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COMPARATIVE ANALYSIS OF THE STORAGE CHEMISTRY OF GROUNDNUT AND PALM OIL.

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ABSTRACT

Storage chemistry of palm oil and groundnut oil samples were studied for their quality over the course of storage time and their impact on quality and health. Palm oil and groundnut oil samples were subjected to different moisture contents (water concentration) for some time. The acid values (AVs), free fatty acid (FFA) values, peroxide (P.O) vales, and iodine values (IVs) were determined using standard methods of the American Society of Oil Chemistry monitored during this period. Results indicate that AVs, FFA, and IVs increase with moisture content. Secondly, the AVs, FFA, and IVs of palm oil are higher than those of groundnut oil. Thirdly, the AVs, FFA, and IVs are directly dependent on the moisture content of the oils and increase correspondingly with an increase in water content. Generally, palm oil was found to be more susceptible to spoilage during storage and more affected by lipid oxidation. It is recommended that a threshold limit a_w of ≤ 0.21 for moisture content be the standard for stored edible oils. Consumers should avoid storing and eating palm oil stored for a long period.

Keywords: Acid value, free fatty acid value, peroxide value, iodine value, palm oil, groundnut oil.

INTRODUCTION

Palm and groundnut oil are essential components of almost every Nigerian diet. While the latter is comprised of oleic acids, it is, however, generally referred to as groundnut oil or vegetable oil among consumers nationwide. Palm oil has a 50 % significant proportion of saturated fatty acids [1] and has ostensibly a good proportion of semi-solid triglycerides content [2]. Palm oil is native to tropical regions of West Africa and South America [3]; it is dominant in Nigeria, Brazil, Malaysia, and Indonesia where they are one of the highest producers in the world [4].

Fats and oils are members of the lipid family of natural products. These are triglyceride molecules formed from the neutralization reaction of glycerol and fatty acids. Palm oil is the orange-colored condensate obtained from the evaporation of the juicy extract of the mesocarp of the palm fruit (Eliasis guineensis) [5–9], groundnut oil is light yellow near transparent

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(less pigmented) oil compared with palm oil which has a higher proportion of carotenoids [10,11]. It contains no obvious precipitate at room temperature and is used for frying and making stews (tomato sauce).

Both oils are sold together under similar conditions in the environment. They are thus affected by the same factors of the environment and so, similarly susceptible to deleterious factors and degradation. The notable chemical difference between these two oils lies in the presence and number of olefinic (double) bonds [11,12] and carotenoid pigmentation. Groundnut oils are essentially polyunsaturated olefinic fatty acid molecules having more proportion of polyunsaturation [12,13]. They are therefore more amenable to various forms of addition reactions with electrophilic reagents. This should make groundnut oil more reactive than palm oil.

The stability of oils depends on the factors of moisture content, oxidation, heat, light, and the presence of metal (heavy) ions. The interaction between oxygen and oil produces free radicals – peroxides [14]. While heat, moisture content, light, and heavy metal ion content (especially Fe and Cu) affect the hydrolysis of oils into free fatty acids [15–17].

In this exercise, the properties of groundnut and palm oils studied under similar water activity a_w storage conditions will be comparatively analyzed and the wholesomeness of these oils determined over a period of storage time.

MATERIALS AND METHODS

Samples:

Groundnut oil and Palm oil samples were bought from the market and stored in the refrigerator before use.

Storage:

Samples of groundnut and palm oil samples in two 150 mL beakers were placed in three different desiccators each containing a beaker of saturated solutions (250 g in 150 g of water) of potassium ethanoate (CH_3COOK), magnesium chloride ($MgCl_2$), and sodium chloride (NaCl) respectively; corresponding to water activity (a_w) values of 0.23, 0.33, and 0.75 respectively. The water activity measures the amount of water present in food substances that can sustain microbial and enzyme activities (cite). Water activity expresses the ratio of the water vapour in a food substance to that of pure water.

$$a_w = \frac{P\ (food\ product)}{P\ (water)} \qquad (1)$$

Control samples of only the groundnut and palm oil samples of the same volume are placed by the window in the laboratory outside the desiccator. Analysis of samples took place over a period of one month.

Acid Value

The acid value (AV) of a fat or oil measures the amount in milligrams (mg) of potassium hydroxide required to neutralize the fatty acid present in 1 g of fat or oil [18]. It determines the extent of triglyceride hydrolysis which liberates

fatty acids from their triglyceride linkages [19–21]. This is why, acidity is often quoted in terms of free fatty acid [18].

