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Potentials of Soil on Palm Kernel Oil Free Fatty Acid

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Abstract*— Potentials of soil on Free Fatty Acid from Palm kernel Oil was conducted to correlate the soil physiochemical parameters and heavy metals to the free fatty acid of the palm kernel oil. Five samples of the soil were collected from Mbano and a sample of locally made palm kernel oil. The parameters analyzed were pH, temperature, organic matter, moisture, electrical conductivity, heavy Metals and free fatty acid of the oil. Results revealed : pH (5.57 ±0.49, 5.64 ± 0.36, 6.14 ±0.07, 5.95 ±0.16, 6.79±0.47), temperature (2.81 ±1.06, 28.0 ±0.83, 29.7 ±0.57, 29.7 ±0.64, 28.2 ±1.06), moisture (11.0 ±0.1, 18.0 ±0.2, 11.9 ±0.15, 12.9 ±0.25, 17.4 ±0.7), electrical conductivity (624 ±0.1, 541 ±0.2, 482.6 ±0.2, 477.0 ±0.1, 619.6 ±0.2) organic matter (77.7 ±0.15, 94.08 ±0.02, 48.6 ±0.25, 68.2 ±0.25, 38.8 ±0.15) Ca (0.644, 3.235, 1.453, 1.015, 1.673), Mg (1.467, 0.892, 1.483, 1.687, 1.147), K (2.017, 3.0054, 2.013, 1.0028, 2.067), Pb (0.036, 0.017, 0.015, 0.00, 0.0017), Fe (0.416, 0.826, 0.318, 0.316, 0.544), Na (0.656, 1.450, 0.908, 1.751, 1.956) cation exchange capacity (4.78, 8.58, 5.83, 5.45, 6.84) and free fatty acid (2.7 ±0.15, 4.3 ±0.15, 6.1 ±0.1,7.6 ±0.15,11.4 ±0.2). There was a strong positive correlation between the free fatty acid of palm kernel oil and soil sodium concentration. The study revealed that quality of the soil has a relationship with the free fatty acid of the palm oil.

***Keyword*— PKO, Potentials, freefatty, Acid, soil**

I. INTRODUCTION

Palm Kernel Oil is a triglyceride typically unctuous, viscous, combustible, liquid at ordinary temperatures, and soluble in ether or alcohol but not in water [1,2].

The triesters of fatty acids with glycerol (1,2,3-trihydroxypropane) compose the class of lipids known as fats and oils. These triglycerides (or triacyglycerols) are found in both plants and animals, and compose one of the major food groups of our diet. Triglycerides that are solid or semi-solid at room temperature are classified as fats and oils, and occur predominantly in animals [3]. Those triglycerides that are liquid are called oils and originate chiefly in plants. Fats have a predominance of saturated fatty acids, and oils are composed largely of unsaturated acids [4].

Soil is the mixture of minerals, organic matter, gases, liquids and countless organisms that together support life on earth [5]. Soil is the mixture of minerals, organic matter, gases, liquids, and the countless organisms that together support life on earth. [6] Soil is a natural body known as the pedosphere and which performs four important functions: it is a medium for plant growth; it is a means of water storage, supply and purification; it is a modifier of the atmosphere of earth: it is a habitat for organisms all of which, in turn, modify the soil [7,8]. Soil is considered to be the "skin of the earth" and interfaces with its lithosphere and biosphere· Soil is consists of a solid phase (minerals and organic matter) as well as a porous phase that holds gases and water ·It is often treated as a three state system [9,10].

The chemistry of a soil determines its ability to supply available plant nutrients and affects its physical properties and the health of its microbial population [11].

The aim of the research was to correlate the physiochemical parameters and heavy metals in soil to free fatty acid in palm kernel oil in other to determine the trend To achieve this aim specific objectives were to determine the physiochemical parameters of soil and oil, determine the some heavy metals content in soil and determine the relationship between physicochemical parameters and metals in soil and free fatty acid in palm kernel oil.

