Comparative Studies on the Quality of Palm Oil Samples Collected from Different Markets (*Galadima, Sabon Gari and Singa*) of Kano State, Nigeria West Africa.

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Abstract
The quality of different palm oil samples collected in triplicates from different market in Kano state, Nigeria West Africa, metropolis namely; Sabon gari, Singa and Galadima market were studied using standard analytical procedures and methods. The results obtained showed that the acid value ranged from 0.86± 0.17 (singa) to 0.9±0.1 mgKOH/g (galadima), Iodine value ranged from 30.2±0.3 (sabon gari) to 35.37±0.561wiji`s (singa). The peroxide value ranged from 5.0±0.21 (sabon gari) to 6.93±0.28 meq/kg (Singa). The saponification Value ranged from 182.97±0.07 (galadima) to 192.07±0.11mg/KOH/g (sabon sari). The unsaponifiable matter ranged from 7.03±0.67 (Galadima) to 8.23±0.59 g/kg (sabon gari). Refractive Index ranged from 1.4725 (galadima) to 1.5626 (singa). The moisture content ranged from 0.97±0.31% (Sabon Gari) to 1.77±0.62% (singa). pH Values ranged from 5.90 (singa) to 6.77 (galadima). The Ester Value ranged from 182.076±0.05 (galadima) to 191.2±0.11mg KOH/g (sabon gari). Rancidity was not detected in all the samples collected. The results obtained from the research showed that the palm oils consumed in the selected markets of Kano State, Nigeria have an acceptable value when compared to the specifications of standard Organization of Nigeria 2010.

Key words: *palm oil, standard analytical methods, quality, Market.*

Introduction

Palm oil is derived from the *mesocarp* of the fruit of the oil palm. It has a light yellow to red colour (Aribido, 2001). Red palm oil get its name from its characteristic dark red colour, which come from carotenes, such as alpha-carotene, beta-carotene and *lycopene* which are responsible for the high vitamin A content, (Aribido, 2001). The oil palm (*Elaeis guinensis)* is West Africa's most important oil producing plant. The fruit produces two distant types of oil. The orange to red crude palm oil which is extracted from the *mesocarp* and

brown light yellow crude palm kernel oil extracted from the seeds (kernel). The former consists of mainly palmitic and oleic acids and the latter, mainly lauric acid.

Both oils are important in the world trade. Crude palm oil (CPO) is the richest natural source of carotenoilds and cotrienols. While it's semi-solid consistency at a tropical room temperature is mainly due to the presence of triacylgycerols of palmitic and oleic acid (Gee, 2007).

There is wide spread speculation that Nigerian palm oil is being adulterated. The Adulteration is believed to be practiced by producers in order to increase the quantity of palm oil, for the sole purpose of profit maximization. Unfortunately, the adulteration practice is normally done without considering its possible effect on the quality and the health of consumers. The adulterant reportedly used includes carrot, papaya, natural potash, and red dye. The potash and red dye being the preferred and most widely used adulterants due to their abundance and low cost. Natural potash, also called lake salt and locally known as "*Kanwa*" is a mineral consisting of chlorides, sulphates, and carbonates of sodium, Calcium, and potassium, as well as some micronutrients (Aribido, 2001).

Palm oil is an important vegetable oil which has an increasing consumer interest in tropical West Africa. It contained approximately 50% saturated fats and 40% unsaturated fats. The light yellow to orange red colour of palm oil is due to the fats soluble carotenoids which are responsible for the high vitamin content. Industrially, palm oil could be refined to give a light coloured product which could be used in the manufacture of margarine, shortenings, Biscuits, cooking fats, ice cream, bakery fats as well as cooking oils. The importance of quality palm oil in our diet cannot be overemphasized. It is the main vegetable oil consumed in the world today, accounting for 33% of all oils consumed globally, closely followed by soya oil with 31% (ICEX, 2014). In the previous decade, world palm oil consumption has more than doubled from around 16.7 million tons in 1997/98 to over 40 million tons in 2007/08 and this figure estimate to surpass 70 million tons by 2020 (Grapevine, 2008).

