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IDENTIFICATION AND EXTRACTION OF BIO DIESEL FROM MICRO ALGAE

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ABSTRACT
This study was carried out to identify species of algae that can produce bio diesel considering the physico chemical parameters that favour the growth of these algae. Water samples were taken from five (5) different locations to assess the physic-chemical parameters, micro algae productive capacity of the water in terms of their quantity. The most productive out of these stations were sampled for micro algae for extraction of bio diesel. The micro algae identified were *Neoclanis oleoabundans, Scenedesmus dimorphus, Dunaliella tertialecta, Chlamidomonas, Mallomna spp, Anabena, Richteriella, Chlorella.* The physic chemical parameters measured were hardness, alkalinity, pH and conductivity and all fell within the tolerable limit. The water body that produce more algae were KP1, KP2 and FAFP. The quantity of bio diesel extracted from the micro algae was 27.92g.

KEYWORDS: micro algae, physic chemical parameters, bio diesel

INTRODUCTION
The global economy literally runs on energy, the economic growth combined with the rising population has led to a steady rise or increase in the global energy demands. If the world government will stick to the current global policies on energy, then the world will be needing almost 60% more energy in 2030 than our present day, of this, 60% and 45% will be accounted for by China and India alone (International Energy Agency Publication: Paris, France 2007).

Transportation is one of the fastest growing sectors of our economy using about 27% of the primary energy (Antoni, *et. al.* 2007). The continued use of fossil fuel is not sustainable, as they are finite or limited resources and their combustion will eventually lead to increase energy related emissions of Green House Gases (GHG) viz Carbon dioxide (CO_2), Nitrogen Oxide (NO_2) etc (Srivastava A. *et al.* 2000).

The future reduction in the emission of this gases or in the ecological footprint of energy generation will reside or rest in a multi – faceted approach that includes nuclear, solar, wind, hydrogen, fossil fuel and bio fuels. Bio-fuel can be broadly defined as solid, liquid or gas fuel consisting of or derived from biomass. Rudolph Diesel first demonstrated the use of bio-diesel from a variety of crops in 1990. However the widespread availability of cheap petroleum during the 20th century determined otherwise, generally shifting society dependence away from petroleum to renewable biomass will contribute to the development of sustainable industrial society and effective management of GHG (Demirbas and Deinirbas 2007).

The major criticism often levelled against biomass, partially against large scale fuel production are that it will consume vast swaths of farmlands and native habitat, drive up food prices and results in little reduction in GHG emission (Pacala, 2004 and Socolow, 2004). However, this so called *"food versus fuel"* controversy appears to have been exaggerated in many cases. Credible studies show that, with plausible technology developments, biofuels could supply some 30% of global demand in an environmentally friendly manner without affecting food production.

To tackle the problem of food scarcity due to the use of food crops like sugarcane, sugar beet, maize (corn), sorghum wheat etc in fuel production, other alternative sources of energy is being developed. These new developments in biofuel production are what is referred to as *"second generation biofuels"*, which are derived from non – food feedstuff. They are extracted from microalgae and other microbial sources, Lingo – cellular biomass, rice straws etc.

Microalgae are name used in describing all the relevant algal-groups. All algae are essentially aquatic and are widely distributed in our water bodies. (Marine; freshwater; estuaries), few are able to survive on moist soils or on organic materials. In size, algae range from microscopic single celled organisms to giant kelps, seaweeds in which their thallus may reach lengths of over 200ft. Most algae contain chlorophyll, but many of them do not appear green because they are masked by other pigment. The colours of algae are based on the pigment it contains. Below are types of algae based on their colouration.

i. Green algae (Chlorophyceae)
ii. Blue green algae (Cyanophyceae) e.g. Anabena
iii. Red algae (Rhodophyceae)
iv. Yellow algae (Xanthophyceae)
v. Brown algae (Crysophyceae) etc

Therefore, this work was carried out to identify oil producing micro algae species and extraction of oil for bio diesel production. It also determines the physic-chemical parameters of the water that encourages the growth of the algae.

METHODOLOGY

Water samples were taken from five different locations in Minna environ viz: Bosso dam, Ponds in F.U.T. Minna, Bosso drainage channel and stagnated water body in kpagungu in order to quantify the most productive in terms of algae among these water sources. The water bodies sampled were:

Shango Stagnant Water 1 (SH1)
Abandon Bosso Dam Station 1 (ABD1)
Kpakungu Stagnant Water Station 1 (KP1)
FUT Drainage Station 1 (FUT1)
FUT Abandon Fish Pond (FAFP)

Water samples were taken from each of these different locations for analysis and the following were determined from the samples.

Physico-chemical parameters like hardness and alkalinity of these water sources were determined using the method of APHA, 1995. pH and conductivity were determined with pH and conductivity meter respectively.

Identification and Counting

The algae harvested with phytoplankton net from these different locations were fixed from the field and transported to the laboratory. Identification and counting of the different species were done with the aid of electron microscope and counting chamber.

Extraction of oil

50litres of water containing algae was concentrated to 20litres by decantation and later micro filtered to wet biomass which was weighed. This was converted to dry matter by oven dried at $60^{o}C$ for 5hours and weighed.
The dry matter was milled with pestle and mortal to rupture the cell for easy extraction and oil was extracted from this using soxhlet extractor using hexane as the solvent. The oil was recovered from the mixture of oil and hexane through heating and vapourization.

