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EVALUATION OF FLUORESCENT LIGHT RADIATION ON THE PHYSICO – CHEMICAL PARAMETERS OF RED PALM OIL

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ABSTRACT

The Physico-chemical parameters of red palm oil samples were investigated by irradiating the oil samples with fluorescent light varying the doses at 60, 100 and 200 kwatts then stored for 8 days. The control samples was not irradiated but kept outside at ambient conditions. The parameters considered in this study include; Colour, Free Fatty Acid (FFA), Iodine Value (IV), Peroxide Value (POV), Anisidine Value (AV) and β-carotene. Results obtained showed that Free Fatty Acid, Peroxide Value and Anisidine Values increased with increasing dose of radiation while the Colour, Iodine Value and Beta-carotene contents decreased with increase doses of radiation.

Keywords: Fluorescent Light, Radiation, Red Palm Oil, Physico-Chemical Parameters

INTRODUCTION

The Red Palm Oil (RPO) is an edible plant oil obtained from the mesocarp of the fruit of the best known specie *Elaeis guineensis*. The tree is native to Asian countries like Indonesia, Malaysia, West and Central Africa and Brazil. Indonesia with 20.9 million tonnes is the highest producer and exporter of the RPO, followed by Malaysia (17.7 million tonnes) with Nigeria coming next with a total of 10.45 million tonnes scattered over 120 million hectares of plantation farms **[1]**.

The oil is extracted by either boiling the fruit, pressing and centrifuging to obtain the natural reddish coloured oil that contains high β-carotene content that is semi-solid at room temperature (70 – 90^{o}F). Red palm oil is the richest naturally occurring source of β-carotene, a carotenoid that the human body can convert into usable vitamin A (retinol) **[2]**. It also contains saturated and unsaturated fats, with palmitic acid (44%) and oleic acid (40%) as the main fatty acids **[3]**, with natural fat-soluble tocopherol, tocotrienol and carotonoids, which may act as antioxidants. The red palm oil is free of death – inducing cholesterol and trans fatty acids but packed with health inducing carotenoids, C_{o}Q10, phytosterol and glycolipids and Vitamin E **[2]**.

Red Palm Oil is the most versatile of all major edible oils and fats. Many West African countries (including Burkina Faso, Cameroon, Ghana, Ivory Coast, Nigeria, etc.) produce red palm oil for local consumption and some have developed commercial industries for exporting other palm oil-based products. Its industrial use varies from making vegetable ghee, cosmetics, flour cleaning liquid, fabric detergent, candle, soap, plasticiders, margarines, mayonnaise and for frying and cooking **[4]**.

Zeb and Ahmad, 2004, **[5]** showed that gamma radiation can be used for food preservation but this can lead to unpleasant flavour caused by ionization, dissociation or excitation of the oil, to produce free radicals that combine with food molecules to cause changes in their composition. Earlier works **[6, 7]** on the effects of irradiation at low doses on different oils have been carried out and at high doses on sunflower, soybean and palm oils **[5]**. However the effect of Fluorescent Light radiation on the physico-chemical parameters of the Red Palm Oil is scarce. This study therefore tries to evaluate the physico-chemical parameters under the influence of fluorescent light radiation at different doses.

MATERIALS AND METHODS

Sample Collection

Samples of the Red Palm Oil were obtained from the Bayelsa Palm Ltd factory office in Yenagoa, Bayelsa State, Nigeria. Oil samples were kept in 250ml capped conical flasks for irradiation.

Irradiation

Locally fabricated boxes fitted with fluorescent lights served as source of radiation at doses of 60, 100 and 200 kwatts (25^{o}C). Non – irradiated oil samples were placed outside the box and these served as control.

Physico-Chemical Parameters

The oil samples were irradiated for 8 days with the following physico-chemical parameters analysed.

Colour

The colour of most oil is attributed to the presence of carotene pigment in their composition. Colour of oil samples were determined based on the optical density (OD) as absorbance at 420nm using 50% $^{v}/_{v}$ solution oil in iso-octane, using a Shimadzu UV–160 spectrophotometer.

Free Fatty Acid (FFA)

Free Fatty Acids refers to the fatty acids not esterified to glycerol. The fatty acid in Red Palm Oil is usually calculated in terms of percent of the palmitic acid. For this study, the free fatty acid was measured according to method described in AOAC **[8]**.

Iodine Value (IV)

The Iodine Value is determined by the number of double bond in the unsaturated fatty acid that can react with iodine. Fats with greater number of double bond provides more sites for oxidation **[9]**. For this study, the method described by AOCS was used to estimate the iodine value **[10]**.