Production of Palm Oil

In 2012 the annual revenue received by Indonesia and Malaysia together, the top two producers of palm oil, was $40 billion (FAO, 2002). Between 1962 and 1982 global exports of palm oil increased from around half of million to 2.4 million tons annually and in 2008 world production of palm oil and palm kernel oil amounted to 48 million tones. According to FAO forecasts by 2020 the global demand for Palm oil will double and triple by 2050 (Prokurat, 2013)

Adulteration of palm oil

In recent years there has been rising production (supply) and consumption (demand) of palm oil in Nigeria, with demand growing faster than the supply. As a result, the trend has been that of increasing domestic consumption unequally matched by a rather slow growth in production. This widening gap between demand and production has also been accompanied by increasing result. Adulteration of fat and oils is an old problem and has been the subject of many studies (*Nwosu et al.,* 2017*)*.

One major problem associated with the use of adulterants is that these compounds have not undergone stringent studies and the level of threat they may pose to human health when consumed are not well established. For crude palm oil, adulteration could lead to loss of quality and nutritive properties, loss of organoleptic attributes and overall degradation of the oil.

There are two major adulterations in edible oils and fats namely: admixing cold press with refined one and the other one replacement of more expensive oil and fats with cheaper one (*Nwosu et al.*, 2017*).*

Properties	**SON (2000) Standard**
Acid value (mgKOH/g)	3.5
Iodine value (wiji's)	45-53
Peroxide value (meq/kg)	10
Saponification value (mgKOH/g)	195-205
Unsaponifiable matter (g/kg)	10
Refractive Index (^oC)	1.4720-1.4775
Rancidity	Not Detected
pH value	Not less than 5
Moisture content (%)	0.29
Ester value	

Standard for palm oil by Standard Organization of Nigeria (SON) 2000

The work is aimed at ascertaining the quality of the palm oil samples from different markets (*Galadima, sabon gari and singa)* in Kano State, Nigeria, West Africa for human consumption.

Materials and Methods

Materials: The following materials were used; heating mantle, Analytical electronic weighing balance, Wijis solution, thiosulphate solution, glacial acetic acid, concentration nitric and sulphuric acid, hydrogen peroxide, pH meter refractor meter and hot air oven.

Collection of sample

The palm oil samples used for the study were collected in triplicate from different oil markets in three locations, namely: *Galadima, Sabon gari and Singa* in Kano State, Nigeria.

Determination of acid value

The oil sample (1.0g) was boiled with 50.0 cm^3 ethanol, then allowed to cool and 2 drops of phenolphthalein indicator was added. The resulting solution was titrated against 0.1 mol/dm^3 NaOH until a pink color was obtained (Kafamiya *et al*., 2010).

The acid value was calculated using equation.

$$\text{Acid value} = \frac{V \times M \times 5.61}{\text{Weight of oil}}$$

V was the titre value and W, was the weight of oil, M was the molar mass of NaOH

Determination of iodine value

The method describe by Marshall (2005) was adopted. About (0.5g) was placed in a 250.cm^3 conical flask and 10.0 cm^3 of anhydrous chloroform was added. This was followed by 30ml of solution and the flask was Stopped and allowed to stand in the drawer for 30 minutes after which potassium iodine (10.0cm^3 of 15% v/v) was added to the content of the flask so as to wash down any iodine that might be present on the Stoppard. The resulting solution was titrated with sodium thiosulphate solution (0.14M) until the light yellow color form disappeared. The determination for the blank was conducted in the same manner but without the oil. The iodine value was calculated as;

Iodine = $\frac{(B - S) \times M \times 12.69}{W}$

B and S were titer values of blank and sample respectively, M was the molarity of Sodium thiosulphate 12.69 was the conversion factor from meq Sodium thiosulphate, to gram molecular weight of iodine and W was weight of oil, (kafamiya *et al*., 2010).

