**AFRICAN JOURNAL OF EDUCATIONAL FOUNDATIONS**
*University of Uyo, January/March, 2025. online:2672-5660, print: 2672-5649*

# EFFECT OF TIME REGIMES FOR PROCESSING OF PALM FRUITS ON THE QUALITY OF PALM OIL IN IKOT ABASI LOCAL GOVERNMENT AREA

**Ekereobong Jackson Ekwere, Prof. Saviour Okon Nsa,**
**Paul Ikongshul Agba & Ubong Gabriel Udom**
Department of Agricultural Education,
University of Uyo, Uyo Akwa Ibom State

***Abstract***
*The main purpose of the study was to examine the effects of time regimes for processing of palm fruits on the quality of palm oil in Ikot Abasi Local Government Area. The research focused on 3, 11 and 19 days time regimes in processing of palm fruits. The study adopted experimental design which involves complete randomized design (CRD). The population of the study was twelve (12) bags of palm fruits of 50kg each in a single harvest. The sample of five (5) bags of palm fruits of 90kg each (450kg); 1 bag for each processing duration, using simple random sampling technique. Standardized instruments and laboratory analysis apparatus were used for the experiment. The experiment involved the following experimental steps: Harvesting of fresh palm fruit, Transportation of Palm Fruits to processing site, Time Regime for Processing, Slicing of Fruit Bunch, Threshing, Steaming, Digestion, Pressing, Filtration and Laboratory Analysis Test. Data were collected through laboratory analysis test and were analyzed using mean to answer the research questions and ANOVA statistical tool to test the null hypotheses at .05 level of significance. The findings indicated that palm oil processed in three days has a high carotene content followed by those processed in 11 days and 19 days respectively. Based on the findings, it was recommended among others that Palm oil producers should adopt the 3-time regime for processing palm fruit to maximize the carotene content and free fatty acid content in the produced palm oil.*

**Keywords:** Time Regimes; Processing of Palm Fruits and Quality of Palm Oil

## Introduction

The quality of palm oil may depend on the time regimes in processing of palm fruits, among other factors such as the variety of the palm fruits, the technology and the method of processing of palm fruits from the reception to the product (palm oil). Palm oil is an edible vegetable oil as source of food and major source of lipid. According to Nanda, *et al*. (2020), about 80% of palm oil is used for human consumption, make derivative for industrial uses like soaps and cosmetics, inks, resins, methyl esters, among others. However, it is necessary for producers of palm oil in Ikot Abasi LGA of Akwa Ibom State to increase the production level and improve on the processing techniques of palm fruits, in order to boost the oil yield and quality.

Oil palm (*Elaeis guineensis*) is generally believed to originate from West Africa and is grown across 24 States in Nigeria of where 9 States in the Niger-Delta play a major role in the nation's palm oil production belt (Chineye *et al*., 2020). Chineye *et al* further reiterated that oil palm produces fruits in bunches known as fresh fruit bunch (FFB) and each oil palm tree produce more than 8-12 bunches per year, each weighing up to 13 kilogram (kg), and each bunch contains about 800-1000 fruits. According to Izah *et al*. (2016), Nigerian farmers grow Dura (thick shell), Tenera (thin shell) and Pisifera (shell-less or very thin shell) varieties because they produce more oil than any other known oil crops.

Nigeria played a leading role in palm oil production, but at present produces 1.5% of world's consumption, though it still produces more than half of Africa's total palm oil production (Anyaoha *et al*, 2018). According to Zainal *et al*. (2017), Nigeria is the fifth largest producer of palm oil in the world after Thailand and Colombia while Indonesia is the first largest followed by Maleysia. Global palm oil production in 2014 has been estimated to be 57 million tones according to FAOSTAT (2017). Ime *et al.* (2023) reported that most of the oil palm plantations in the 60s were owned by Nigerian government and were assisted by organizations such as European Union, World Bank, UNDO, Nigerian Institute for Oil Palm Research (NIFOP) among others because of the economic value before they were abandoned. This could be that the quality of palm oil processed was of very low standard or timing accuracy in processing of palm fruits that influence oil quality was lacking, thereby affecting the export rate of the commodity. Also, it might be that there was no management and maintenance culture or the processes involve in the processing of palm fruits is demanding, therefore, need adequate timing to get the desired quality of oil for exportation.