25 mL of 96 % ethanol and diethyl ether were each withdrawn into an Erlenmeyer flask and neutralized by titrating with 0.1 M aqueous solution of NaOH using phenolphthalein as an indicator. Subsequently, weigh out 1.0 g of the sample into a 250 mL Erlenmeyer flask, and dissolve with tetrachloromethane (CCl_4). Titrated against 0.1 M NaOH solution with phenolphthalein as indicator. Calculate the AV of fats or oil from the equation:

$$\text{AV} = \frac{56.1 \times M \times V}{w} \qquad (2)$$

V = Volume (in mL) of NaOH used

M = Molarity of NaOH solution

w = mass (in grams) of sample

Note: Molecular mass of oleic acid 282 g/mol.

Free Fatty Acid Determination

The free fatty acid (FFA) value of fat and oil is the percentage by weight of fatty acid of a given molecular mass present according to the type of fat or oil under analysis for hydrolysis of the triglyceride. Acid values of oil generally serve as indicators of the wholesomeness of oil that is if the oil is in a good condition to be eaten. High FFA values are indicators of rancidity – off taste and smell of oils.

The procedure for determining the F.F.A. of fat or oils follows that of the AV above.

The FFA value (%) was obtained from the equation:

$$\text{F.F.A (\%)} = \frac{V \times M \times m}{10 \times w} \qquad (3)$$

V = Volume (in mL) of NaOH used

M = Molarity of NaOH solution

m = Molecular mass of the F.F.A

w = mass (in grams) of sample

Note: Molecular mass of oleic acid = 282 g/mol.

The molecular mass of palmitic acid = 256 g/mol.

Peroxide Value Determination

The peroxide value (P.O) of fat or oil measures the amount of peroxides present in fat or oil expressed in milli-equivalents of peroxide-oxygen per kilogram (mep-O_2/kg fat or oil).

Weigh 1 g of the sample into a 250 mL Erlenmeyer flask and add 15 mL solvent (glacial acetic acid and chloroform in a ratio of 2:1) to dissolve the sample. Then add 1 mL saturated solution of potassium iodide (KI) and stopper the flask, shake, and allow to stand for 1 min. Add 25 mL distilled water to the solution and titrate with 0.05 M sodium thiosulphate solution with starch indicator. The process is repeated with a blank solution (without the oil samples). The PV is determined from the equation below:

Peroxide value (P.O.) = $\frac{1000 \times (V-x) \times M}{w}$ (4)

w = mass of sample (in grams)

V = Volume of $Na_2S_2O_3$ (in grams)

x = Volume of $Na_2S_2O_3$ (in mL) used in blank

M = Molarity of thiosulphate solution

Iodine Value Determination

The iodine value (IV) measures the amount of halogen observed under specific conditions and is expressed as the number of grams of iodine per 100 g of fat or oil. It is a measure of the degree of unsaturation (olefinic bonds) per molecule of fatty acid of a particular fat or oil.

1 g of fat or oil is weighed into an Erlenmeyer flask and add 5 mL trichloromethane ($CHCl_3$). Shake to dissolve and homogenize. Then, add 5 mL Wij's reagent (containing 26.0 g of reagent grade iodine (I_2) in 2 L of reagent grade glacial acetic acid), stopper, and allow to stand in the dark for 5 min. Add 5 mL of 10 % KI solution and 25 mL water, mix thoroughly, and titrate with 0.05 M sodium thiosulphate solution using starch solution as indicator. Run a blank test (without the sample).

The Iodine value for the fat or oil is obtained from the equation:

I.V = $\frac{12.69 \times M \times (x-V)}{w}$ (5)

M = Molarity of $Na_2S_2O_3$

V = Volume of $Na_2S_2O_3$ solution used in the test (in mL)

x = Volume of $Na_2S_2O_3$ solution used in blank (in mL)

w = mass of sample (in grams)

RESULTS AND DISCUSSION

Acid value

Tables 1 and 2 give the AVs of palm oil and groundnut oil obtained from neutralizing the fatty acid in 1.0 g of fat or oil [22]. The results in the two tables are AVs for both of the oil types containing different amounts of moisture content. The implications of the findings are to determine the effect of moisture content on the rate of hydrolysis of oil during storage. The average titre values for three replicate measurements are reported in Tables 1 and 2 below.

