab]
Akpa	935.10 [a]	12.53[a]	8.33[a]

[a,b] = means with different superscript within the columns differ significantly (P<0.05)
Source: Survey

Table 3: Comparative evaluation of crude palm oil samples from NIFOR and four LGAs in Kogi East Agricultural Zone using the semi scientific method of palm oil production

Source	Carotene	Free Fatty Acid	Peroxide Value
NIFOR	906.57	13.20	7.33[a]
Idah	12.80	12.33[bc]	870.23
Dekina	836.23	13.63	11.00[abc]
Omala	865.30	13.40	9.33[ab]
Akpa	893.30	15.40	10.67[abc]
Idah	893.97	13.63	11.00[abc]

[abc] = Means with different superscripts within each column differ significantly (P<0.05)
Source: Survey

Table 4: Comparative evaluation of crude palm oil samples from NIFOR and four LGAs in Kogi East Agricultural Zone using the traditional method of palm oil production

Source	Carotene	Free Fatty Acid	Peroxide Value
NIFOR	582.2	15.2	11.3[ab]
Idah	466.3	16.3	13.0[ab]
Dekina	467.2	15.7	14.7[ab]
Omala	571.6	15.5	10.7[a]
Akpa	466.6	15.1	13.0[ab]
Idah	467.3	16.8	15.0[b]

[ab] = Means within different superscripts within columns differ significantly (P<0.05) ***Source:*** Survey

3.2 Discussion

The results of the chemical analysis of the crude palm oil samples from different methods of production collected from the Nigerian Institute for Oil Palm Research (NIFOR) are presented on table 1. Results for the carotene content of the crude palm oil samples showed significant ($P<0.05$) differences between the means, with the scientific method having the highest values and the traditional method having the lowest values. These results indicated that the method of production of palm oil has a significant ($P<0.05$) effect on the concentration of carotene in the final product. Carotene is a precursor to vitamin A via the action of beta-carotene 15, 15'-monooxygenase. Red palm oil gets its characteristic red colour from carotenes, such as alpha-carotene, beta-carotene and lycpoene. Recent studies in South Africa (Kruger *et al.,* 2007) show consumption of red oil significantly decreased phosphorylation in rat hearts subjected to high cholesterol diets. The results in this present study indicate that oil produced by the scientific methods contains higher proportions of carotenes than the other methods, indicating that the scientific method is a better method for palm oil production in terms of carotene content.

Table 1 also shows the results for the free fatty acid content of the test materials. Significant ($P<0.05$) differences exist between the means; with crude palm oil from the scientific method of production having the lowest values. Free fatty acid content is the most used criterion for determining the quality of palm oil, and must not exceed 5%, expressed as palmitic acid (Codex Alimentarius/FAO/OMS, 2005). Fatty acids are generally present in oils as part of triacylglycerol molecules. The presence of free fatty acid residues in palm oil is an indication of the impairment of oil quality. This process is essentially attributed to an active *lipase* present in the mesocarp of the oil palm fruit and which is responsible for the hydrolysis of triacylglycerols (Ngando *et al*., 2006). The *lipase* is usually activated at maturity upon bruising of the fruit (Desassis, 2014). The results in this present study indicated that crude palm oil from the traditional method produces higher concentrations of free fatty acids, this would suggest that fresh fruit bunches are more susceptible to bruising when the traditional method of processing is considered. Results for peroxide value also show significant ($P<0.05$) differences between the means, with crude palm oil from the traditional method of processing having higher values than the other test materials and the scientific method having the lowest values.

The peroxide value gives the initial evidence of rancidity in oils which is usually referred to as lipid peroxidation or oxidative degradation. The peroxide value is also used to assess the stability of fats by measuring the amount of lipid peroxides and hydroperoxides formed during the initial stages of oxidation and thus estimate the extent of spoilage of the oil. Peroxidation makes the oil harmful for consumption by man and animals, as the free radicals generated by this process are proven to be carcinogenic. It has been shown that this value increases with storage, which suggests that, the traditional method of processing produces an oil with a shorter shelf life. Peroxide values of the crude palm oil from the semi scientific and scientific methods are within the ranges according to the Codex Alimentarius/FAO/OMS norms which recommend a maximum peroxide value of 10 ± 1.0 meqO_2/kg. The results of the chemical analysis of the crude palm oil samples from the scientific method of palm oil production from NIFOR compared to the samples obtained from four Local Government Councils in Kogi East Agricultural Zone is presented on table 2. The results for carotene and free fatty acids did not show significant ($P>0.05$) differences between the means, however significant ($P<0.05$) differences exists between the peroxide values of the samples from NIFOR and the four local government areas studied. The results of the analysis of the crude palm oil samples obtained from the semi scientific method of oil palm production from NIFOR compared to samples obtained from four Local Government Councils in Kogi East Agricultural Zone is presented on table 3.

Results for carotene values of the crude palm oil samples obtained from the different Local Government Councils in Kogi East Agricultural Zone, using the semi scientific method do not show significant ($P>0.05$) differences between the means. The free fatty acid content of all the samples analyzed did not show significant ($P>0.05$) differences between the means. Results however indicate significant ($P<0.05$) differences in the peroxide values between the different LGAs. Comparatively, samples obtained from NIFOR were found to be significantly ($P<0.05$) lower than the samples obtained from the different Local Government Councils except Idah. The highest values were found in samples obtained from Akpa Local Government Area.

The results of the chemical analysis of the crude palm oil samples obtained from the traditional method of oil palm production from NIFOR compared to samples obtained from four Local Government Councils in Kogi East Agricultural Zone is presented on table 4. Significant differences were not detected for carotene content when comparing the traditional method of crude palm oil production in NIFOR and the four Local Government Councils covered in Kogi East Agricultural Zone; neither were there significant differences in the free fatty content of the test materials. Results for the peroxide value of the test materials show significant ($P<0.05$) differences between the means. Samples from Idah had the lowest values while samples from Akpa had the highest values. No particular reasons could be given for these differences. However it has been shown (Lewkwowitsch, 2014) that two types of oils are produced by the traditional method, these are the soft oil and the hard oil and production of these two types of oils depends on the preliminary production steps with a longer fermentation period being used for the production of hard oil.

4.0 Conclusion

This study has shown that the method of crude palm oil production has a significant effect on the quality of oil produced. The results also indicated that oil produced by the three methods of production in NIFOR is of better quality when compared to the oil produced in the selected Local Government Councils of Kogi East Agricultural Zone. These results also indicated that oil produced by the traditional method is of lower quality than that of the semi-scientific and the scientific methods. In this regards, peroxide and free fatty acid values are useful indicators of oil quality and can be used to control dietary oils safety and quality. It is advisable that small scale farmers make efforts to adopt the methods developed by NIFOR; this would go a long way in improving the quality of their CPO by any of the methods used.

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