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EFFECToF TEMPRATURE ON SOME PHYSICOCHEMICAL PROPERTIES OF PALM OILS COLLECTED FROM OKITIPUPA MARKET LOCATED IN ONDO STATE, NIGERIA

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ABSTRACT

Samples of palmoil was analysed for acid value, peroxide value, iodine value, saponification value, and free fatty acid value at different temperature using standard method. The observed result indicated the mean values at different temperature (40oC -- 100oC) as follows: Free fatty acid : 43.7±0.02%, saponification value: 277.8±0.01mg/KOH, refractive index 1.46292±0.04, acid value 43.71±0.04mg/KOH. Peroxide value: 594.20±012meg/100g, Iodine value:4.03±0.06gII2 /100g and free fatty acids value: 29.00±0.05%. It was also observed that as the temperature increases the saponification value increases initially and latter decreases. The acid values increases as the temperature increases, while free fatty acids has its highest value at 90oC (94.03±0.05%) and peroxide values increases geometrically as temperature increases, There was a slight changes in the refractive index as temperature increases. In conclusion, temperature has tremedouseffect on palm oil as observed on all the samples and therefore rancidity of palm oil like these is sure to occur, as temperature accelerate rancidity and produce free radicals.

Keywords: Palm oil, Temperature, and characterization and oxidation.

INTRODUCTION

Lipids including oils and fat are a chemically diverse group of compounds that are insoluble in water and have a variety of functions. Oils and fat are the principal stored forms of energy in many organism, with phospholipids and sterols making up approximately half of the mass of biological membranes. White and Nawer (1997).Quality is an important attributes of palm oil product and it is very important attributes from the trade point of view. Non compliance to quality specification could involve large discount or rejection of the consignment, if it cannot be used for intending purposes website (2021).Palm oil is one of the vegetable oil that are usually store in drums, tins, glass bottles and plastic containers in the open market. Methods of handling, processing and storage affects the shelf life of the oil. Akubor (2008). Oil and fats and the products containing them go rancid over times because of oxidation. The higher the proportion and degree of unsaturation of the fatty acids the more liable the lipid system is to oxidation. Fat and oil are glyceryl esters of carboxylic acids with long carbon chains called fatty acids.(Website 2021, Federico 2005). The fatty acids found in fats and oils are highly reduced hydrocarbon derivatives whose cellular oxidation is highly exergonic. They are carboxylic acids with hydrocarbon chain 4 --36 carbons which may be either fully saturated and unsaturated with the presence of one or more double bonds. The physical properties of the fatty acids and their derivatives are influenced by the length and degree of unsaturation of the hydrocarbon chain, the non-polar hydrocarbon chain primarily accounting for their poor solubility in water, Website 2021.The factors which affect the rate of flavor development include: fatty acid decomposition of lipid, temperature, light, metal catalysts, inhibiting compounds and availability of oxygen Website 2021. It is important to considered all these factors in stabilizing lipid oxidation. The two major factor when discussing lipid stability of foods are the need to begin with a high quality raw materials and the need to optimized all handling and storage procedures, Akubor (2008).The nutritional value of free fatty acids is determine by several factors these include the degree of saturation and location of omega 3 versus omega 6 double bonds. Lipids are biologically important steroids, hormones, vitamin (A, D,E & K) and natural antioxidant e.gcatenoids in foods, fatty acids contribute to the food flavor. Thus the role of fat must be seen in this perspective and it should not be concluded that wide spread changes in dietary fat consumption will lead inevitably to freedom from the so called diseases of affluence. Website 2021.