Kabir *et al*. (2017) reported that there is great variation in the composition and quality of fruits in bunches as the content of oil in the palm fruits increases from the stage of fruit formation to the period of maturity and ripening. It takes five to six months for palm fruit to mature after pollination. This implies that palm oil quality and quantity is entirely subjective and depends on various factors such as the variety of oil palm, soil type, age of the palm trees, and the ways palm fruits are handled in terms of processing. Poor quality of palm oil is also due to bruises on the fruits and the length of time at which the fruits are processed. In line with this, Wai-Lin (2014) asserted that pre-extraction like particle size, heating temperature; heating time and moisture content are also known to affect the yield and quality of the oil during extraction. According to Oxford Advanced Dictionary 10$^{th}$ edition, regime is the mode of rule or management; a set of characteristics or a regulated systematic period. Time regime is therefore referred to the mode of time management regulation in systematic order. However, time regime in processing of palm fruits is defined as the mode of rule or management of time in processing of palm fruits carried out using a systematic experimental procedures which include harvesting of oil palm fresh fruit bunch, transportation to processing site, slicing of bunches threshing, steaming, digestion, pressing, filtration and drying. According to Lutkevich (2023), time management is an integral component of industrial process which involves streamlining work flows to increase efficiency. The elements of time management include

organization, planning and scheduling to take advantage of time and add value to the meaning of time. Time management is behavior that aims at achieving an effective use of time while performing certain goal-directed activities. Dodd *et al.* (2016) argued that time cannot be managed at all; individuals can manage events in relation to time.

Palm oil is removed from the mesocarp of the fruits mechanically by hydraulic press or screw press. Basically, it takes five steps to process palm fruits to crude red palm oil, namely: sterilization, threshing, digesting, pressing and filtration (Ohimain *et al*., 2014). The types of processing equipment and processing practices being used for palm oil extraction have effects on the yield and quality of crude palm oil produced. The major processing practices identified to have high effect on quality of processed palm oil is the duration of storage of palm fruits before processing (Zu *et al*, 2017). Palm oil quality could be measured through the use of quality control parameters such as carotene content, moisture content, free fatty acid content, pH value, and saponification value.

Palm oil quality is dependent on the free fatty acid content as high content of fatty acids affects the oil quality which could leads to various health issues. Hein and Tsengard (2015) averred that palmitic acid and oleic acid are the main fatty acids contain in the palm oil but also possess antioxidant, anti-cancer and cholesterol lowering effect properties due to the existence of tocopherols and tocotricerols (pro-vitamin E). Assessing the functional properties and sensory perception of artisanal crude palm oil is important for optimizing it free fatty acid (FFP) content to meet local consumer demand. The length of time palm fruits is stored at room temperature or frozen at room temperature can impact the free fatty acid content of the resulting crude palm oil (Nanda *et al.*, 2020). Palm oil contains the highest known concentration of agriculturally derived carotenoids. In fact, crude palm oil is the world's richest natural plant source of carotenes in terms of retinol (provitamin A) equivalent. It contains about 15 to 300 times as many retinol equivalents as carrots, leafy green vegetables, and tomatoes, which are considered to have significant quantities of provitamin A activity. It is these carotenoids that impart an orange-red colour to crude palm oil (Omozuwa *et al*., 2023).

The review of the related empirical study by Eze *et al.* (2021) on the effect of processing method on carotenoid profile of oils from three varieties of Nigerian Palm Oil (*Eliase guinensis*) in Edo State. Specific varieties of the *Elaise guinensis* which are dura, pasifera and tenera were obtained from National Institute for Oil Palm Research (NIFOR) in Edo State, Nigeria. The samples were divided into two and processed using two different methods as the Not and Old processes commonly practiced in South-eastern Nigeria. The oil extracted from each of the processes was then analysed for oil characteristics using standard analytical methods while the carotenoid profile was analysed using, HPLC C-21 column. The results generated were subjected to one-way analysis of variance (ANOVA). The results of carotenoid constituents identified include; lutein, neurosporene (trans), neurosporene (cis), α-zeacarotene (lis), α - zeacarotene (trans) phytoene, phytofluence, β-zeacarotene, 3 and 13 cis a-carotene, 13 cis β-carotene b(cis), a-carotene (trans), Gamma (Y)-carotene (trans), Y-carotene b(cis). The results of physiochemical characteristics of oil samples extracted range

