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Monitoring the Free Fatty Acid Level of Crude Palm Oil Stored under Light of Different Wavelenghts

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ABSTRACT

The effect of light of different colours (wavelength) on the Free Fatty Acid (FFA) value of stored crude palm oil is hereby reported. Equal portions of the palm oil samples were stored in an environment of red, blue and green lights, respectively for a period of 21 days. Aliquots were taken from each of these samples at two days interval for analysis. And the FFA values obtained plotted against the number of days of storage. Results obtained indicate that the FFA values of the oil increased with storage time. Also and more revealing is the fact that the FFA values of the samples did not follow any established order, especially as related to the spectrum of light.

Key words: Palm oil, mesocarp, fluorescent, free fatty acid, hydrolysis, wavelength

INTRODUCTION

Fats and oils are compounds of glycerol (propan-1, 2, 3-triol) and fatty acids. The latter formed from the hydrolysis of fats and oils with the help of the enzyme lipase in the presence of moisture, heat and catalyst. The physical and chemical properties of fats and oils are essentially determined by the fatty acid composition of their tryclicerides. Palm oil (*Eleasis guinneesis*) is an edible vegetable oil obtained from the mesocarp of the oil palm fruits (Njoku *et al*., 2010). It contains the highest concentration of agriculturally derived carotenoids of the vegetable oils that are widely consumed (Ahmad *et al*., 2010). Palm oil is a mixture of different fatty acids_saturated, unsaturated and polyunsaturated fatty acids, depending on the presence and number of double bond(s) or indeed the absence of it. However it contains by higher proportion more of the saturated fatty acids (Manorama and Rukmini, 1991; Aremu *et al*., 2006; Microsoft Student Encarta DVD, 2008).

In terms of oil quality, the free fatty acid value of oil is an important qualitative parameter. Since fats and oils contain some level of free fatty acid, FFA, there will always be an increase in acidity with time during transport and storage (Chong, 2000; Syam, *et al*., 2009). This hydrolysis reaction is acid catalyzed and the FFA inherent in palm oil subsequently autocatalyze the hydrolysis reaction (Chong, 2000; Sykes, 1985).

In Nigeria, palm oil production is a common commercial enterprise especially among rural dwellers (Microsoft Student Encarta DVD, 2008). The cultivation and milling of this oil has become a major income earner for these indigent farmers because of its use in cooking and in soap making (McNaught and Wilkinson, 1997) popularly called soda in local parlance. The nutritional value of a fat depends, in some respects, on the amount of free fatty acid which develops (Nzikou *et al*., 2007).

Similarly, because of the seasonal variation in availability and supply, bulk production and storage of the product is variously practiced during the peak season of production. Tons of palm oil are therefore hoarded for quantum gains during the off- season (usually in June/July and November/December) when sales of the product is up from between ₦2000-₦2500 ($14-$17) to ₦5000-₦7000 ($35-$50) per 20 L gallon.

More often, white 20 L gallons are used to store palm oil in the country. These gallons are hardly ever filled to the brim, this practice being a market strategy to maximize gains; thereby, leaving air spaces above the oil level in the gallons. Since in majority of the cases, this oil is improperly distilled, they would be expected to contain some degree of moisture (Law *et al*., 1984; Chong, 2000) and therefore, susceptible to oxidative and hydrolytic (Chong, 1995) deterioration.

Meanwhile, if all fats and oils were kept in the refrigerator and in the absence of air, they would all be stable (James, 2000). However, in the real world of domestic and commercial food preparation and storage, they are exposed to oxygen, light and heat.

Foods become exposed to several sources of light during production and marketing. According to James (2000), some common sources of light are: sunlight, incandescent lamps and fluorescents. Light is a form of energy whose intensity is measured in wavelength (Skoog and West, 1995). Light intensity requirement depends on the absorbing material (Affendy *et al*., 2010). When light strikes a package of food, a number of things happen-light is reflected off the surface of the package, absorbed by the food and transmitted through the food (James, 2000). In liquid foods, light penetration can be greater with mixing of the product due to agitation.