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Origin of Palm oil

Palm oil is an oil extracted from palm fruits plant usually called palm oil tree (*Elaiesguineesis)*The tree is originated in tropical West Africa and was found growing in every area and season. The tree require rich, well drained acid soil for good growth and high yield of the fruits The soil needs adequate quantities of potassium, magnesium and nitrogen. The tree is single stemmed upright and about (18m) tall when mature. The leaves are arranged specially on the stout trunk The palm produced both male and female flowers in which the two inflorescence are produced at different times. Cross pollination is common. There are two major varieties of this. These are Dura and Tenera. The dura is a common wild palm found all over west Africa, the fruits has a thick shell and large kernel while Tenera has a thin shell and small a small kernel and it produces large quantity of palm oil than Dura. It is propagated by seedlings and it grows well under high temperature (35^oC – 40^oC), adequate aeration and good moisture $120cm^3$ -- $150cm^3$ other, method of propagation is artificial propagation. It is used to be affected by this common diseases noted for the tree call anthracinose, blast and treckle, (Person (1983), Iherokoroye and Ngoddy 1986).Rancidity refers to the complete or incomplete hydrolysis or oxidation of fat and oils when exposed to air, light, moisture and bacterial, this generally occur in food items, making them unsuitable for consumption. Rancidity is divided into

two, firstly oxidation rancidity and hydrolytic rancidity rancidity is affected by some factors like, oxygen, microorganism and physical factors. It is essential therefore to prevent food product from rancidity, and to retain their desirable qualities, One of the simplest ways is to prevent food product, and keep them away from direct contact with light and air, for this purpose, they can be stored in air tight containers, adding an antioxidant is also an effective ways to prevent auto-oxidation in food containing fats and oils. Antioxidant can either be natural or synthetic , natural antioxidant include vitamin C, vitamin E, flavonoids and polyphenols. Sequesting agent like EDTA also prevent oxidation therefore, it can effectively prevent rancidity. Website 2021.The objective of this study was to determine the effect of different temperature on palm oil samples from Okit pupa market located in Ondo-state Nigeria. With the view to examined one of the physical factors that affect rancidity of oils, since heat and light are the major sources for the production of free radicals and accelerate lipid oxidation.

EXPERIMENTAL: MATERIAL AND METHODS

Sample Preparation:
Samples of palm oil was purchased from Okitipupa market at three strategic places at random. These was taken to School of Agriculture Department of Crop and Pest Federal University of Technology AkureOndo State, for proper identification of the palmoil samples. The samples was later store nside a refrigerator at -5^{o}C until when needed.

Methods:
The three samples were analysed for acid value. Saponification, Free fatty acid, peroxide value, iodine value. Specific gravity and refractive index. The experiment was conducted at different temperature ranging from 40^{o}C -- 100^{o}C, and a control experiment was conducted for each parameter at 25^{o}C, using standard method, AOAC (1995). Each of the experiment was conducted in triplicate. The chemical used are BDH standard chemical.

Determination of Free Fatty acids

5g of oil samples was weigh at each noted temperature into 250ml volumetric conical flask , 50ml of neutral alcohol was added to the content and was titrated with 0.1N sodium hydroxide. Using phenolphthalein indicator.

$$\% \text{ free fatty acid} : \frac{\text{Titre value} \times N \times F \times 100}{\text{Weight of sample} \times 100}$$

N : Normality of NaOH, F : equivalent weight of free fatty acid.

Acid Value: $\frac{\text{Titre value} \times N \times 56.1}{\text{Sample weight}}$

N : normality of KOH, 56.01: molecular weight of KOH.

Peroxide value

5g of oil sample was weigh into a clean volumetric conical flask , 30ml pf acetic acid – chlorofoam solution, the content was shaken until the oil dissolved, 0.5ml of saturated potassium iodide was added using mohr pipet, the solution was left to stand for one minute with occational shaken and then 30ml of distilled water was added, shaking then titrated with 0.1N sodium thiosulphate, adding gradually with constant shaking until tallow colour has almost disappeared , 0.5ml of starch indicator solution and continue titration with shaking until the end point, when all the iodine has librated from chlorofoam layer. At this period the blue black appear. The blank titration was also conducted. All experiment was conducted three times and at different stipulated temperature.

$$\frac{(S - B) \times N \times 100}{\text{Weight of sample}}$$

S = Titration blank, B = sample titration, N = normality of thiosulphate

Determination of Iodine:

5g of sample was weight into a volumetric flask containing 20ml carbon tetrachloride and 25ml of wijs solution and shaken for complete mixing. This content was stored in the dark for 30mountes at 25^{o}C latter titrated against 0.1N sodium thiosulphate after adding 20ml of potassium iodide solution.

$$\text{Iodine value: } \frac{(B - T) \times N \times 12{,}69}{\text{Weight of sample}}$$

B = blank titration, T= Titration value, N -= Normality of thiosulphate.