Determination of peroxide value

The peroxide value was determined by dissolving 5.0g of the oil sample in 30cm^3 of glacial acetic acid: chloroform (3:2 v/v) then 0.5cm^3 of KI was added. The solution was then titrated with standardized sodium thiosulphate using starch indicator. The peroxide value was calculated using equation (Marshal, 2005)

Peroxide value (meq/kg) = $\frac{(S - B) \times M \times 1000}{\text{Weight of oil}}$

Where; B and S titre values of blank and sample respectively, M is the molarity of $Na_2S_2O_3$

Determination of saponification value;

Two grams of the oil sample was weighed in to a clean dried conical flask and 25cm^3 of alcoholic potassium hydroxide was added. The flask was heated for an hour with frequent shaking. 1cm^3 of phenolphthalein indicator was added and the hot excess alkali titrated with 0.5 mol/dm^3 hydrochloric acid (HCl) until it reached the end point where it turned colorless. A blank titration was carried out at the same time.

The saponification value was calculated using equation;

$$SV = \frac{(S\text{-}B) \times M \times 56.1}{\text{Sample weight (g)}}$$

Where S = sample titre value, B = blank titre value M = molarity of HCL (0.5 M) and 56.1 = molecular weight of potassium hydroxide, (kafamiya *et al*., 2010).

Unsaponifiable Matter

After the titration of the saponification value, the resultant solution was made alkaline again with 1ml of aqueous 3.0M potassium hydroxide solution. And then was transfer to a separator and washed in with water.

The solution was extracted while still just warm 3times with 50ml quantities of diethyl ether and also poured into another separator containing 20.0cm^3 water.

After the third extract has been added, the combined ether extract was shake with the first 20ml of wash water and then vigorously with another 20.0cm^3. The ether extract was washed twice with 20.0cm^3 of aqueous 0.5M potassium hydroxide solution and at last twice with 20.0cm^3 quantity of water until the wash water is no longer alkaline to phenolphthalein.

The ether extract was poured into a weighed flask, the solvent was evaporated off and the residue dried at about 550^{o}C and when cooled it was weighed (Kafamiya *et al* 2010).

Refractive Index

The refractive index was determined using Abbe's refractor meter. The Abbe's refractor meter was reset with a light compensator (water at 20^{0}C). The oil sample was smeared on the lower prism of the instrument and closed. Light was passed by means of the angled mirror, the reflected light appeared inform of a dark background. Used the fine adjustment of the telescope tubes was used until the black shadow appeared at central in the cross wire indicator. The refractive index was read off and recorded (Kafamiya *et al.,* 2010).

Determination of Rancidity:

The rancidity of the oil samples was determined qualitatively using Kries Test as described by Person. About 5.0cm^3 of the oil samples was placed in 100 cm^3 test tube and then mixed vigorously with 5.0cm^3 of universal indicator and 5.0cm^3 of concentrated HCl for about 20 seconds. The presence of pink colour indicates incipient rancidity (Kafamiya *et al.*, 2010).

Determination of pH Value:

The pH of the oil samples was determined with a pH meter. About 30.0 cm^3 of the oil sample was poured in to a beaker, then the pH meter electrode was immersed into the beaker containing the oil sample and the pH values were recorded (Babatunde *et al., 2016).*

Determination of Moisture Content:

Gravimetric method was used for moisture determination. About 5.0g of sample was weighed into evaporation dish. It was placed in an oven and maintained at 105^{o}C for 3hours interval. After drying to a constant weight, the samples were cooled in a desiccator and re-weighed using analytical balance (Elija *et al*., 2013).

$$\% \text{ moisture} = \frac{b - c \times 100}{b - a}$$

Where b = weight of crucible and sample
c = weight of crucible and dried oil
a = weight of crucible only.

Determination of Ester Value

The ester value was determined by subtracting acid value from saponification value (Elija *et al.*, 2013).

Results and discussions

Table 1 physicochemical property of palm oil samples from *Sabon Gari, Singa and Galadima* markets.