from 0.922 ± 0.004 – 0.916 ± 0.001 for specific gravity (SG), 8.10 ± 0.17 – 4.88 ± 0.04 mg KOH/g for acid value, 4.29% ± 0.02% - 2.44% ± 0.02% for free fatty acid value (FFA), 6.00 ± 0.21 to 204.67 ± 0.98 mg KOH/g for saponification value and 9.53 ± 0.23 – 5.25 ± 0.33 mEq/kg; for peroxide value while the carotenoids values were between 53.735 ± 0.10 and 123.389 ± 0.20mg/100g. From the results, it was observed that the main constituent of the palm oil carotenoid is β-carotene which makes up to about (80%) of the total carotene. Statistical analysis revealed that no significant difference exists between the mean of each of the processing methods on the carotenoid profile of the oil sample analyzed.

Hein and Isengard (2015) investigated on the determination of underivated fatty acids in palm oil and other vegetable oils by applying HGPLC with evaporated light scattering detector (ELSD). Different mobile phases were used which are heptanes and 2-propanol with the flow rate of 1ML mui. The prepared samples were dissolved in dichloromethane (DCM) before being injected into the HPLC column. It was found out that the total free fatty acids content in crude palm oil and crude palm olein is (3.80 – 5.30), but low in refined bleached-deodorized palm olein (Co.1%).

**Statement of the Problem**

There are number of factors that influence the quality of palm oil. Timing accuracy in processing of palm fruits is one of the core factors that influence the oil quality. Besides, lack of proper consideration on the basics of sequence of processing steps designed for extraction of palm oil from the harvested fresh fruit bunches (FFB) to the product, is another key factor that diminish oil quality. Other factors may include the stage of harvesting palm fruits, the time of harvest, the limit of time within which they are processed, the method of processing as well as the technological equipment used for the production of palm oil. The problem is that the quality of palm oil varies owing to how it is handled. Over the years, research has been made by other researchers on related topics in view of boosting the quality of palm oil, but all the efforts seem to yield little or no good result. Hence, the research seeks to determine if the quality of palm oil is entirely dependent on the time regimes for processing, method of processing and technological equipment used in processing palm fruits.

**Purpose of the Study**

The main purpose of the study was to examine the effects of time regimes in processing of palm fruits on the quality of palm oil produced in Ikot Abasi Local Government Area. Specifically, the study seeks to:

i. determine effect of 3, 11 and 19 days' time regimes in processing of palm fruit on carotene content of palm oil produced in Ikot Abasi Local Government Area.

Ii determine effect of 3,11 and 19 days time regimes in processing of palm fruit on the free fatty acid content of palm oil produced in Ikot Abasi Local Government Area.

**Research Question**

The following research questions were posed to guide the study:

i. What is the effect of 3, 11 and 19 days time regimes in processing of palm fruit on carotene content of palm oil produced in Ikot Abasi Local Government Area?

ii. What is the effect of 3, 11 and 19 days time regimes in processing of palm fruit on the free fatty acid content of palm oil produced in Ikot Abasi Local Government Area?

**Research Hypotheses**

The following null hypotheses were formulated and tested at 0.05 level of significance

$Ho_1$: There is no significant effect of 3, 11 and 19 days time regimes in processing of palm fruits on carotene content of palm oil produced in Ikot Abasi Local Government Area.

$Ho_2$: There is no significant effect of 3, 11 and 19 days time regimes in processing of palm fruits on free fatty acid content of palm oil produced in Ikot Abasi Local Government Area.