Table 1: Acid values (mg/g) of palm oil samples stored at different a_w values.

Storage time (Days)	Sunlight (control)	CH_3COOK (a_w=0.21)	$MgCl_2$ (a_w=0.33)	NaCl (a_w=0.75)
2	1.527	2.042	1.350	2.014
4	1.687	2.244	1.683	2.525
6	2.246	3.647	1.964	3.366
8	1.680	2.509	1.964	3.647
10	2.539	1.964	2.244	3.363
12	2.528	1.962	1.683	3.642
14	2.813	1.963	2.525	3.036
16	2.801	3.647	2.244	3.649
18	2.291	1.964	1.683	2.805
20	2.248	1.960	2.525	2.244
Average A.V.	**2.236**	**2.390**	**1.987**	**3.029**

The average AVs recorded in Table 1 show that AVs of palm oil samples increase with increasing moisture content during storage except for the a_w = 0.33 which appears to be points of inflection noticeable in both oil samples at this moisture content. These increases in AVs imply that changes in the moisture content of palm oil impacted the AVs obtained. That is, the hydrolysis reaction improved with water content of the oil. Secondly, the different AVs obtained for the three a_w values are an indication that the three desiccator environments were active and different.

Table 2: Acid values (mg/g) of groundnut oil samples stored at different a_w values.

Storage time (Days)	Sunlight (control)	CH_3COOK (a_w=0.21)	$MgCl_2$ (a_w=0.33)	NaCl (a_w=0.75)
2	1.122	1.122	1.683	1.122
4	1.683	1.680	1.670	1.684
6	1.124	1.124	0.561	1.403
8	1.122	1.126	0.842	1.124
10	1.403	1.123	1.120	1.124
12	0.506	1.121	0.084	0.842

14	1.128	1.127	1.120	1.843
16	1.125	1.404	1.123	1.125
18	1.405	1.683	1.404	1.685
20	1.125	1.543	0.842	1.401
Average AV.	**2.135**	**2.373**	**1.899**	**2.428**

AVs obtained in Table 2 are lower than those of the palm oil in Table 1 above. The difference in AVs of these two oil types is indicative of the various levels of hydrolysis. The levels of fatty acids in the groundnut oil available to be neutralized by aqueous KOH are not as high as in the palm oil sample. These low AVs also demonstrate the relative stability of the groundnut oil over some time during storage.

Average AVs of groundnut oil samples slightly increased with increasing moisture contents (Table 2 above). The highest AVs obtained for the three desiccator samples was 1.685 while 0.842 was the lowest recorded during the storage period. Similarly, 1.683 and 0.506 were the highest and lowest AVs respectively for the groundnut oil control sample during this study period. Again, these values generally portend stability of the groundnut oil to lipase activity [19–21]. However, the reaction of this oil with oxygen (lipid oxidation) as well as the iodine values which is a reflection of the proportion of unsaturation are other factors that impinge on oil stability.

