Evaluation of the Quality and Level of Adulteration of Palm Oil Obtained from Different Locations in Enugu Metropolis, Nigeria

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***Abstract*– Palm oil is one of the major fats and oils produced in Nigeria, which is of great value in the diet of many people. This paper therefore, evaluates the quality of palm oil samples obtained from major palm oil producing towns in Enugu State and the parameter done and the results obtained were as follows: Moisture content range from 0.13-0.2%, Specific gravity 0.844–0.896, Saponification value from 194.90–198.57mgKOH/g, Peroxide value from 4.25– 6.80mgKOH/g, iodine value from 52.46–53.74Wij's, Free fatty acid (FFA) from 2.68–2.96 mgKOH/g, Smoke value range from 115.35–117.80^{o}c ,Fire point from 337.15–338.70^{o}c, Melting point 34.75–35.55^{o}c and Carotene contents range from 1380.20–1520.64mg/kg, also the results obtained after the analysis of varians (ANOVA) showed that there were no Significant different (P>0.05) in the specific gravity, smoke value, fire point and melting point. Meanwhile, the only significant difference were observed in carotene content which is (P>0.05) in palm oil samples respectively.**

***Keywords*– Quality Evaluation, Palm Oil, Physiochemical Properties and Market**

I. INTRODUCTION

The oil palm (Elaeis guineesis) is one of the Africa's most important oil producing plants [1]. The oil palm (Elaeis) is native of West Africa, comprises of two species, and also exists in a wild, semi wild and cultivated state in the tree land areas of the equatorial tropics in Africa, South-East Asia and in America [2].The palm fruits takes five to maturity. The fruit reddish and each fruit is made up of an oily, fleshy outer layer(Pericarp),with a single seed and palm kernel oil from the seeds both of which are important in the world trade. Palm oil plant is the highest oil producing plant [3].with an average 3.5tons of which has an increasing consumer interest in tropical West. Palm oil contains approximately 50% saturated fats and 40% unsaturated fat. Meanwhile, the light yellow to orange-red colour of palm oil is due to the fat soluble carotenoids in terms of retinol which are responsible for the high Vitamin A content [4]. Palm oil is used for edible purposes unlike palm kernel oil which is used in the Oleochemical industry. Infact, culturally it is more valued than other edible oils. Meanwhile, in some tropical countries,it contributes up to 80% of the total edible oil needs [5].Industrially ,palm oil could be refined to give a light coloured product which could be used in the manufacturing of margarine, biscuits, ice-cream, shortenings, cooking fats as well as cooking oils [6].The quality of palm oil could be affected by various factors ranging from improper post harvest handling, processing and storage. Recently, there has been wide spread speculation that palm oil is adultrated in order to maximize profit. The quality of palm oil is generally determined by the percentage of Free fatty acid(FFA), Moisture, Saponification value, Peroxide value purity level. The objective of this work therefore was to evaluate the quality of palm oils sold in some major market in Enugu State, Nigeria.

II. MATERIALS AND METHODS

The palm oil samples used for the experiment were purchased from different major markets of the producing towns in Enugu State, namely: Orie Ugwogo-Nike market, Afor-Ohum market, Nkwor-Akagbe market and Eke-Obinagu market. All samples were collected in polyvinylchloride screw capped contained filled to the brim and firmly locked. The samples were kept at ambient temperature and then taken to the laboratory for immediate analysis (1-3days after collection).

A) Analysis

Moisture content was assayed by the gravimetric method of air-oven drying to constant weight at 105^{o}c.ie by using Official Standard Method [7]. The specific gravity was determined using a pycrometer gravimetric method as described by [8]. The Free fatty acid (FFA) content was determined by titrating the alcoholic solution of the oil with 0.1M NaOH using phenolphthalein as a percentage of palmitic acid being the major fatty acid in palm oil. The smoke and melting points were determined according to the methods of [9]. Lovibond tintometer [10] was also used to determine the colour of the oil samples. Acid value, iodine value, saponification value, peroxide value and unsaponifiable matters were determined according to the methods of [7]. Carotene content was determined spectrophotometrically. The impurity level was determined as described by [3]. The oil samples were mixed with excess hexane, and filtered. The

residue on the filter paper was then washed with N-hexane and oven dried to a constant weight at 105^{o}c.

B) Statistical Analysis

Analysis of variance (ANOVA) was used to test the data obtained. Each of oil samples were analyzed in triplicate in other to assay the mean and mean deviation.

III. RESULTS AND DISCUSSIONS

A) Results

Table 1: Properties of the palm oil samples obtained from four locations

Properties	Ugwogo-Nike	Ohum	Eke-Obinagu	Akagbe-Ugwu
Moisture(%)	0.15	0.13	0.2	0.18
Specific gravity	0.896	0.845	0.874	0.820
Smoke point(^{o}c)	117.80	117.50	115.40	115.35
Fire point(^{o}c)	338.70	338.65	337.15	337.20
Melting point(^{o}c)	34.80	34.75	35.50	35.55
Iodine value(Wij's)	52.46	53.19	53.42	52.50
Peroxide value(Meq/kg)	6.80	6.45	5.60	5.29
Saponification value(mgKOH/g)	118.57	196.45	195.55	194.90
Unsaponifiable matters(mg/kg)	7.74	7.66	7.82	7.82
Free fatty acid(FFA)(MgKOH/g)	2.96	2.68	2.82	2.74
Carotene content(Mg/kg)	1380.20	1620.64	1472.40	1420.33