Peroxide Value (POV)

This is a measure of the concentration of peroxide and hydro-peroxides formed in the initial stages of lipid oxidation, which results in rancidity. It is the most widely used test for oxidative rancidity, while milliequivalent of peroxide per kg of fat are measured by titration with iodide ion. The method described by AOCS **[10]** was used for the peroxide value test.

Anisidine Value (AV)

Aldehydes are by-products of lipid hydro-peroxide oxidation. The unstable alkoxy free radical react with the oil given raise to flavours that are described as ranging from sweet, pungent to oxidized milk. The anisidine value, were determined using spectrophotometric at 350nm **[4]**.

β-Carotene

β-Carotene is known as the precursor of vitamin A present in all natural fats and oil and acts as strong natural antioxidant. The β-carotene in the oil was measured according to PORIM's test method **[11]** as described by Bangash *et al*., 2004, **[12]**.

Statistical Analysis

All the parameters were determined in triplicates and mean values obtained. Analysis was carried out using computer software SPSS to compare differences among mean values **[13]**.

RESULTS AND DISCUSSION

Data obtained from the analysis of all parameters investigated are as presented in **Table 1**.

Colour of the Red Palm Oil showed a decreasing trend of 0.022 to 0.0055 from the control with increase in the dose of radiation. This decreasing trend is attributed to breakdown in the carotene pigments of the oil. The values of this study tallies with previous research works **[9]**. Results of the free fatty acid (FFA) for the control and radiated samples of the oil as shown in **Table 1** increases as dose of radiation was increased. This is due to the conversion of triglycerides to free fatty acids. This increase was also reported in the works of Nawar, 1972, **[14]** and Egharevaba and Omojola, 2009, **[15]**.

Values obtained for the Iodine Value (IV) for control samples is 59.40±7.02 and the irradiated samples gradually decreased from 57.06±7.20 to 51.60 ± 7.22 for 60 kwatts and 200 kwatts radiation respectively. This decreasing trend in the Iodine Value which is a measure of unsaturated double bond in the oil was also reported in previous works **[12, 16]**.

Peroxides or hydro-peroxides are formed by enzymatic or auto oxidation of triglycerides and fatty acids. The peroxides values (POV) as shown in **Table 1** reveals an increase with increasing dose of radiation. The control being 10.20±1.35meq/kg and at 200 kwatt the POV of the oil is 12.80±1.74meq/kg. The increase is an indication of rancidity caused by deterioration. Results from this study agree with works reported by earlier investigators **[17, 18, 19]**.

The result of the anisidine values as shown in **Table 1** also revealed an increase as the dose of radiation is increased, which indicates rancidity of the oil. The unstable hydro-peroxide of the oxidized oil is broken down to form the non-volatile aldehyde which reacts with anisidine. The value increased from 4.55±0.77 of the control to 11.80±2.36 at 200 kwatts radiation.

The red colour of the palm oil is attributed to β-carotene pigment. High level of β-carotene provides high stability to the oil against rancidity **[12]**. Data obtained for β-carotene in this study decreased from 550.20± 49.52 ppm for the control to 285.20± 34.51ppm at 200 kwatts. This decreasing trend is due to the splitting of the β-carotene molecule by gamma radiation releasing alcohols, aldehydes and other oxidative products. Similar trend was reported for soybean oil **[9, 5]**.

CONCLUSION

Results of this study showed that increase in the rate of fluorescent radiation increases the development of rancidity of the red palm oil. The data is complementary to those already reported for soybean and sunflower oils. This is expected to serve as baseline information for exposure of oil to radiation. Storage of oils should be in an air tight container and placed in cool and dark environments to avoid photo-lysis.

Table 1: Effect of Fluorescent Radiation Doses on the Physico-Chemical Parameters of Red Palm Oil

Parameters	Radiation Dose (K Watts)			
	Control	60	100	200
Optical Density (Colour)	0.022 ± 0.003	0.0095±0.0011	0.0070±0.0008	0.0055±0.0007
Free Fatty Acid (%)	0.35 ± 0.05	0.39 ± 0.06	0.42 ± 0.05	0.45 ± 0.06
Iodine Value (g/100g of oil	59.40 ± 7.13	57.06 ± 7.20	54.20 ± 7.15	51.60 ± 7.22
Peroxide Value MEq/kg	10.20 ± 1.35	10.80 ± 1.62	11.20 ± 1.57	12.80 ± 1.74
Anisidine Value	4.55 ± 0.77	6.92 ± 1.46	9.10 ± 2.23	11.80 ± 2.36
Beta – Carotene (ppm)	550.20 ± 49.52	460.90 ± 42.52	370.50 ± 35.20	285.20 ± 34.51

NOTE: * The Values Were Determined in Triplicate (n=3)

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