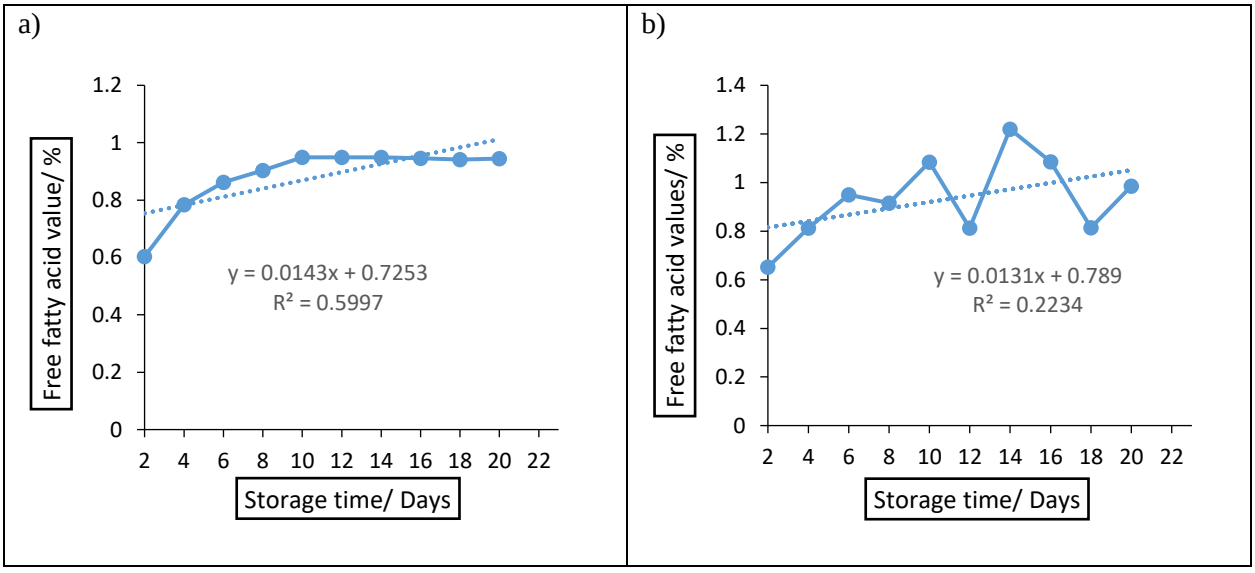
Free Fatty Acid Value

Table 3: The average free fatty acid values (mg/g) from three replicate measurements of palm oil samples stored at different a_w values.

Storage time (Days)	**Sunlight (control)**	**CH_3COOK (a_w=0.21)**	**$MgCl_2$ (a_w=0.33)**	**NaCl (a_w=0.75)**
2	0.738	0.603	0.652	0.981
4	0.813	0.784	0.813	1.200
6	1.084	0.862	0.950	1.628
8	0.813	0.903	0.915	1.718
10	1.226	0.949	1.084	1.626
12	1.220	0.949	0.813	1.760
14	1.355	0.949	1.220	1.451
16	1.358	0.946	1.085	1.355

18	1.220	0.941	0.814	1.357
20	1.084	0.945	0.985	1.080
Average FFA	**1.091**	**0.883**	**0.933**	**1.416**

Table 3 shows that the FFA values of the palm oil increased steadily with moisture content. That is, FFA values were highest at a_w = 0.75, and least at a_w = 0.21. Increases in FFA are a reflection of increased lipid hydrolysis as the lipase enzyme becomes more active [23,24]. Without a doubt, the presence of more water content in the palm oil promoted the activity of the lipase enzyme which is responsible for breaking down triglycerides. For example, an increase in a_w from 0.21 to 0.33 resulted in a 1.30 % rise in the FFA of palm oil. This becomes more compelling when we consider the rise in FFA value of 48.0 % recorded for more than doubling the moisture content from a_w value of 0.33 to 0.75.



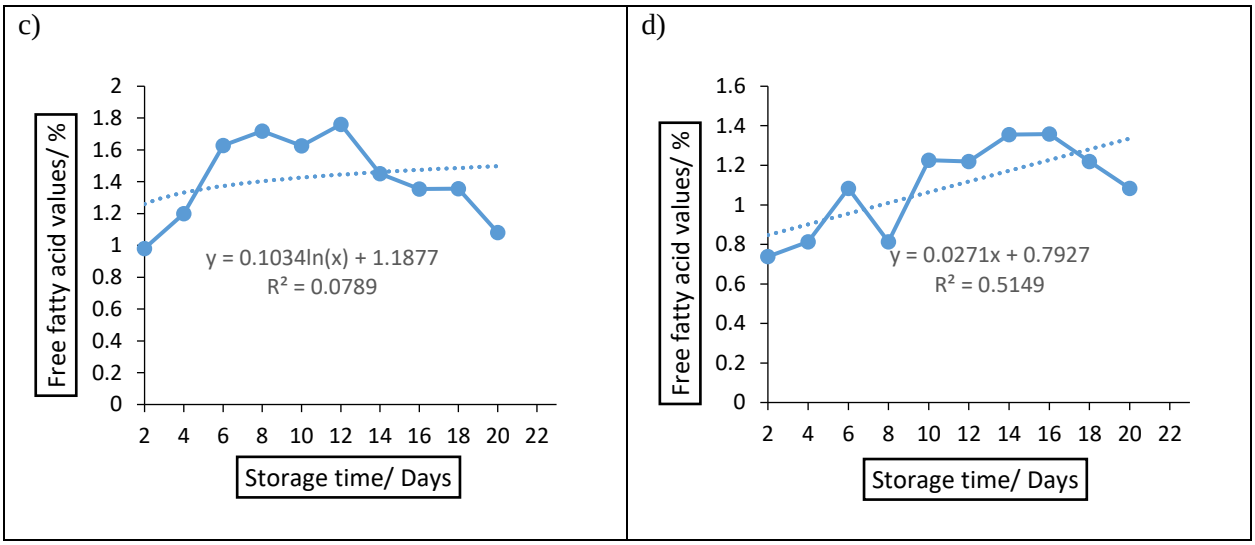


Figure 1: shows a plot of the free fatty acid values vs storage time/days for palm oil samples at a) a_w = 0.21, b) a_w = 0.33, c) a_w = 0.75, and d) control respectively.