II. MATERIALS AND METHOD

2.1 Sampling Sites

Sampling sites were selected to reflect spatial variability and quality of the soil associated with sampling zone. The locations includes- Anara – Sample A, Obollo –Sample B, Amauzari – Sample C. Osuachara - Sample D, Oka – Sample E

2.2 Sampling and Pretreatment

Twenty five samples were collected from the five different sites. At each site a **W** shaped line was drawn on a 2×2m surface along which five samples were collected from each 0f the top soil area and mixed homogeneously to form one sample [12, 13]. The soil samples were taken from 0-15cm depth. The soil samples were five samples in number and stored in a polyethene bag and taken to Imo State University laboratory for analysis.

2.3 Visual Classification

The colour was determined with the naked eyes and a standard munsell colour chart. The soil sample was placed on a paper to detect the moisture effect. This was determined using a soil textural triangle. Texture Group was determined by felling the soil sample by hand while Odour was was determined by smelling the sample. Evidence of Contamination was assessed when The soil sample was placed on a white cloth, which it stained [14,15,16].

2.4 Quality assurance, Chemicals and reagent

All instrument used in this work were in good working condition and were used according to manufacturer's instructions. Aqua-Regia, Hydrochloric acid (HCl), Nitric acid (HNO3), Ethanol,Sodium hydroxide (NaOH) (0.1N), Phenolphthalein indicator, Potassium Chloride (KCl), Distilled water

2.5 Determination of Physicochemical properties

50g of soil sample was weighed and poured into an empty, clean quart jar. Water was added in the quart jar and left overnight. The sand, silt, and clay was examined and the soil texture was determined using a soil textural triangle [17].

Reaction With Hydrochloric Acid was done as follows: 10ml 0f Hydrochloric Acid and 30ml of Distilled water was measured. Dilute the Hydochloric Acid by pouring it into distilled water. 5g of of soil sample was weighed. Place each sample on a filter paper; the Hydrochloric Acid was gradually poured on the soil sample to examine the reaction. The P^{H} values of the soil samples were determined using a Jenway 3510 PH meter. The pH was determined by dipping the electrode into a 2:1 soil/water mixture that had been stirred and allowed to equilibrate for about one hour. The pH meter was calibrated with pH 7.0 and pH 4.0 buffer before use. Electrical conductivity was determined using Hanna (HI 8733).Half of a cup of the dried soil was measured and poured into a beaker, half of a cup of distilled water was added into the beaker and the mixture was stirred gently for 30 seconds. The soil - water suspension was allowed to stand for 30minutes and stirred again [18, 19, 20].

The probe of the Electrical conductivity was inserted into the soil solution and swirled gently in the soil – water extract .Conductivity was determined after about 30 – 60 seconds when the Electrical conductivity meter has stabilized [21]·The Electrical conductivity meter was calibrated with potassium chloride solution before use.

The temperature of the soil sample was determined using a Gardener soil thermometer. The soil sample was poured into a quart jar and the thermometer bulb was inserted into a 3cm depth of the soil inside the quart jar [22].

An Oven (Drier Box DHG-9053) was use in drying the soil sample.10g of the soil sample was weighed into a porcelain dish and dried in the oven for 24 hours at 106^{O}C. The dry sample was reweighed to determine how much water was lost.

The organic matter of the soil sample was determined by recording the mass of an empty, clean and dry porcelain dish (MP). The entire oven – dried test specimen from the moisture content experiment was placed in the porcelain dish and the mass recorded (MPDS). The dish was placed in a muffle furnance at 248ºC and left in the furnance overnight. The porcelain dish was removed using the tongs and alow to cool to room temperature .The mass of the dish containing the ash (burned soil) was recorded [23,24].