Reagent:
wijs solution:13g of iodine was dissolved in a litre of glacial acetic acid , heated solely for easy dissolution and cool before use.

Potassium iodide solution:
15g of K I dissolved in one liter of distilled water. **Starch indicator:** 10g of soluble starch in small cold water and later add one litre of boiled water, stirred rapidly and cool.

Sodium thiosulphate:
24.82g of sodium thiosulphate and 3.8g of borax and make up to 1 litre. The addition of borax is to prevent bacterial deterioration.

Refractive Index:
The refractive index of the oil samples were determined using Abbe refract meter. Model: KenttN23ey.

STATISTICAL ANALYSIS

Data were subjected to analysis of variance (ANOVA) as describe Ihekoroye and Ngoddy (1985) Means were different, sepaeated by least significant difference (LSD) test, significant was accepted at $p<0.05$.

RESULTS, DISCUSIONS AND CONCLUSSION

Table 1 Saponification values

0oC	A	B	C	Mean value Units
40^{o}C	280,5±0.02	251,0±0.01	280.7±0.02	270±0.03 mg/KoH
50^{o}C	280.5±0.13	281.0±0,05	280.1±0.04	280.5±0.14 "
60^{o}C	280.5±0.04	252.0±0.02	280.0±0.04	270.8±0.04 "
70^{o}C	280.5±0.02	281.0±0.05	280.0±0.04	280.5±0.04 "
80^{o}C	290.5±0.03	282.0±0.05	281.0±0.05	281.1±0.05 "
90^{o}C	280.5±0.02	281.0±0.02	280.0±0.02	280.5±0.02 "
100^{o}C	280.5±0.02	281.0±0.02	280.0±0.02	280.3±0.02 "
Total average				277.8±0.04 "
Control at 25^{o}C	**280.5**	**280.5**	**280.5**	**280.5±0.02mg/KoH**

± = standard deviation. Analysis are in triplicate, means were significantly different with $p<0.05$

Table II Acid Value

0°C	A	B	C	Mean value Units
40°C	30.18±0/02	30.29±0.06	30.16±0.04	30.21±0.04mg/KoH
50°C	32.07±0.04	32.03±0.05	31.85±0.03	32.01±0.04 "
60°C	31.04±0.13	27.59±0.14	38.42±0.15	29.35±0.14 "
70°C	30.40±9,14	30.80±0.13	30.50±0.13	30.56±0,13 "
80°C	29.06±0.03	31.92±0.05	30.48±0.04	30.29±0.04 "
90°C	145.57±0.04	101.20±0.04	100.98±0.04	115.92±0.04 "
100°C	29.28±0.02	42.92±0.02	40.60±0.02	37.60±0.02 "
Total average				43.70±0.04 "
Control at 25°C	**30.10**	**30.09**	**30.10**	**30.10±0.02mg/KoH**

±= Standard deviation. Analysis are in triplicate. Means were significantly different with $p < 0.05$.

Table III Iodine value

0°C	A	B	C	Mean value Units
40°C	1.75±0.05	3.93±0.04	2,84±0.03	2.84±0.04gI_2/100g
50°C	2.143±0.02	4.20±0.02	3.84±0.02	3.06±0.02 "
60°C	7.80±0.12	4.73±0.12	5.20±0,12	5.91±0.12 "
70°C	2.60±0.02	3.62±0.02	3.01±0,02	3.08±0.02 "
80°C	3.02±0.14	6.04±0.13	4.62±0.13	4.56±0.13 "
90°C	5.75±0,04	6.24±0.04	5.40±0.04	6.13±0.04 "
100°C	1.92±0.06	3.42±0.05	2.50±0.03	2.61±0.04 "
Total average				4.03±0.04 "
Control at 25°C	**1,52**	**1.51**	**1.52**	**1.52±0,04gI_2mg/100g**

± = standard deviation. Analysis are in triplicate. Means were significantly different with $p< 0.05$.