Figure 1 is a graphical representation of the patterns of FFA in palm oil samples at different moisture levels during a one-month storage period. A quick observation of the patterns of the FFA in these graphs illustrates that moisture content played a role in the hydrolysis of lipids in palm oil during storage. Figure 1a demonstrates that palm oil is stable at low moisture levels (a_w = 0.21). A gradual rise in lipase activity led to increasing FFA values from day 2 to 10, corresponding to FFA values of 0.60 to 0.95; and remained relatively constant afterward for the remaining storage time (Figure 1a). As the moisture content increased to a_w = 0.33, the lipase enzyme activity accelerated to FFA values of 1.08 and 1.22 respectively on days 10 and 14 (Figure 1b). The latter is the highest FFA value obtained during the entire storage time at this a_w = 0.33 value.

But when the moisture content was doubled from a_w = 0.33 to 0.75, the activity of the lipase enzyme rose dramatically, culminating in an FFA value of 1.76 on day 12 (Figure 1c) before dropping drastically from day 12 to 22. This infers a significant effect of the drastic increase in moisture content on the activity of lipase enzymes. It demonstrates that hydrolysis of triglyceride in palm oil rose to a maximum in quick time before rapidly dropping for the remaining storage period. Values of the FFA for the control sample also increased rapidly to a maximum in the 14 to 16th day (Figure 1d) before dropping steadily for the rest of the storage period. From Figures 1c and 1d, it is apparent that the moisture contents are close going by the maximum FFA values reported, 1.76 and 1.36 respectively, and that the moisture content in the a_w = 0.75 was higher than that of the control. Finally, the critical FFA value of palm oil is 0.77 approximately as reflected in the regression equation on the graphs.

Table 4: Free fatty acid values (mg/g) from three replicate measurements of groundnut oil samples stored at different a_w values.

Storage time (Days)	**Sunlight (control)**	**CH_3COOK (a_w=0.21)**	**$MgCl_2$ (a_w=0.33)**	**NaCl (a_w=0.75)**
2	0.564	0.564	0.846	0.564
4	0.846	0.846	0.842	0.282
6	0.546	0.564	0.282	0.705
8	0.566	0.565	0.442	0.564
10	0.705	0.564	0.564	0.566
12	0.282	0.364	0.420	0.432
14	0.564	0.464	0.567	0.430
16	0.566	0.505	0.564	0.584
18	0.705	0.646	0.705	0.848
20	0.568	0.376	0.423	0.705
Average FFA	**0.591**	**0.546**	**0.566**	**0.568**

There was only a marginal increase in the FFA values of the groundnut oil samples in Table 4. This indicated a small rise in FFA values as the moisture content of the oil increased even though these increases were rather negligible. The average values of FFAs were 0.546, 0.566, and 0.568 for the a_w values of 0.21, 0.33, and 0.75 respectively. The control sample had the highest average FFA value of 0.591. Invariably, these results demonstrated that little hydrolysis occurred in groundnut oil and that the oil was rather stable to hydrolysis. Consequently, increases in moisture content only resulted in negligible changes in the hydrolysis reaction in groundnut oil. This may suggest that the presence of some proportion of unsaturation in groundnut oil may likely confer some form of stability by the olefinic bonds in groundnut oil.