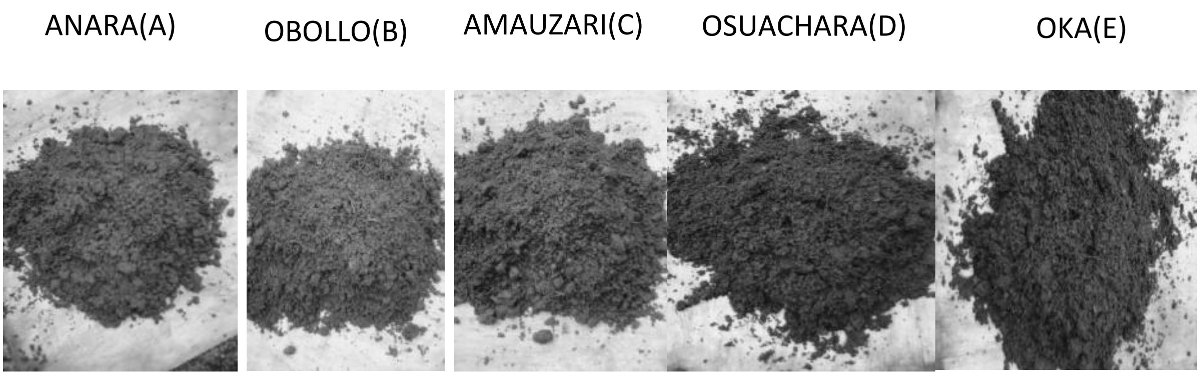
2.6 Determination Of Heavy Metals

The heavy metals was determined using Atomic Absorption Spectrometer(VARIAN AA 240). 1g of the soil sample was weighed into a test tube and digested with 24ml of Aqua Regia then left for two days. The mixture was filtered and the filtrate was poured into a sampling container, then analyzed in the Atomic Absorption Spectometer [25].

2.7 Sampling and Analysis of Palm Oil

Sampling Sites

Three oil samples were bought from Orie Amaraku. The oil was checked for adulteration.



Figs 1. : Photos of soil samples on paper

2.7.1 Physiochemical Parameters of oil

2.7.2 Determination of Free Fatty Acid

5g of palm kernel oil was measured into a clean dry conical flask and make up to 100 cm3 of ethanol, and then heat on water bath till boiling. 2 -3 drops of phenolphthalein was added and the mixture was mixed properly. Titrate with 0.1 m NaoH, shake vigorously till the appearance of a pink colour, which persist for at least 30 seconds. Measure the volume of sodium hydroxide titrant [26, 27].

2.7.3 Determination of Moisture Content

The moisture content was determined using oven (drier box dhg -9053). 10g of palm kernel oil was weighed and poured into a known weight of an empty beaker. The oil in the beaker was kept in an oven for 6 hours and maintained at a temperature of $105^{O}C$, allowed to cool and reweighed to a constant weight [28].

Table 1: Visual Characteristics of soil samples from Mbano

Classification	**AnaraA)**	**Obollo (B)**	**Amauzari(C)**	**Osuachara (D)**	**Oka(E)**
Colour	Brown	Dark brown	Brown	Brown	Black
Moisture description	Moist	Moist	Moist	Moist	Moist
Texture group	Medium	Medium	Medium	Medium	Medium
Texture class	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Odour	Organic	Organic	Organic	Organic	Organic
Evidence of contamination	Staining	Staining	Staining	Staining	Staining
Other comment	Presence of living organism and debris	Presence of living organism and debris	Presence of living organism and debris	Presence of living organism and debris	Presence of living organism and debris

2.7.3 Determination of Viscosity

The viscosity of the oil was determined using a Rotary viscometer Test method. The oil was placed in a beaker, housed in an insulated block at a fixed temperature. A metal spindle is then rotated in the oil at a fixed rpm, and the torque required to rotate the spindle is measured [29].

2.7.4 Determination of pH

The pH value of the oil was determined using a Jenway 3510 pH meter. The oil was poured into a 200ml beaker; the pH electrode was dipped into the oil. The pH meter was calibrated with pH 7.0 and 4.0 buffer before use [30].

