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Effect of Bleaching on Some Quality Attributes of Crude Palm Oil

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Abstract
Oil bleaching is usually done to improve colour, remove impurities and improve taste. The effect of bleaching on some quality attributes of crude palm oil was investigated. Crude palm oil was obtained from a local oil processing mill in *Ika* North East LGA, of Delta State Nigeria. The crude palm oil sample was divided into sample A, B and C. Sample A was unbleached, while sample B and C were bleached with heat only and bleached using Activated Coconut Pod Ash (ACPA) respectively. The physical and nutritional properties of the samples were evaluated using standard methods. The result shows that sample A had 4.93% moisture content, 7.45% crude protein, with a refractive index of 1.47, viscosity of 10.50 centipoises and was orange red, while sample B had 2.86% moisture content, 6.07% crude protein with a refractive index of 1.40, viscosity 10.08 centipoises and was pale red in colour. Sample C had 2.74% moisture content, 4.21% crude protein, with a refractive index of 1.06, viscosity 5.21 centipoises and was orange yellow in colour. Sample C had a lower Free Fatty acid (FFA) content with a higher saponification value (SV) content. The free fatty acid, peroxide value, iodine value, density, refractive index and viscosity decreased with bleaching while the saponification value increased with bleaching. It is concluded that bleaching will increase the shelf life of crude palm oil and make it more suitable for soap making.

Keywords: *Bleaching, crude palm oil, temperature, quality attributes*

I. INTRODUCTION

Oil palm (*Elaeis Guineensis*) grows wild in West Africa and Equatorial Africa, and has been used as a food and energy source for a very long time. The oil palm has an economic life of 20 to 25 years with an average annual oil yield of 3.5-5 tons per hectare. The palm bears 8 – 12 fruit in bunches annually, each varying in weight from 10 to 40 kg containing 1000-3000 fruits. The individual fruit, ranging from 6 to 20 gm, are made up of an outer skin (the exocarp), a pulp (mesocarp) containing the palm oil in a fibrous matrix; a central nut consisting of a shell (endocarp); and the kernel [1, 2]. The oil palm fruit has a unique characteristic of producing two oils; crude palm oil obtained from the fleshy mesocarp and palm kernel oil from the seed, which is usually in a ratio of ten to one.

Crude palm oil is an edible vegetable oil extracted from the fleshy part of ripe oil palm fruit (*Elaeis guineensis*). Palm oil extracted from the mesocarp of palm fruit contains approximately 50% fats and 40% unsaturated fats [3]. The oil palm consists of 16 carbon saturated fatty acid, palmitic acid, monounsaturated oleic acid and 10% linoleic acid, which is an unsaturated omega-6 fatty acid. Linoleic acid is one of the two essential fatty acids that humans require [4]. Palm oil is also high in vitamin K and dietary magnesium. It is rich in minor components which have nutritional attributes with about 500-700ppm of carotene consisting mainly of α and β carotenes that constitute 90% of the total carotene [5]. Carotenes found in palm oil play an important role in the prevention of cancer, cataracts and degenerative diseases such as heart diseases [6]. Other minor components of palm oil are phytosterols which are very useful in pharmaceutical industries, tocotrienols and tocopherols which serve as powerful radical antioxidant in scavenging free radicals and squalene.

Palm oil is a common ingredient in cooking, frying, making soap and its products. In homes, it is serves as a first aid treatment when a harmful or poisonous substance is ingested, used for treatment of injuries (wounds and cut) and serves as a remedy to cough. Presently in industries, palm oil is used in the manufacture of margarines, cosmetics, toothpaste, waxes, detergents, ink and production of bio fuels. The beneficial roles of fresh palm oil to health include reduction in the risk of arterial thrombosis and atherosclerosis, inhibition of cholesterol biosynthesis and platelet aggregation, and reduction in blood pressure [7, 8, 9, 4].