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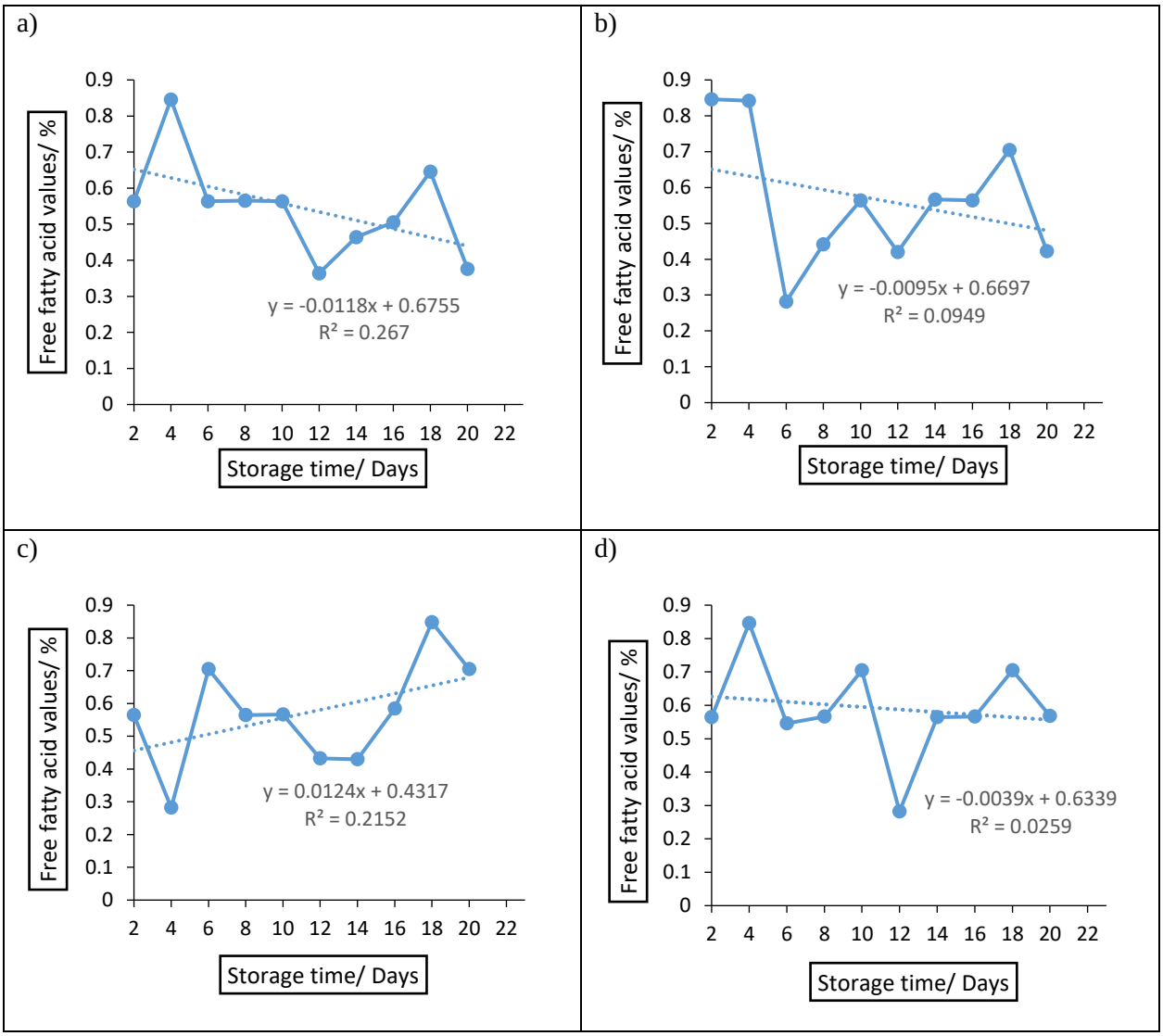

Figure 2: shows a plot of the free fatty acid values vs storage time/days for groundnut oil samples at a) a_w = 0.21, b) a_w = 0.33, c) a_w = 0.75, and d) control respectively.

The patterns of the FFA values of the groundnut oil samples were irregular and random (Figure 2). It is evident that low moisture content inhibited the activity of lipase enzyme. The apparent drop in the FFA values reported for the samples as represented by the regression lines in Figures 2a,b, and d, with the obvious exception of the a_w = 0.75 is a clear indication of the impact of moisture content on hydrolysis of this oil. At a significantly higher moisture content, the hydrolysis reaction peaked as demonstrated in Figure 2c above. Generally, both oil types were affected by significantly high moisture content (a_w = 0.75) but the groundnut oil was more stable below a_w of 0.75. The ground nut oil sample had a critical FFA value of approximately 0.66 at the

start of the study according to the regression equations from the graphs.

Peroxide Value

Table 5: Peroxide values (mep-O_2/kg fat) from three replicate measurements of palm oil samples stored at different a_w values.