III. RESULTS AND DISCUSSION

The results of the visual characteristics, physiochemical parameters, heavy metals of the soil were summarize in table 3.1, 3.2, and 3.3

3.1 Visual Characteristics

In table1, sample A,B,C,D has a Dark Brown, Brown colour and sample E a Black colour which indicates the presence of organic matter and decaying vegetation which make the soil sample fertile and stores plant nutrients.The texture class and group which is a medium sandy loam soil and has organic odour because of the presence of organic matter in it [31,32].

3.2 Physiochemical Parameters

From graph 1 in figure 2: There is a strong positive correlation between the free fatty acid of palm kernel oil and the pH, (R =0.9466) and (R^2= 0.8961) .As the pH increases the free fatty acid increases , the relationship between the variable is strong. From graph 2 in figure 3, There is a positive correlation between the free fatty acid of palm kernel oil and the temperature, (R =0.1776) and (R^2=0.0315), but the relationship between the variables is weak. The temperature don't have much effect on the free fatty acid. From graph 3 in figure 4: A positive correlation exist between the free fatty acid of palm kernel oil and the moisture content,(R= 0.4391) and (R^2=0.1928), the relationship between the variables is weak. The moisture content has little effect on the free fatty acid. From graph 4 in figure 5: There is a positive correlation between the free fatty acid of palm kernel oil and the Electrical conductivity, but has a weak relationship. (R=0.0261) and (R^2=0.0007).Electrical conductivity has little effect on the free fatty acid .

Table 2: Physiochemical parameters and OM

SAMPLES	Texture	pH	Temp (^OC)	Moist (%)	EC (μS)	RXN with HCl	OM (%)
Anara (A)	Sandy	5.57 ±0.49	28.1 ± 1.06	11.0 ± 0.1	624± 0.1	Strong	77.7±0.15
Obollo (B)	Sandy	5.64 ± 0.36	28.0 ± 0.83	18.0 ± 0.2	541.5 ± 0.2	S.strong	94.08±0.02
Amauzari (C)	Sandy	6.14 ±0.07	29.7 ± 0.57	11.9 ±0.15	482.6 ±0.2	S.strong	48.6±0.25
Osuachara (D)	Sandy	5.95 ±0.16	29.7 ±0.64	12.9 ±0.25	477.0 ±0.1	Strong	68.2±0.25
Oka (E)	Sandy	6.79 ±0.47	28.2 ±1.06	17.4 ±0.7	619.6 ±0.2	Strong	38.8±0.15

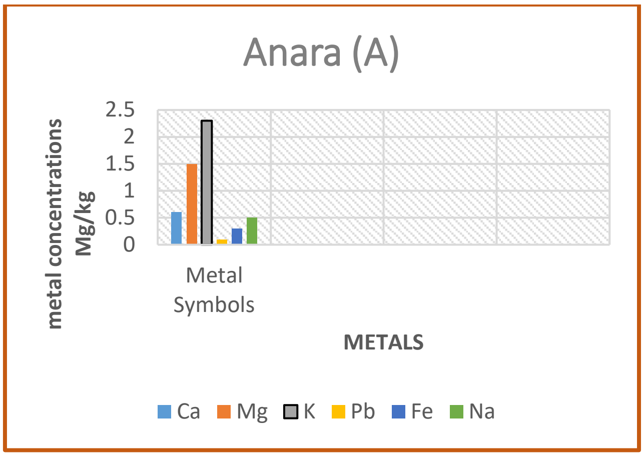
From graph 5 in figure 6: This has a moderate negative correlation between the free fatty acid of palm kernel oil and the organic matter,(R =-0.6379) and (R^2=0.4069) which means that as the free fatty acid increases the organic matter decrease or as the organic matter increases the free fatty acid decreases. Organic matter has an opposite effect on the free fatty acid [33, 34, 35, 36, 37].