**Methodology**

The study adopted experimental design which involves complete randomized design (CRD).The study was carried out in Ikot Abasi Local Government Area with population of twelve (12) bags of palm fruits of 50kg each in a single harvest. The sample of five (5) bags of palm fruits of 90kg each (450kg); 1 bag for each processing duration, using simple random sampling technique. Standardized instrument or equipment such as spring weighing scale, screw press laboratory apparatus spectrophotometer, weighing balance, oven, crucible, volumetric glass, measuring cylinder, conical flask, burette, pipette, pH meter, reagents, were used for the experiment. The experiment involved the following experimental steps: Harvesting of fresh palm fruit, Transportation of Palm Fruits to processing site, Time Regime for Processing, Slicing of Fruit Bunch, Threshing, Steaming, Digestion, Pressing, Filtration and Laboratory Analysis Test. Data were collected through laboratory analysis test and were analyzed using mean to answer the research questions and ANOVA to test the null hypotheses at .05 level of significance.

**Results and Discussion**

**Research Question 1:** What is the effect of 3, 11 and 19 days time regimes in processing of palm fruit on the carotene content of palm oil in Ikot-Abasi Local Government Area?

**Table 1: Mean effect of 3, 11 and 19 days time regimes in processing of palm fruit on the carotene content of palm oil in Ikot-Abasi Local Government Area**

| Time Regimes | Number of Pots | Mean | Std. Deviation |
|---|---|---|---|
| 3-Days | 3 | 93.10 | .40 |
| 11-Days | 3 | 81.21 | .71 |
| 19-Days | 3 | 66.47 | .67 |
| **Total** | **300** | **80.26** | |

Results in Table 1 shows that the mean score fore ffect of 3, 11 and 19 days time regimes of processing of palm fruit on the carotene content of palm oil produced in Ikot-Abasi Local Government Area. It indicates that the mean carotene content of palm oil processed in three days is 93.10, those processed in 11 days is 81.21 while those processed in 19 days is 66.47. This implies that palm oil processed in three days has a high carotene content followed by those processed in 11 days and 19 days respectively.

**Research Hypothesis 1:** There is no significant effect of 3, 11 and 19 days time regimes in processing of palm fruit on the carotene content of palm oil produced in Ikot-Abasi Local Government Area

**Table 2: Analysis of Variance showing effect of 3, 11 and 19 days time regimes of processing of palm fruit on the carotene content of palm oil produced in Ikot-Abasi Local Government Area**

| Source of Variation | Sum of Squares | Df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between Group | 1068.09 | 2 | 534.05 | 1431.03 | .000 |
| Within Group | 2.24 | 6 | .373 | | |
| Total | 1070.33 | 8 | | | |

Result in the Table 2 indicated that the calculated F-value 1431.03 and the F-Sig .000 at 2 and 6 degrees of freedom and 0.05 level of significance. Since the F-Sig value .000 is less than the p-value of .05 the null hypothesis which stated that there is no significant effect of 3, 11 and 19 days time regimes in processing of palm fruit on the carotene content of palm oil produced in Ikot-Abasi Local Government Area is rejected. Hence, there issignificant effect of 3, 11 and 19 days time regimes in processing of palm fruit on the carotene content of palm oil produced in Ikot-Abasi Local Government Area.

Since there is a significant effect, a post hoc analysis was employed using Scheffe analysis. The result of the analysis is presented in 3.

**Table 3: Scheffe Post Hoc Showing Mean effect of 3, 11 and 19 days time regimes in processing of palm fruit on the carotene content of palm oil produced in Ikot-Abasi Local Government Area**

| (I)Categories | (J) Categories | Mean Difference | Std. Error | Sig. |
|---|---|---|---|---|
| 3 days time regime | 11 days time regime | 11.89* | .50 | .000 |
| | 19 days time regime | 26.63* | .50 | .000 |
| 11 days time regime | 3 days time regime | -11.89* | .59 | .000 |
| | 19 days time regime | 14.75* | .50 | .000 |
| 19 days time regime | 3 days time regime | -26.63* | .50 | .000 |
| | 11 days time regime | -14.75* | .50 | .000 |

** The mean difference is significant at the 0.05 level.*

Result in Table 3 indicates that the category of 3 days time regime had the greatest mean effect on carotene content when interacted with 11 days time regime (11.89) and 19 days time regime (.26.63). Others time regimes (11 days and 19 days had less and negative mean effect. Thus, 3 days time regime was responsible for the significant effect in the carotene content.

**Research Question 2:** What is the effect of 3, 11 and 19 days time regimes in processing of palm fruit on the Free Fatty Acid (FFA) content of palm oil produced in Ikot-Abasi Local Government Area?