Table 2: The colour value(Lovibond unit) of the palm oil samples

Samples	Lovibond Unit
Ugwogo-Nike	2.54
Ohum	2.7
Eke-Obinagu	2.90
Akagbe-Ugwu	2.83

B) Discussions

The physiochemical properties of the palm oil samples are presented as follows in Table 1. The moisture content of palm oil samples is great value and its used in assessing the quality of an oil sample. The moisture content of the oil range from 0.13 - 0.2%,which is lower than the recommended standard of 0.29% [11] and [12].The moisture content of any food is an index of its water activity(a_w) [13]. Meanwhile, the amount of moisture content of palm oil samples are pertinent to know because, high moisture content value is an indication of its rancidity, ease spoilage and as well as short shelf-value while the low the low moisture content value is indicating the ability and stability storage of palm oil samples.

According to [14], [15], [16] and [17] stated that the moisture content of palm oil is depended directly on efficiency of the final extraction and clarification processes [2], as certained that moisture content could remove by boiling at elevated temperature. The specific value obtained range from 0.820 – 0.896 and were closely related and they are also within the approved range by [11] and [12] of 0.897 – 0.907. Also there was no significant difference (P>0.05) observed in the specific gravity (SG) of the palm oil samples. The smoke value ranged between 117.35 – 117.80^{o}c and there were significant difference (P>0.05). The high value of smoke point, indicates the suitability of the palm oil samples been

used for frying purposes. There were difference in melting points ranged between 34.75 – 35.55°c.

The palm oil samples from Akagbe-Ugwu showed the highest melting point value followed by the sample from Eke-Obinagu, Ugwogo-Nike and Nkwo-Ohum ,and the melting point results obtained were within the range as approved and recommended by [11]. Thus, the oil samples will remain liquid at room temperature. The acid value is a measure of the Free fatty acids in oil. Its also usually in the triglyceride form but during processing, the fatty acid may get hydrolysed into Free fatty acid which also means decreased in oil quality. Acceptable levels for all oil samples should be less than 0.6mgKOH/g [18]. It has been reported that ripe palm oil fruits contains autolipolytic enzymes which start to split the fruits oil to fatty acid and glycerol once the fruit is burised [19], [20] and [2]. Free fatty acids could also be generated to some extent by contaminating lipases from micro-organism [21] and [22]. The presence of Free fatty acid moieties in palm oil is an indication of the impairment of oil quality. The fatty acid obtained from this work ranged from 2.69 – 3.03mgKOH/g.

These values are higher than the recommended value by [18] but lower than the recommended maximum value of 3.5mgKOH/g [11].The results were also comparable with those of [23], [24], [25], [26] and [27]. The high free fatty acid values obtained may be due to the fact that the palm oil samples were exposed to normal room temperatures at the market stores [28]. Also, it could be due to the decomposition of glycerides by fungi and micro-organism and might be accelerated by the exposure of palm oil to either sunlight or heat [21], [22] and [27]. Iodine value is a measure of the degree of unsaturated in oils [30]. Also, the value is a useful in index of detecting adultration in oils. The values obtained ranged from 52.46 – 53.19Wij's with no significant difference ($P>0.05$).

The iodine values obtained were within the standard range of 45 – 53Wij's as recommended by[11] and[12] However, the values obtained indicates that the oil samples are highly unsaturated and therefore susceptible to oxidation when compared with the results obtained by [25], [31], [28] and [26] but higher than those obtained by [17]. Therefore, the addition of antioxidants may be necessary to employ in other to prolong the storage stability of the oils. The peroxide value determines the extent to which the oil has undergone rancidity. Thus, it could also be a measure of oxidation during storage and the freshness of the lipids matrix. Peroxide value is used as an indication of quality and stability of fats and oil [29] and [30].

The value obtained ranged from 5.29 – 6.80meq/kg. These values are closely related to the standard value of 10meq/kg specified by [11] and [12].The obtained values are below the [11] and [12] standard but the high values could indicate the onset of primary oxidation due to lipid degrading enzymes like peroxidase and lipoxygenase [31]. Saponification value is an indication of the molecular weights of triglycerides of oils high saponification value indicates high proportion of low fatty acids since saponification value is inversely proportional to the average molecular weight or length of fatty acids [32]. Therefore, the shorter the average chain length ($C_4 – C_{12}$), the higher the saponification value [33]. The values obtained were between 194.90 – 198.57mgKOH/g. These values are within the recommended range of 195 – 205mgKOH/g for palm oil [11] and [12].

These values are indication that the oils are well suited for soap making. The carotene level of palm oil decreases with the time of storage. The results obtained for carotene level for these samples were reasonable and were within the recommended value by [11] and [12] and also indicative of the freshness of the palm oil samples. Palm oil is rich in Vitamin A with carotene as the major precursor [6]. It has been reported that the impurity level depends directly on the efficiency of the final extraction and clarification procedures [14], [15], [16] and [17].

IV. CONCLUSION

The results obtained from the study showed that the quality of palm oil samples investigated were within the standards recommended by [11] and [12]. It is reasonable to conclude that the palm oil samples investigated were neither conterminated nor adulterated and also the processing and storage methods employed were adequate. The results also indicated the suitability of the palm oil samples for both domestic and industrial uses and as well as export trade.

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