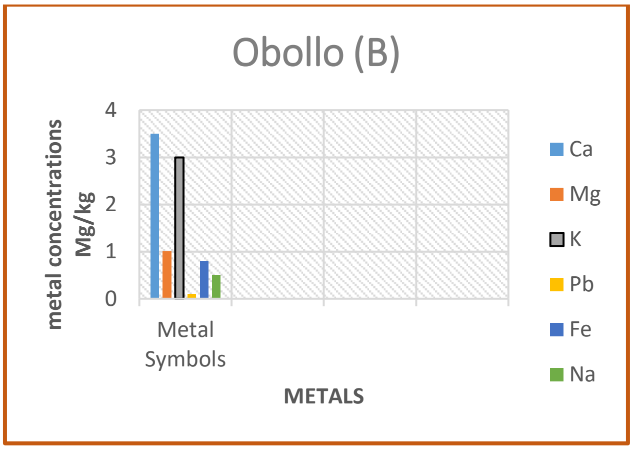
3.3 Heavy Metals in Soil

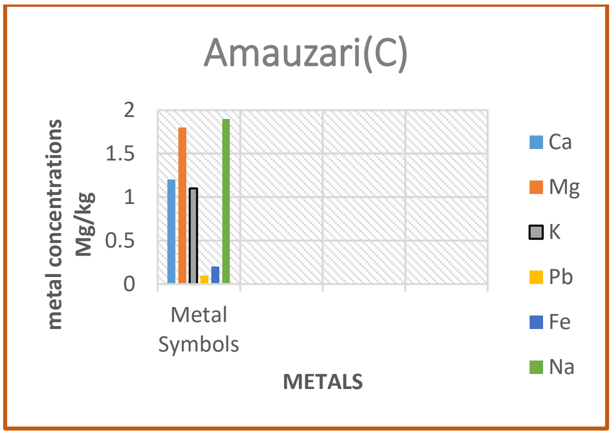
From graph 6 in figure 7: There is a positive correlation coefficient between the free fatty acid of palm kernel oil and the cation exchange capacity, (R=0.09) and (R^2 =0.0081). It has a weak relationship. The cation exchange capacity has little effect on the free fatty acid .From graph 7 in figure 8: There is a negative correlation between the free fatty acid of palm kernel oil and calcium, (R= -0.0139) and (R^2= 0.0002). It has a weak relationship. Calcium has little effect on free fatty acid. From graph 8 in figure 9: A negative correlation exist between the free fatty acid of palm kernel oil and magnesium(R=-0.0316) and (R^2 = 0.001).It has a weak relationship. Magnesium has a little effect on the free fatty acid. From graph 9 in figure 10: A negative correlation exist between the free fatty acid of palm kernel oil and potassium,(R =-0.3217) and (R^2 =0.1035). It has a weak relationship. Potassium has a little effect on the free fatty acid. From graph 10 in figure 11: A moderate negative correlation exist between the free fatty acid of palm kernel oil and lead, (R=-0.7325) and (R^2= 0.5366).As free fatty acid increases it goes with a decrease in lead, or as lead increases the free fatty acid decreases. From graph 11 in figure 12: There is a negative correlation between the free fatty acid of palm kernel oil and iron,(R=-0.1503) and (R^2= 0.0226).it has a weak relationship. iron has a little effect on the free fatty acid. From graph 12 in figure 13: There is a strong positive correlation between the free fatty acid of palm kernel oil and sodium, (R=0.8119) and (R^2= 0.6592).This means as the sodium increases it goes with an increase in the free fatty acid and as the free fatty acid increase it goes with an increase in sodium [37,38,39].