The bleaching of edible oils and fats is a part of the refining process of crude oils and fats, which removes contaminants that adversely affect the appearance and performance of this triglyceride. In the purification, decolourisation and stabilization of vegetable oils, the bleaching step is a critical step. Bleaching of vegetable oils is important for producing a light coloured oil of acceptable quality. This improvement in colour is due to the removal of organic compounds such as carotenoids, especially β-carotene, and their derivatives, xanthophylls, chlorophyll, pheophytin, tocopherols, gossypol, and their degradation products, which impart undesirable colour to the oils [10]. Bleaching is a process which involves the removal of pigments, impurities, trace metals and high molecular oxidative component from fats and oil [11, 12]. The removal of these substances is essential in the refining of oils as it improves the stability, appearance and the sensory quality of the oil [2].

Bleaching could be achieved by heat treatment and adsorption methods. The heat treatment bleaching is a process whereby the oil is ordinarily heated to a high temperature and the temperature maintained for some time until the colour of the oil changes. On the other hand, the adsorption bleaching process is the most common form of bleaching which involves mixing the oil with an adsorbent such as activated clay, silica gel, activated charcoal or waste ash then heating it for period of time at temperatures ranging from 70^oC to 120^oC after which filtration is done to remove particles. The most effective and widely used is the adsorption bleaching. This removal of colour is usually achieved by the adsorption of these colour pigments on to an adsorbent for which, the most widely used are activated clays. Though activated clays are efficient and effective adsorbent for bleaching, attention is currently directed at agro waste ash as alternative adsorbent [13]. The aim of this study is to evaluate the effect of heat bleaching and absorbent bleaching using activated coconut pod ash (ACPA) on the quality attributes of crude palm oil.

II. MATERIALS AND METHODS

The crude oil was obtained from a local processing mill in *Ika* North East Local Government area of Delta State, Nigeria and divided into samples A, B and C. Coconut pod was used to produce the activated coconut pod ash (ACPA).

2.1 Preparation of Activated Coconut Pod Ash (ACPA)

One hundred grams (100g) of coconut pod was weighed in a crucible and incinerated at 300^oC for 3 hours in a muffle furnace, after which the ash was crushed into powder and sieved with a 2mm sieve. The coconut pod ash was soaked in 0.5M of H_2SO_4. The ratio of H_2SO_4 to coconut pod ash used was 3:1 and it was soaked for 24 hours at room temperature. After 24hrs, it was washed with distilled water and the pH was adjusted to 7.0 and then dried in the oven at 105^oC for 2hrs.

2.2 Experimental set up

The initial properties of the crude oil palm (sample A) were determined [14]. Fifty milliliter (50 ml) of crude palm oil (sample B) was measured and poured into a 200ml beaker and heated at 100^oC for 15mins. Fifty milliliter (50 ml) of crude palm oil (sample C) was measured into a 200ml beaker and 1.7g of the ACPA was added to it. It was then stirred with a magnetic stirrer and heated at 90^oC for 15 minutes; the slurry was filtered with a filter paper into a test tube. The moisture content, crude fat, crude protein, oil extract, refractive index, viscosity, density, peroxide value, free fatty acid (FFA), iodine value and saponification values were determined [14, 15].

III. RESULTS AND DISCUSSION

The quality attributes of the crude palm oil (sample A), heat bleached palm oil (sample B), and palm oil bleached with Activated Coconut Pod Ash (ACPA) as an adsorbent (sample C), are as presented in Table 1. The moisture content and crude protein content decreased with bleaching irrespective of the type of bleaching method used. The value of the oil extract was higher for palm oil bleached using an adsorbent. Moisture content is an essential constituent in food composition database because water content is one of the most variable components especially in plant foods. The variability affects the composition of the food. The low value of the moisture content in the crude palm oil is responsible for the low fatty acid. The moisture content affects the percentage of the free fatty acid in oil and must be reduced to a range of 0.15 to 0.25 percent to prevent an increasing free fatty acid through autocatalytic reactions [16]. The crude protein also decreased significantly with bleaching and it is more significant in oil bleached with ACPA.