Storage time (Days)	**Sunlight (control)**	**CH_3COOK (a_w=0.21)**	**$MgCl_2$ (a_w=0.33)**	**NaCl (a_w=0.75)**
2	30.0	26.0	28.0	26.0
4	27.5	2.30	2.10	2.00
6	4.50	1.80	1.40	1.10
8	3.50	3.00	2.60	2.20
10	6.20	3.50	2.00	1.50
12	3.50	1.00	6.00	1.00
14	1.50	6.00	7.00	6.00
16	3.00	9.00	8.00	7.00
18	9.50	8.50	6.00	6.00
20	7.00	2.00	2.00	4.50
Average P.O.	**9.62**	**6.31**	**6.51**	**5.73**

Peroxide (P.O) values were highest in the control samples for palm oil in Table 5. This indicated that moisture content increased the rate of peroxide formation and eventually, rancidity; and that dissolved oxygen content in oil promoted oxidation and consequently, peroxide formation. However, the P.O. values of the palm oil were random and in no particular order during the period of storage. However, as the moisture content increased initially from a_w 0.21 to 0.33, there was a corresponding increase in P.O values (Table 5); which later dropped as the a_w value rose to 0.75, that is, more than double the previous value of 0.33. This may suggest that lipid oxidation may be impeded by rising levels of moisture content in palm oil. Chemat et al., (2023) cited factors like the number and type of double bonds, unsaturation) type of lipid and oxygen interface, light and heat, as well as antioxidants as being responsible for impeding the oxidation of lipids [25]. Early inferences from these results may indicate, that levels of moisture content had no direct correlation with the P.O values of the palm oil.

Table 6: Peroxide values (mep-O_2/kg fat) from three replicate measurements of groundnut oil samples stored at different a_w values.

Storage time (Days)	**Sunlight (control)**	**CH_3COOK (a_w=0.21)**	**$MgCl_2$ (a_w=0.33)**	**NaCl (a_w=0.75)**
2	1.00	2.00	1.80	1.20
(4	1.00	3.00	2.60	2.30
6	3.50	3.50	3.50	2.70
8	3.50	3.50	3.50	3.20
10	6.00	3.50	1.00	1.00
12	8.00	1.00	2.00	1.50
14	6.00	8.50	6.50	2.00
16	7.50	9.20	4.50	3.10
18	1.00	10.0	3.50	7.50
20	8.00	6.00	6.00	5.00
Average P.V.	**4.55**	**5.02**	**3.49**	**2.95**

For the groundnut oil samples, P.O values were lowest at a_w =0.75 like in the palm oil sample in Table 5 above. This corresponds to the highest moisture content value of the three samples in the desiccators. Furthermore, the highest P.O value of the three samples was recorded for the a_w = 0.21. This implies that P.O values decreased with rising moisture content for the groundnut oil samples. These results contradict those obtained with the palm oil samples, thereby indicating that besides the moisture content, other factor(s) may be at play concerning the P.O values of oils [25]. These could include the nature of fatty acids and triglycerides and the degree or proportion of unsaturation (mono- or polyunsaturation). Notably, the difference between palm oil and groundnut oil lies in the high proportion of saturated fatty acids and pigmentation (antioxidants) of the former as against the high unsaturation and less pigmentation of the latter. Further studies will be required to see how this impact the P.O values of oils generally.

Iodine Value

Table 7: Iodine values (gI_2/100 g fat) from three replicate measurements of palm oil samples stored at different a_w values.

Storage time (Days)	Sunlight (control)	CH_3COOK (a_w=0.21)	$MgCl_2$ (a_w=0.33)	NaCl (a_w=0.75)
2	51.98	50.23	50.50	50.10
4	52.10	50.32	50.55	51.17
6	52.16	50.38	50.52	51.23
8	52.14	50.45	50.72	51.22
10	52.35	50.38	50.79	51.32
12	52.50	50.61	50.83	51.30
14	52.81	50.60	50.81	51.90
16	52.90	50.73	51.05	51.48
18	53.22	50.82	51.19	51.50
20	53.45	51.20	51.38	51.63
Average I.V.	**52.56**	**50.57**	**50.83**	**51.29**

The I.Vs in Table 7 show that the control sample had the highest I.Vs of all the samples. I.Vs were lowest in the a_w = 0.21 samples being the lowest of the three desiccators samples in moisture content. This significant finding underscores the importance of low moisture content to oil stability during storage. High water activity values result in increased I.Vs for palm oil as demonstrated by values reported in Table 4a for a_w = 0.75. Certainly, palm oil was stable during storage at a_w = 0.21.