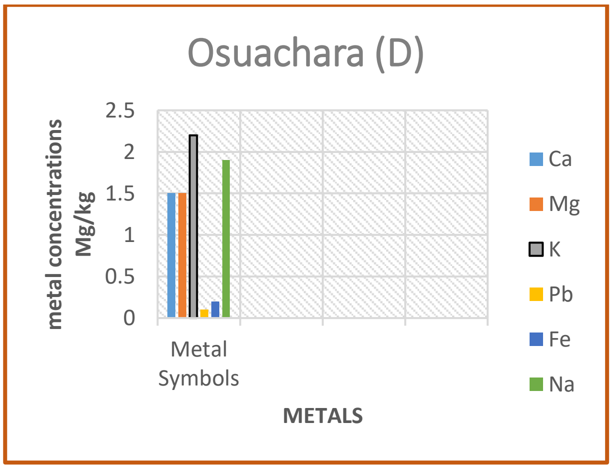
Table 3: Mean Heavy Metals concentrations (mg/kg) of soils at various locations

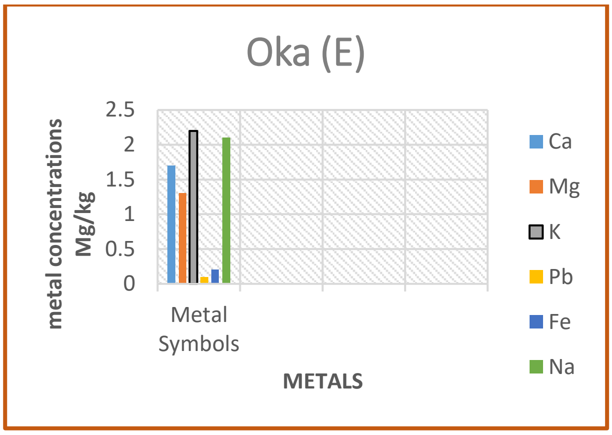
SAMPLES	Ca	Mg	K	Pb	Fe	Na	CEC
ANARA (A)	0.644	1.467	2.017	0.036	0.416	0.656	4.78
OBOLLO(B)	3.235	0.892	3.0054	0.017	0.826	1.450	8.58
AMAUZARI (C)	1.453	1.483	2.013	0.015	0.318	0.908	5.83
OSUACHARA (D)	1.015	1.687	1.0028	0.00	0.136	1.751	5.45
OKA (E)	1.673	1.147	2.067	0.017	0.544	1.956	6.84