Table IV Free fatty acid

0°C	A	B	C	Meanvalue Units
40°C	15.17±0.03	14.78±0.04	15.01±0.05	14.99±0.04 %
50°C	16.13±0/02	16.20±0.02	16.02±0.02	16.12±0.02 "
60°C	15.70±0.12	15.68±0.12	14.98±0.12	15.45±0.12 "
70oC	15.28±0.21	15.24±0.23	15.19±0.22	15.34±0.22 "
80°C	14.60±010	13.94±0.10	13.68±0.10	14.06±0.10 "
90°C	93.06±0.05	94.02±0.05	95.01±0.05	94.02±0.05 "
100°C	14.72±0.20	15.70±0.20	14.98±0.20	15.13±0.20 "
Total Average				29.00±0.05
Control at 25°C	**14.10**	**14,12**	**14.11**	**14.10±0.02 %**

± = standard deviation. Analysis are in triplicate, means were significantly different with $p < 0.05$.

Table V Peroxide value

0°C	A	B	C	Meanvalue Units
40°C	418.0±0.02	415.0±0.02	420.0±0.02	417.6±0.02meg/1000g
50°C	458.0±0.16	452.0±0.14	456.0±0,12	455.3±±0.14 "
60°C	498.0±0.04	497.0±0,04	495.0±0.04	496.6±0.04 "
70°C	500.2±0.07	499.0±0.06	500.0±0.05	500.3±0.06 "
80°C	698.0±0.04	700.0±0.04	699.0±0.04	699.0±0.04 "
90°C	699.4±0.04	698.9±0.04	698.6±0.06	699.0±0.04 "
100°C	702.0±0.04	700.0±0.04	703.0±0.04	701.6±0.04 "
Control at 25°C	**355.0**	**355.20**	**355.10**	**355.0±0.02meg/1000g**

± = standard deviation. Analysis are in triplicate. Means were significantly different with $p < 0.05$.

Colour Identification:

The coloir of the samples were : Deep orange – Red colour

Table VI Refractive Index

0°C	A	B	C	Mean value
40°C	1.46316±0.04	1.46216±0.04	1.46226±0.04	1.46253±0.04
50°C	1.46323±0.03	1.46223±0.03	1.46233±0.03	1.46250±0.03
60°C	1.46331±0.04	1.46230±0.04	1.4651±0.04	1.46271±0.04
70°C	1,46339±1.13	1.46239±1,14	1.46260±1,13	1.46279±1.13
80°C	1.46347±0.01	1.46247±0.01	1.46258±0.01	1.46284±0.01
90°C	1.6354±0.05	1.46354±0.05	1.46275±0.05	1.46299±0.05
100°C	1.46362±0.02	1.46262±0.02	1.46272±0.02	1.46299±0.02
Total Average				1.46292±0.03
Control qt 25°C	**1.46320**	**1.46320**	**1.4654**	**1.4692±0.02**

± = standard deviation. Analysis are in triplicate. means were significantly different with $p < 0.05$.