Properties	**Sabon Gari** $\overline{x}$ ± SD	**Singa** $\overline{x}$ ± SD	**Galadima** $\overline{x}$ ± SD
Acid value (mgKOH/g)	0.87 ± 0.15	0.86 ± 0.17	0.9 ± 0.1
Iodine value I_2/g	30.2 ± 0.3	35.37 ± 1.56	30.37 ± 0.61
Peroxide value (meq/kg)	5.0 ± 0.21	6.93 ±0.28	6.8 ± 0.62
Saponification value (mg KOH/g)	192.07 ± 0.11	187.49 ± 0.56	182.976 ± 0.07
Unsaponifiable matter (g/kg)	8.23± 0.59	7.54 ±0.93	7.03 ±0.67
Refractive index	1.4766±0.11	1.562±0.12	1.4725±0.16
Rancidity	ND	ND	ND
pH value	6.50	5.90	6.77
Moisture content (%)	0.97± 0.31	1.77± 0.62	1.3±0.6
Ester value	191.2±0.11	186.63±0.03	182.076±0.05

Note; ND = Not Detected

Discussions

The quality of the palm oil samples are presented in Table 1 above. The moisture content of oils is an important parameter in assessing the quality of an oil sample. The moisture content of any food is an index of its water activity (W_a) (Frazian and Westoff, 1979). High moisture content is an indication of ease of spoilage and rancidity as well as short shelf-life. The moisture content of samples ranged from 0.97±0.31% (Sabon Gari) to 1.77±0.62% (Singa) of the palm oil. The moisture contents of the samples is little higher than standard of 0.29% (SON, 2000). The high moisture content obtained will discourage the storage stability of the oils samples and also the low moisture content encourages the storage stability of palm oils. It has been revealed that the moisture content of palm oil depended directly on the efficiency of the final extraction and clarification processes. There was significant difference in the moisture content of sample investigated.

The pH value ranged between 5.90 (Singa) to 6.77 (Galadima) of the palm oil samples. This showed that the oil samples are weakly acidic and almost neutral for most of the oil samples. This indicated that they contained low amount of fatty acid and making them good for edible purposes. The concentrations of free fatty acid are undesirable in vegetable oils because they can reduce the palatability and the shelf-life of the oil (kafamiya *et al.*, 2010). There was no significant difference between the refractive index of the different oils samples. This ranged between 1.4766 (Sabon gari) to 1.5622 (Singa). These values obtained are within the results of Babatunde *et al*, 2016, Musa and Suleiman. 2012, and also is within the

standard limits set by SON. Rancidity was not detected. Rancidity was not detected in all the samples collected and analysed.

Iodine value of the palm oils ranged between 30.2±0.3 (Sabon Gari) to 35.37±0.11 wiji's (Singa). These values were low compared to the results obtained by Musa and Suleiman 2012, Babatunde *et al* and Bello 2016. The iodine value of oils is an indicator of double binding molecular structure which influence the long term stability properties (quality) of the oils (important for storage). The greater the iodine value, the more the unsaturation and the higher the susceptibility to oxidation, Anyasor *et al*., 2009.

The Ester values in the samples ranged from 182.076±0.05 (Galadima) to 191.2± 0.11mg KOH/g (Sabon Gari). The values were in the agreement with what was reported by Musa and Sulieman 2012. The higher the Ester value, the more intact the ester bond between the glycerol molecule and the fatty acids. Therefore, the oil samples analyzed are of low quality and might not be able to be stored for a long time (Musa and Suleiman 2012).

The Saponification value of the palm oil sample ranged between 182.97±0.07 (Galadima) to 192.07± 0.11mg KOH/g (Sabon Gari). These values obtained are in agreement with the standard guidelines set by SON 2000 and literatures of Siyanbola 2012, Kafamiya 2010, and Musa and Suleiman 2012.

The Acid value ranged from 0.86±0.17 (Singa) to 0.9±0.1mg KOH/g (Galadima). These values obtained are in agreement with other studies Udensi and Iroegbu 2014, Kafamiya *et al*., 2010 and Siyanbola *et al*., 2012.

The peroxide value of the palm oils ranged from 5.0±0.15 (Sabon gari) to 6.93±0.28 meq/kg (Singa). The low peroxide value indicates the slow oxidation of the analyzed oil and the value should be less than 10 meq/kg.

Conclusion

Palm oil is an important contribution to the diet of people, serving as a good source of lipid and fatty acid for human nutrition including the repair of worn out tissues, new cells formation as well as source of energy. The results obtained from the work showed that the quality of palm oil samples studied were within the recommended specification set by SON. The results also indicate the suitability of the palm oil samples for both domestic and industrial uses.

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