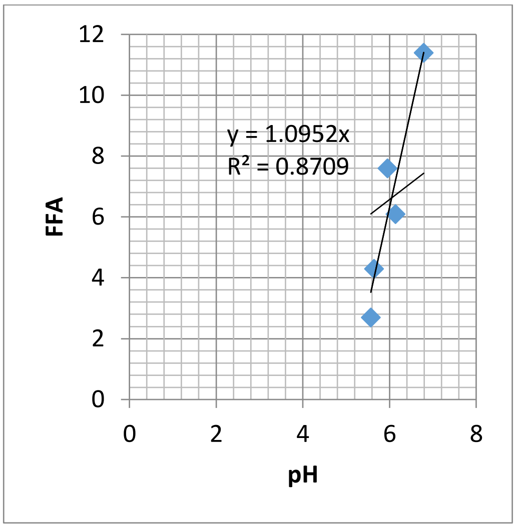


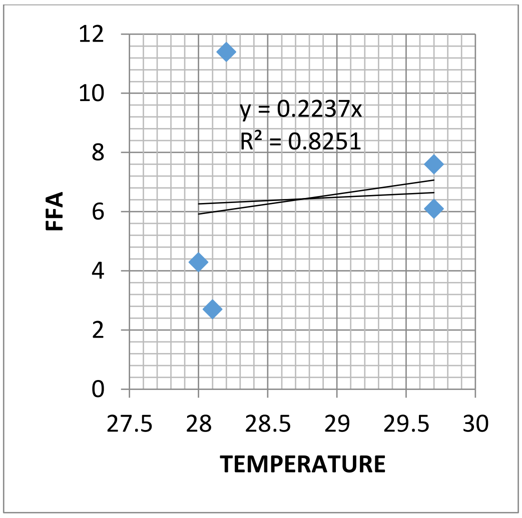


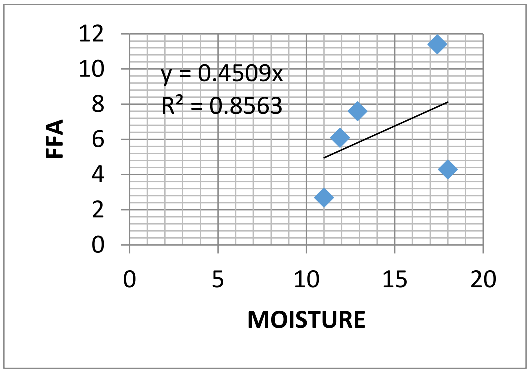


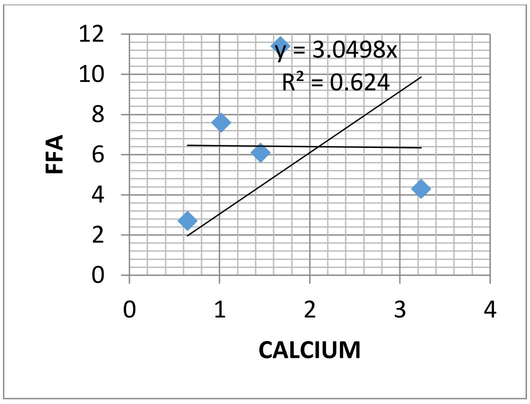


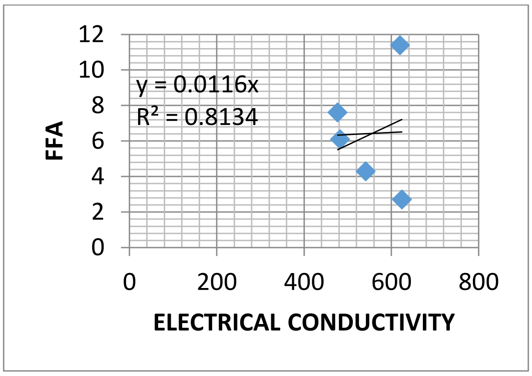
3.4 Correlation of physiochemical parameters in soil to free fatty acid in oil