Although the effect of light on the hydrolysis of oil may not be immediately discernible, it however, adds the factor of heat (temperature); in other words, raising the temperature of the oil and consequently hydrolysis reaction. Herschel, according to Nelkon and Parker (1988) in 1800 was able to show that light energy when absorbed by substances was converted into heat.

Furthermore, Chong (2000) contends that one of the factors which affect hydrolysis is temperature of the oil. He argued that like the rate of oxidation, the rate of hydrolysis of oil is doubled for every 10°C increase in temperature. This is more so against the backdrop of Arrhenius` law that the temperature of a reaction bears a direct relationship with the reaction rate constant.

It is the thrust of this study therefore to monitor the changes in FFA level of palm oil arising from the indiscriminate storage of this oil under sundry environmental conditions including light of different colours (wavelengths).

MATERIALS AND METHODS

A set of three identical 35 by 50 cm cartons were provided with perforations at the sides to avoid overheating. To each of these boxes, red, blue and green 40 W electric bulbs respectively hung from the top inside the cartons and connected to a public power source. A 500 mL beaker of the oil sample was kept in each of the three cartons and a fourth sample left by the window in the laboratory under the influence of sunlight. All samples were maintained at ambient temperature and covered with filter paper to prevent insects falling to the oils.

Determination of Free Fatty Acid value: The FFA value of the oil samples was determined in duplicates using standard analytical methods for fats and oils by the American Oil Chemists Society, AOCS (1990) at 95% confidence limit. The percentage FFA value was calculated from the equation below:

$$\text{Free fatty acids (FFA)\%} = \text{VmM} = /10\text{w}$$

where, w = weight (in grams of samples), v = volume (in millitres) of sodium hydroxide solution used, m = molarity of sodium hydroxide solution used and M = molecular weight of the FFA.

Table 1: Free fatty acid value (mg g^{-1}) of palm oil samples at different colours of light

Storage time (days)	Sunlight	Red light	Green light	Blue light
	(mg g^{-1})			
2	0.738	1.310	2.310	1.125
4	0.813	1.626	2.830	1.865
6	1.084	1.626	3.794	3.790
8	0.813	2.510	4.472	2.252
10	1.226	2.980	3.792	2.710
12	1.220	3.523	3.659	2.981
14	1.355	3.520	3.793	2.846
16	1.358	3.533	3.117	2.980
18	1.220	2.168	2.710	2.846
20	1.084	2.500	2.513	2.742
Total	10.911	25.296	32.990	26.137
Average	1.091	2.530	3.299	2.614

Significance level is considered at p = 0.05

RESULTS AND DISCUSSION

Table 1 displays the FFA values of palm oil samples kept under different colours of light. The values in the table are obtained at 95% confidence level. Readings were taken at every two days interval in duplicates from each of the three oil samples at different colours of light and the control.

Perhaps the first critical observation to be deduced from Table 1 is the fact that there is a slight increase in FFA value with storage time in line with the findings of Law (1993) and Chong (2000). Secondly, it is also noticeable that the palm oil sample in the green light recorded the highest FFA values, followed by the oil samples under the red and blue lights, respectively. Thirdly, the control sample under the influence of sunlight recorded the lowest FFA of the four samples under consideration. The highest FFA value of 3.533 is recorded for the sample under red light and 3.790 for the sample under blue light, while the highest value of 4.472 was recorded for the green light sample. The obvious differences in the FFA values of the three samples maybe attributed to some form of preferential selection of light by the palm oil samples. This is synonymous with the preferential absorption of red and blue lights by chlorophyll during photosynthesis as observed by Dickson (2009).

Meanwhile, the palm oil sample kept by the window under the influence of sunlight had a rather low FFA value comparatively. This may be attributed to the type of the light source, its intensity (Affendy *et al*., 2010) and distance of incident radiation on the palm oil samples as suggested by Gravani (1983).

CONCLUSION AND RECOMMENDATION

The storage of palm oil under different colours of light has some obvious implication on the FFA value of the oil. Generally, the effect of light on stored palm oil is that of increasing not only the rate of oxidation but also that of hydrolysis as well, since light is a source of energy.