Table 8: Iodine values (gI_2/100 g fat) from three replicate measurements of groundnut oil samples stored at different a_w values.

Storage time (Days)	Sunlight (control)	CH_3COOK (a_w=0.21)	$MgCl_2$ (a_w=0.33)	NaCl (a_w=0.75)
2	61.13	60.50	60.83	61.70
4	61.18	60.53	60.88	61.75
6	61.24	60.58	60.70	61.81

8	61.20	60.45	60.96	61.78
10	61.31	60.73	61.18	61.90
12	61.36	60.67	61.25	62.94
14	61.35	61.05	61.34	63.20
16	61.50	60.89	61.20	63.28
18	61.58	60.91	61.46	63.30
20	61.74	60.98	61.55	63.34
Average I.V.	**61.36**	**60.73**	**61.14**	**62.50**

The lowest I.V was recorded in a_w = 0.21; this implies that the oil sample was most stable at this moisture content level. Data from Table 8 support this finding when we compare the difference in a_w = 0.21 to 0.33 (a value of 0.12) which amounts to less than 0.01 % rise in I.V, whereas, a doubling of the a_w from 0.21 to 0.33 produced 3.00 % increase in I.V. The significance of this observation is that oil samples are safe if the a_w is low. This is in line with a similar observation made by Yang *et al*., (2020). The effect of low a_w for oils is further demonstrated in the result of the control sample whose moisture content was not controlled. From the results of the control sample, the effect of the a_w media in the three desiccators becomes obvious. The a_w = 0.21 medium showing I.Vs lower than the control, while the a_w = 0.33 recorded I.Vs close to those of the control sample; thus, depicting similarities in moisture contents.

Meanwhile, a comparative analysis of the I.Vs of these two oil types shows ostensibly that the palm oil was more stable than the groundnut oil. This is sequel to their having a lower I.V which may not be unconnected with the presence of a higher proportion of saturated fatty acids, and the presence of a lesser amount of unsaturated fatty acids which are centres of olefinic (double) bonds for an electrophilic attack.

CONCLUSION

AVs of groundnut oil are lower than those of palm oil from the results of this study, therefore implying that lipase enzyme hydrolysis was higher in palm oil during storage. Production and storage of these oil types with low moisture content is crucial to maintaining oil quality. The result is similar for the FFA of the two oil types under analysis in some respect but the critical inference is that the effect of rising moisture levels was negligible for the groundnut oil sample during storage until a threshold moisture content is reached. Generally, lipid hydrolysis is favoured by rising moisture content for both oil types during storage according to the average FFA values in the study.

P.O values were generally random for both of these oils during storage and appeared to be inhibited as the moisture content doubled from 0.33 to 0.75. Suggesting that free radical formation typically prevails in non-aqueous conditions. For the prevalence of peroxide formation, chemical reactions should persist in less aqueous systems where dipole species are formed from the effect of polarization. Consequently, P.O values results from these studies for the two oil types support this hypothesis. Portending that lipid oxidation subsists in less aqueous systems; that is, it is sensitive to increasing water content. Furthermore, the average P.O. values for both of these oil types show that the groundnut oil was again more stable to oxidation (P.O. formation) during storage and that the palm oil was more likely to deteriorate during the course of storage.

I.Vs increased generally with storage for both oil samples as the moisture content increased. This implied that electrophilic addition reactions to the olefinic bonds are moisture sensitive. Therefore, increases in the moisture content of these oils will directly impact the I.Vs during storage. Nonetheless, of the two oil types studied, I.Vs were expectedly higher in the groundnut oil samples than in the palm oil. This result is not unexpected bearing in mind the higher proportion of the mono- and poly-unsaturation of the groundnut oil triglyceride molecule.

Finally, results from this study demonstrate that moisture content accelerated palm and groundnut oil senescence. While it promotes the hydrolysis of triglycerides, and addition reactions to the olefinic centres of the oils, it appears to inhibit the oxidation and the formation of peroxides and deleterious free radicals during storage. It is therefore safer to limit moisture content in edible oils to a_w = 0.21 for optimum quality and limit contact with air. Caution should be placed on the consumption of palm oil after a long stretch of storage time for obvious reasons. This is the problem considering that palm oil milling in Nigeria is dominated by uneducated, scientifically ignorant small-scale entrepreneurs usually in the rural areas of the country; and also similarly ignorant consumers who carelessly consume whatever is available to them.

CONFLICTING INTEREST

The authors declare that they have no conflict of interest to report.

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