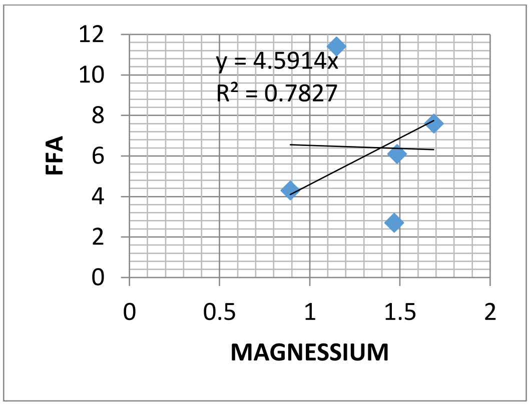


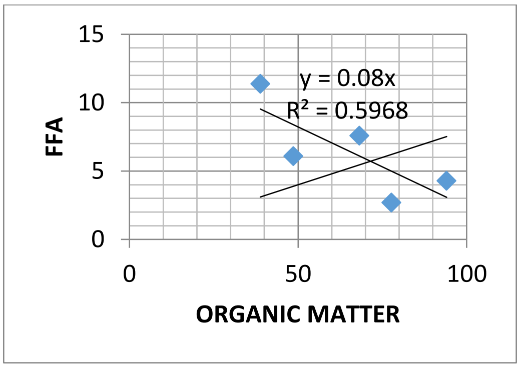


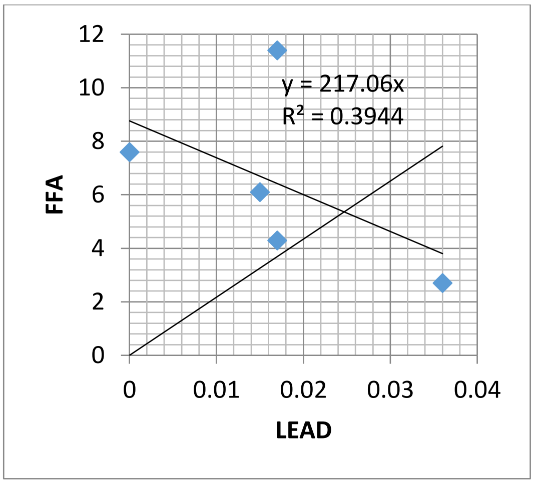












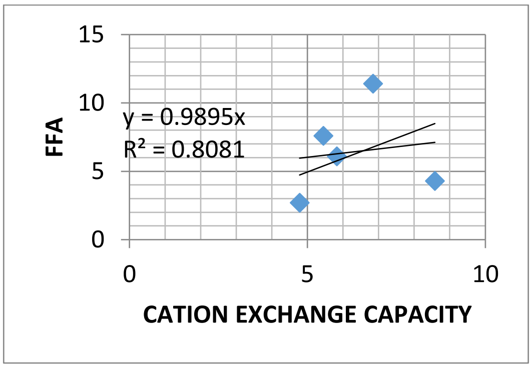
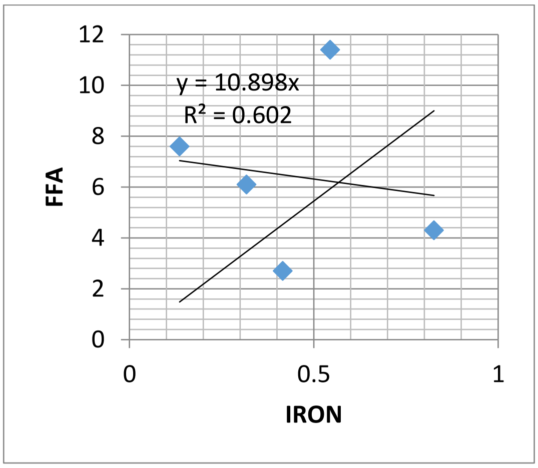


Fig.6- 12: Correlation of physiochemical parameters of soil and free fatty acid in oil



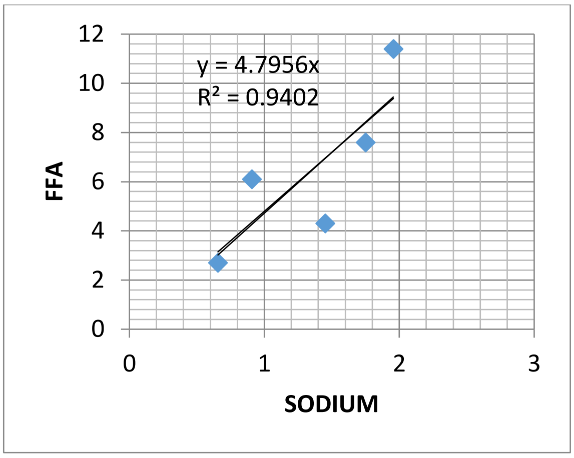


Fig 13-16: Correlation of metals in soil and free fatty acid in oil

3.5 Physiochemical parameters of oil

The pH (5.28 ± 0.01) is indicative of the presence of fatty acids in the oil, which is a good indicator of the advantageous utilization of the oil as a result of the presence of free fatty acids [40].

IV. CONCLUSION

The physiochemical parameters and heavy metals of the soil showed a positive and negative correlation with the free fatty acid of the palm oil. Therefore soil quality have an effect on the free fatty acid of the oil. However there was no defined trend of the relationship between soil and oil properties.

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