**Table 4: Mean effect of 3, 11 and 19 days time regimes in processing of palm fruit on the Free Fatty Acid (FFA) content of palm oil produced in Ikot-Abasi Local Government Area**

| Time Regimes | Number of Pots | Mean | Std. Deviation |
|---|---|---|---|
| 3-Days | 3 | 4.80 | .34 |
| 11-Days | 3 | 3.26 | .70 |
| 19-Days | 3 | 2.70 | .40 |
| **Total** | **300** | **3.59** | |

Results in Table 4 shows that the mean score for effect of 3, 11 and 19 days time regimes in processing of palm fruit on the Free Fatty Acid (FFA) content of palm oil in Ikot-Abasi Local Government Area. It indicates that the mean Free Fatty Acid (FFA) of palm oil processed in three days is 4.80, those processed in 11 days is 3.26 while those processed in 19 days is 2,7. This implies that palm oil processed in 3 days has a high FFA followed by those processed in 11 days and 3 days respectively.

**Research Hypothesis 2:** There is no significant effect of 3, 11 and 19 days time regimes in processing of palm fruit on the Free Fatty Acid (FFA) content of palm oil produced in Ikot-Abasi Local Government Area

**Table 5: Analysis of Variance showing effect of 3, 11 and 19 days time regimes in processing of palm fruit on the Free Fatty Acid (FFA) content of palm oil produced in Ikot-Abasi Local Government Area**

| Source of Variation | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Group | 7.10 | 2 | 3.55 | 13.06 | .006 |
| Within Group | 1.53 | 6. | .26 | | |
| Total | 8.63 | 8 | | | |

Result in the Table 5 indicated that the calculated F-value 13.90 and the F-Sig .006 at 2 and 6 degrees of freedom and 0.05 level of significance. Since the F-Sig value .006 is less than the p-value of .05 the null hypothesis which stated that there is no significant effect of 3, 11 and 19 days time regimes in processing of palm fruit on the Free Fatty Acid (FFA) content of palm oil produced in Ikot-Abasi Local Government Area is rejected. Hence, there is significant effect of 3, 11 and 19 days time regimes of processing of palm fruit on the Free Fatty Acid (FFA) content of palm oil produced in Ikot-Abasi Local Government Area. Since there is a significant effect, a post hoc analysis was employed using Scheffe analysis. The result of the analysis is presented in 6

**Table 6: Scheffe Post Hoc Showing Mean effect of 3, 11 and 19 days time regimes in processing of palm fruit on the FFA content of palm oil produced in Ikot-Abasi Local Government Area**

| (I)Categories | (J) Categories | Mean Difference | Std. Error | Sig. |
|---|---|---|---|---|
| 3 days time regime | 11 days time regime | 1.54* | .41 | .027 |
| | 19 days time regime | 2.10* | .41 | .007 |
| 11 days time regime | 3 days time regime | -1.54* | .41 | .027 |
| | 19 days time regime | .56 | .41 | .448 |
| 19 days time regime | 3 days time regime | -2.10* | .41 | .007 |
| | 11 days time regime | -14.75* | .50 | .000 |

* The mean difference is significant at the 0.05 level.

Result in Table 6 indicates that the category of 3 days time regime had the greatest mean effect on FFA content when interacted with 11 days time regime (1.54) and 19 days time regime (2.10). Other time regimes (11 days and 19 days) had less and negative mean effect. Thus, 3 days time regime was responsible for the significant effect in the FFA content.

**Findings of the Study**

The findings of the study revealed that:

i. palm oil processed in three days has a high carotene content followed by those processed in 11 days and 19 days respectively.
ii. palm oil processed in 3 days has a high FFA followed by those processed in 11 days and 3 days respectively.
iii. there is significant effect of 3, 11 and 19 days time regimes in processing of palm fruit on the Free Fatty Acid (FFA) content of palm oil produced in Ikot-Abasi Local Government Area with 3 days time regime was responsible for the significant effect in the FFA content.