It is therefore suggested that palm oil samples for storage should be kept in the dark and also in more opaque containers to inhibit the effects of light generally. Measures should also be taken to prevent over-heating in storage environment.

REFERENCES

AOCS, 1990. Official Methods and Recommended Practices of the American Oil Chemists Society. 4th Edn., American Oil Chemists Society, Champaign, California.

Affendy, H., M. Aminuddin, A. Arifin, M. Mandy, K. Julius and A.T. Tamer, 2010. Effects of light intensity on *Orthosiphon stamineus* benth. seedlings treated with different organic fertilizers. Int. J. Agric. Res., 5: 201-207.

Ahmad, A.L., C.Y. Chan, S.R. Abd Shukor and M.D. Mashitah, 2010. Adsorption chromatography of carotenes from extracted oil of palm oil mill effluent. J. Applied Sci., 10: 2623-2627.

Aremu, M.O., A. Olonisakin, D.A. Bako and P.C. Madu, 2006. Compositional studies and physicochemical characteristics of cashew nut (*Anarcadium occidentale*) flour. Pak. J. Nutr., 5: 328-333.

Chong, C.L., 1995. Hydrolysis of palm oil products-An overview. Palm Oil Res. Instit. Malaysia Bull., 30: 25-34.

Chong, C.L., 2000. Storage, Handling and Transportation of Palm Oil and Palm Oil Products. In: Advances in Oil Palm Research, Basiron, Y., B.S. Jalani and K.W. Chan (Eds.). Palm Oil Research Institute, Kuala Lumpur, Malaysia.

Dickson, L.G., 2009. Photosynthesis: Microsoft Student DVD. W.A. Microsoft Corporation, Washington.

Gravani, R.B., 1983. Food facts. Facts Sheets, No. 119, pp: 1-4.

James, M.J. and L.G. Cleland, 2000. Fats and Oils: The Facts. Meadow Lea Foods Ltd., Richmond, USA., pp: 96.

Law, K.S., R.E. Timms and N.C. Wong, 1984. Application of the portable dissolve oxygen analyser for the determination of dissolved oxygen content in palm oil products. PORIM Report, No. PO(82)84 General, pp: 28.

Law, K.S., 1993. Quality, Handling and Storage of Palm Oil Products, Palm Oil Familiarization Course Notes. Palm oil Research Institute, Bangui.

Manorama, R. and C. Rukmini, 1991. Nutritional evaluation of crude palm oil in rats. Am. J. Clin. Nutr., 53: 1031-1033.

McNaught, A.D. and A. Wilkinson, 1997. Compendium of Chemical Technology (the Gold Book). 2nd Edn., Blackwell Scientific Publications, Oxford.

Microsoft Student Encarta DVD, 2008. Palm Oil. Microsoft Cooperation, Redmund.

Nelkon, M. and P. Parker, 1988. Advanced Level Physics. 6th Edn., Heinemann Educational Books Ltd., London.

Njoku, P.C., M.O. Egbukole and C.K. Enenebeaku, 2010. Physio-Chemical characteristics of dietry metal levels from *Elaeis guineensis* species. Pak. J. Nutr., 9: 137-140.

Nzikou, J.M., M. Mvoula-Tsieri, L. Matos, E. Matouba, A.C. Ngakegni, M. Linder and S. Desobry, 2007. *Solanum Nigrum* L seeds as an alternative source of edible lipids and nutriment in Congo Brazzaville. J. Applied Sci., 7: 1107-1115.

Skoog, D.A. and D.M. West, 1995. Fundamentals of Analytical Chemistry. 3rd Edn., Hot-Saunders International Editions Ltd., California, pp: 500-510.

Syam, A.M., R. Yunus, T.I.M. Ghazi and T.C.S. Yaw, 2009. Methanolysis of jatropha oil in the presence of potassium hydroxide catalyst. J. Applied Sci., 9: 3161-3165.

Sykes, P., 1985. A Guide to Mechanism in Organic Chemistry. 6th Edn., Longman Group, Essex.