Table 1: The quality attributes of crude and bleached palm oil

Property	Sample A	Sample B	Sample C
Moisture content (%)	4.93	2.86	2.74
Crude protein (%)	7.45	6.07	4.22
Oil extract (%)	92.00	93.11	98.00
Free fatty acid (%)	3.56	3.08	2.87
Iodine value (g/100g)	88.00	77.40	66.20
Saponification value (mg/g)	180.00	187.00	193.00
Peroxide value (mol/kg)	7.20	4.80	1.08
Density (g/cm3)	0.91	0.91	0.68
Refractive index	1.47	1.40	1.06
Viscosity	10.50	10.08	5.21
Colour	Orange red	Pale red	Orange yellow

Where sample A = crude palm oil, sample B = heat bleached palm oil sample C = ACPA bleached palm oil

Free fatty acid (FFA), is formed due to hydrolysis of triglycerides and may be promoted due to reaction with moisture [17]. Determination of FFA is important in the measure of rancidity in fats and oil. The FFA is among the undesirable constituent to be removed and thus its low percentage enhances the efficiency of the refining process [18]. The FFA contained in cooking oil lie within the limits of 0.0-3.0%, the results obtained in this study was within allowable limits. The low level of FFA suggests that the oil is good edible oil, which will store for a long time without spoilage through oxidative rancidity [19]. The FFA also reduced after bleaching irrespective of the bleaching method used. The reduction in the value of the FFA indicates that the palm oil used is fresh. It has been previously reported that as the life of the palm oil prolongs, its percentage free fatty acid increases due to hydrolysis which occurs in the presence of water and heat [16].

Iodine value is a measure of overall unsaturation measured in g/100g of fat. It is used in the characterization of oil and fats. The iodine value is a useful index to detect adulteration of palm oil with any other vegetable or animal fat [1]. The high iodine value in the crude palm oil and the bleached samples shows that palm oil is a rich source of poly unsaturated fatty acids that is beneficial to health and helps in regulating and lowering blood cholesterol level and high blood pressure. High iodine value in oil shows that the oil has good qualities of edible oil [20].

The saponification value of crude palm oil increased with bleaching. The saponification value suggests that the palm oil can be used for soap making. The peroxide value is a test used to measure the concentration of peroxides and hydro peroxides as well as determination of oxidative rancidity. Good quality oil has a peroxide value less than 10 units [16]. The lower peroxide values in the bleached palm oil suggest that the oil can be stored for a long time without deterioration [21]. Oil with high peroxide values are unstable and become easily rancid. Oil becomes rancid when the peroxide value ranges from 20.0 to 40.0mg/g.

Bleaching with ACPA reduced the viscosity from 10.50 to 5.20. This implies that oil viscosity decreases with increasing temperature resulting in better dispersion of particles, improved adsorbent oil interactions, and flowability as bleaching temperature typically ranges from 90 – 125^{0}C [22]. The refractive index and the density of the crude palm oil were higher than the bleached oil samples. This may be due to impurities contained in crude palm oil as well as the presences of carotenoids.

IV. CONCLUSION

It is concluded that oil extract and saponification values increases with bleaching, the highest values was obtained for the ACPA bleached palm oil. The FFA, iodine value, peroxide value, density, refractive index and viscosity decreased with bleaching. The increase in saponification value of bleached oil is an indication of its suitability for soap making and the reduction in its FFA value will enhance its shelf life. Adsorption bleaching made the crude palm oil lighter and clearer which shows that the ACPA used had absorbed much of the impurities hence making it better than heat bleached palm oil. It is therefore recommend that the efficiency, adsorption kinetics and isotherm of using Activated Coconut pod Ash for bleaching should be investigated.

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