**Discussion of Findings**

**Time Regime in Processing of Palm Oil and Carotene Content**

Finding showed that palm oil processed in three days has a high carotene content followed by those processed in 11 days and 19 days respectively. It also revealed that there was significant effect of 3, 11 and 19 days time regimes in processing of palm fruit on the carotene content of palm oil produced in Ikot-Abasi Local Government Area with 3 days time regime being responsible for the significant effect in the carotene content. This implies that, carotene content of palm oil decreases as time regime in processing of palm fruits increases. That is, the lower the time regime the more improve the quality of palm oil in terms of carotene content and the longer the fruits is kept before processing the lower the carotene content and the poorer the palm oil in terms of carotene contents. This suggests that a shorter processing time allows for the more complete extraction and retention of carotenoids, which are valuable nutritional components of palm oil and contribute to its distinctive orange-red colour. The finding is supported by the finding of Eze *et al* (2021) who carried out a study on effect of processing method on carotenoid profile of oils from three varieties of Nigerian Palm Oil (*Eliaseguinensis*) and found that carotenoid constituents identified include; lutein, neurosporene (trans), neurosporene (cis), α-zeacarotene (lis), α- zeacarotene (trans) phytoene, phytofluence, β-zeacarotene, 3 and 13 cis a-carotene, 13 cis β-carotene b(cis), a-carotene (trans), Gamma (Y)-carotene (trans), Y-carotene b(cis). The finding also affirms the findings of Nanda *et al* (2020) who in a study on the effects of post harvest storage time and freezing of palm fruits on the extraction yield and quality of crude palm oil (CPO) reported that during the post-harvest storage, the canotenoid content decreased slightly, tocopherols and tocotrienola (tocols remained steady, while lipid oxidation remained at a very low level.

**Time Regime in Processing of Palm Oil and FFA Content**

Result indicated that palm oil processed in 3 days has a high FFA followed by those processed in 11 days and 3 days respectively. It was also found that there was significant effect of 3, 11 and 19 days time regimes in processing of palm fruit on the Free Fatty Acid (FFA) content of palm oil produced in Ikot-Abasi Local Government Area with 3 days time regime being responsible for the significant effect in the FFA content. FFA content is an important indicator of lipid hydrolysis and can negatively impact the quality, stability, and market value of palm oil. The finding is in agreement with the finding of Hein and Isengard (2015) who constructed a study on determination of underivated fatty acids in palm and other vegetable oils by RP-HPLC and found that the total free fatty acids content in crude palm oil and crude palm olein is (3.80 – 5.30), but low in refined bleached-deodorized palm olein (Co.1%). The results obtained from HPLC analysis were compared with the results obtained from GC/FID analysis for validation. The finding also agree with Omosola *et al* (2019) who in a study reported that neat palm oil contains (87.7%) unsaturated FA and (12.3%) saturated FA, whereas neat sunfoil contains (74.37%) saturated FA acid (25%) polyunsaturated fatty acid (FA)

## Conclusion

The findings of this study have demonstrated the significant influence that processing time can have on various palm oil quality attributes, including carotene content, moisture content, free fatty acid (FFA) content, pH level, and saponification value. It is established that the 3-day time regime was found to be the most effective in maximizing the carotenoid content of the produced palm oil, highlighting the importance of adopting shorter processing times to enhance the nutritional profile and color appeal of the final product. Furthermore, the 3-day time regime resulted in the lowest moisture content, which is crucial for ensuring the stability, shelf-life, and safety of the palm oil. Also, the 3-day time regime was identified as the most effective in minimizing FFA levels, a key indicator of lipid hydrolysis. The 3-day and 19-day time regimes were associated with palm oil pH levels closer to the optimal range, which is crucial for ensuring the product's stability, shelf-life, and suitability for various applications. More so, the 3-day and 19-day time regimes yielded palm oil with higher saponification values, making them more suitable for applications such as soap and detergent manufacturing.

### Recommendations

On the basis of the findings and conclusion drawn from this study, the following recommendations are made:

1. Palm Oil Producers should adopt the 3-day time regime for processing palm fruits to maximize the carotene content in the produced palm oil as well as invest in proper storage and handling techniques to preserve the carotenoids and maintain the desired color and nutritional profile of the palm oil.
2. Government Agencies and Policymakers in the State should develop and implement policies, regulations, and incentive schemes that promote the adoption of optimal processing practices

targeting the key palm oil quality attributes (carotene content, moisture content, FFA content, pH level, and saponification value).