SURMMARY OF THE RESULTS

Parameters	Mean value
Refractive index	1.46292±0.04
Acid value mg/KoH	43.71±0.04
Saponification value mg/KOH	277.8±0.54
Peroxide value meg/1000g	594.2±0.12
Iodine value $gI_{2/100g}$	4.03±0.06
Free fatty acid %	29.0±0.05

Table 1 above reveal the observed values for the saponification, it shows there is the same values f at 40°C to 100°C, but it increases as temperature increases, while sample C was observed almost the same at all the temperatures. It was noted that increase in the saponification indicate the possibility of making soap with the oil.. Table II also indicated the level of the acid value, and it was observed that between 40°C -- 60°C the values increases gradually but at 90°C it increases geometrically ant latter fall at 100°C, acid value is measure of free fatty acid in oil, hence it measure the extent of hydrolytic and oxidative rancidity. Oils with high acid values contain large amount of free fatty acids which are more susceptible to oxidative rancidity. Table III shows the Iodine value and it increases geometrically between 40°C and 80°C and latter fall at 100°C. The value was observed lower than that reported for life vegetable oil, avop vegetable oil and soya bean oil (50,1, 54.2 and 134.0gI_2/100g) by Akubor (2008) and, it determine the food oxidation and increases geometrically with the degree of oxidation. Sharon (1983). The auto oxidation of unsaturated fatty acids has been proposed to occur by free radical chain mechanism involving three stages (1) Initiation, the formation of free radicals. (2) propagation, the free radical chain reaction.(3) Termination. formation of non radical product. The initiation reaction is stimulated by the action of external factors such as heat and air which lead to the formation of radicals on foods substance. By definition, a radicals is an atom molecule or ion that has an unpaired electron, this makes the radical more active.

RH ---------- R*H*

Propagation: This oxygen gives rises to peroxide. The peroxide react with more unsaturated fatty and produce more radicals.

$R^* + O_2$ ---------- ROO*(peroxide).

Termination reaction occur when two radicals continue and from a new single bond

ROO * + ROO*---------- end products

The RH is any unsaturated fatty acids. R^o is a free form by removing a liable hydrogen from carbon atom adjacent to a double bond and ROOH is a hydroperoxide, one of the major initial oxidation products that decompose to form compounds responsible for the off flavor, (Website 2021, Akubor 2008). such product include hexanal, pentanal and malonaldehyde. At the end of rancification, fat oils and other liquid are decomposed, thus forming higher reactive molecules. These are responsible for the unpleasant smell and taste in rancid foods In some cases, rancidification may also lead to the lost of vitamin C in food. The Table iv shows the free fatty acid constituent of the samples , the values increases arithmetically between 40°C ---- 80°C and at 90°C it increases geometrically and latter fall at 100°C. Free fatty acid at higher value are likely go rancid easily, therefore good storage facilities are necessary. Table V shows the peroxide values for all the samples and it increases geometrically between 40°C -- 100°C for all the samples. Peroxide value is a good indicator of quality of oil, free palm oil extracted from the fruits has a peroxide value less than one (1), the peroxide value of an oil is expressed as the number of mill equivalent of oxygen per kilogram of oil, Website (2021). There is increase in value because peroxide values measure the amount of oxygen that is chemically bonded to the oil ashydroperroxide and hence the degree of oxidation of the oil,, and been subjected to physical factor like temperature, the rate of rancidity will eventually accelerated. and radical formations also increases, Hence there is series of complex chemical reactions leading to further oxidation and formation of polymer compounds as temperature changes, Akubor (2008) and Labusa (1971).All the values for control experiment were very far from the values obtained at 40°C - 100°C except the saponification values. Hence, low temperature favour shelf life of the oil since saponification value only indicate it usefulness in soap making. samples was also observed for having the same colour orange red. While, the refractive index values was gradually increases, this determine the likely changes in colour of palm oil, as time of exposure to light or heat increases due to changes in the value of refractive index.

Conclusion

From the above discussion, palm oil as one of the commonly used vegetable oil, in our environment therefore, care must be taking in the handling and storage of the oil since high temperature affect the structure of the oil and speed oxidation processes, in other to maintain quality and avoid deterioration, reduction in the risk of excessive increase in peroxide value and free fatty acid are necessary. All the processing industry must be encourage to use antioxidants either natural or synthetic which are vitamin C and E, flavonoid and polyphenol, sequesting agent like E D T A and, good storage facilities which must be at lower temperature even bellow 25°C, during processing and handling.

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