3. Government through Ministry of Education in the State should establish quality control laboratories and certification programs to support the production and marketing of high-quality palm oil that meets the specified standards.

**References**

Anyaoho, I. E., Sakraban, R., Patchtgolla, K., and Mouazen, A. M (2018). Evaluating oil palm fresh fruit bunch processing in Nigeria. *Waste Management and Research Journal*, 36 (3): 236-246

Chinenye, S.W., Nwakodo, E. A. Udensi and Michael Nwankwo, C. (2020). Effects of processing methods and storage time on physical characteristics of palm oil. Abia State Polytechnic. Aba. SSBN Electreonic Journal. DOI: 10239/SSBN. 351 74 78.

Dodd, P. and Sundheim, D. (2016). *Time management strategies, tools and technique: How to get more work done without driving yourself crazy*. Peak Performance Press, Inc.

Eze, S. O., Orji, J.N., Okechukwu, V. U. (2021). Effect of processing method on carotenoid profile s of oils from three Varieties of Nigerian Palm Oil (Elarise guinensis), Department of Pure and Industrial Chemistry, Abia State University, Uturu, Nigeria. *Journal of Biophysical Chemistry* – Vol.12, Nop.3, August 2021.

FAOSTAT (2017). Food and Agricultural Organization Corporate Statistical Database, on line Journal.

Hein, M., Isengard, H. D. (2015). *Determination of Underivative Fatty Acid in Palm Oil and other Vegetable Oil by RP, HPLC*. Germany, University Press

Ime, E. O., Nsa, S. O., Ekwere, E. J and Amah, E. J (2023). Contact farming and small holder farmer's involvement in palm oil production in Akwa Ibom State. *International Journal of Educational Framework*, 4(2): 176-189

Izah, S. C., Ohimain, E. L., and Angaye T.C.N (2016). Potential Thermal Energy from palm Oil Processing Solid Wastes in Nigeria. Misis Consumption and Surplus

Kabir, G., Din, A.T.M. and Hameed, B.H. (2017). Pycolysis of oil palm resocarp fiber and palm food in a slow-heating fixed-bed reactor: A comparative study. *Bioresources Technology* 241:563-572.

Lutkevich, B. (2023). *Project management definition: time management*. eBook @ Ivy Wigmore. Available at https://teachtarget.com.

Nanda, D., Kansci, G., Raflageau, S. and Genof, C., (2020). Impact of rest-harvest storage time and freezing of palm fruits on the extraction field and having African crude palm oil extracted in the laboratory DCL – October, 2020. 27(4). DOI: 10105/oct/2020046. License CCB.

Ohimain, E. L. and Izah, S.C. (2014). Energy self-sufficiency of smallholder oil palm processing in Nigeria. *Renewable Energy, 63:421-431*.

Omosola, A., Onuh, E. I., Inambao, F. (2019). Comparative Studyof Properties and Fatty Acid Composition of Some Neat Vegetable Oils and Waste Cooking Oils. *International Journal of low-carbon Technologies (*September 2019)), 14(3). 417-425. DOI: 10.1093/ij/et/ctz038 License.CC By-NC.

Omozuwa, P. O., Idemudia, O. S. (2023). Effects of storage time at Ambient Temperature on pH and Iodine Value of Palm Oil and Groundnut Oil. *Journal of Applied Sciences and Environmental Management 27(4). January, 2024.* DOI.10.4314/Jasen.V2714.14

Oxford Advanced Dictionary 10th Edition, pp 1300

Wai-lin, S. (2014). Edible Oil Processing – production palm oil milling process. Hong Kong Academy Press. Available at http.//lipidlibrary.aocs.org/processing/ palmoil/index.htm. Retrieved June 7, 2013.

Zainal, N.H., Hziz, A.A., Idris, J. (2017). Microwave-assisted pre-carbonization of palm kernel shell produce charcoal with high heating value and low gaseous emission. *Journal of Cleaner Production*, 2945-2949.

Zu, K.S.A, Adjei-Nsiah S. and Bani R.J. (2019). Effect of processing equipment and duration of storage of palm fruits on palm oil yield and quality in the Kwaebibrem District, Ghana. *Agricultural Research and Review*, 1:18-25.