Percentage moisture was determined by using formula:

$$\frac{W1-W2}{W1} \times 100$$

Where W1 = weight of the wet matter and
W2 = weight of the dry matter.

Percentage oil extraction was determined by using formula:

$$\% \text{ oil } (x) = \frac{(w_2 - w_1) - (w_3 - w_1) \times 100}{(w_2 - w_1)}$$

Where
W_1 = weight of thimble or paper
W_2 = weight of thimble or paper + sample before drying
W_3 = weight of thimble or paper + sample after drying

RESULTS AND DISCUSSION

Table 1: Physico-chemical parameters of the water bodies sampled

Water Bodies/Station	Hardness (Mg/L)	Alkalinity (Mg/L)	Conductivity	pH
SH1	11.65	24.50	972	7.50
SH2	10.00	18.20	529	7.38
ABD1	2.85	2.60	64	8.25
ABD2	0.95	1.50	30	7.90
KP1	8.20	9.80	440	7.88
KP2	6.55	7.35	230	7.25
FUT1	5.35	7.20	40	8.15
FUT2	6.55	6.50	50	8.33
FAFP	4.30	6.30	30	8.10

Table 2: ALGAE IDENTIFICAL AND CLASSIFICATION

The following algae were identified and classified from the water samples through the electron microscope.

ALGAE	CLASSIFICATION	LIFE FORM
Spirogyra	Chlorophyceave	Filamenteous
Neoclanis oleoabundans		Microalga
Scenedesmus dimorphus	Chlorophyceave	Unicellular
Dunaliella tertialecta	Chlorophyceave	Unicellular
Chlamidomonas		
Mallomna spp		
Anabena	Chlorophyceave	Filamenteous
Richteriella		
Chlorella		

COUNTING/POPULATION ESTIMATION

Table 3: breakdown of the algae species of the highest algal biomass concentration of FAFP and KP1 & 2 which were the most productive ones out of the water bodies and stations

S/N	Algae species	KP 1	KP2	FAFP
1	*Scenedesmus*	22	18	34
2	*Chlorolla*	7	6	24
3	*Chlymaodomonal*	3	1	5
4	*Spirogyra*	30	25	11
5	*Dunaliella*	10	6	16
6	*Deoclarias*	2	2	11
7	*Anabaena*	11	10	13
8	*Richteriella*	4	1	3
9	*Mallomus*	4	3	10

HARVESTED ALGAE BIOMASS

The biomass of algae is made up of many species of algae:

* Using phytoplankton net 50 litre of the biomass was harvested
* The 50 litre harvest was concentrated to 20 litres by decantation
* Filtration with micro screen material gave us wet residue (wet algal) biomass which is weighted to give 1.64kg.
* When oven dried a weight (dry weight) of 250.46g

Moisture content of the algae biomass
Wt of wet biomass – dry wt
= 1.64 – 0.25046(kg)
= 1.3895kg

% moisture = $\frac{\text{Wt of } H_2O \text{ loss x 100}}{\text{Wt of wet biomass}}$

= $\frac{1.3895 \times 100}{1.64}$

= 84.725
= 85% moisture

The water or moisture content in algal biomass is so much and such needs to be well dried before milling.

OIL EXTRACTION

Table 4: The 250.46g milled dry algal biomass weighted in to 10 (ten) parts with each part extracted as a trial (T_O) below are the data detailing the extractions.

Extractions (T_O)	*Wt of timbale/ paper (W_1)*	*Wt of timbale/ paper + sample before extraction (W_2)*	*Wt of timbale/ paper + sample after extraction (W_3)*	*Percentage of lipid extracted*
T_1	2.72	24.54	23.18	3.48
T_2	2.62	22.10	21.28	2.16
T_3	1.80	27.15	25.06	5.88
T_4	1.80	30.15	28.64	3.21
T_5	1.80	30.05	28.91	1.91
T_6	1.90	30.10	29.35	1.95
T_7	2.72	24.60	23.81	1.78
T_8	1.90	32.35	31.31	1.77
T_9	1.88	28.70	27.61	2.24
T_{10}	1.84	20.50	19.24	3.54
% Lipid(x) = $\frac{(w_2 - w_1) - (w_3 - w_1) \times 100}{(w_2 - w_1)}$				27.92

Where
W_1 = weight of thimble or paper
W_2 = weight of thimble or paper + sample before drying
W_3 = weight of thimble or paper + sample after drying
(% bio diesel) = 27.92g

Weight of extract

= $\frac{\text{(\% bio diesel) x wt of dry mater}}{100}$

= $\frac{27.92 \times 250.46}{100}$

= 69.93g

Weight of Residue
Wt of dry matter – wt of bio diesel
= 250.46 – 69.93
= 180.53g

DISCUSSION AND CONCLUSION

The physic-chemical parameters of the sampled water measured all fell within tolerable limit but the most productive in terms of algae production were KP1, KP2 and FAFP. SH1, SH2, KP1 and KP2 had high conductivity which could be attributed to the high level of dissolved mineral in them. This agrees with the findings of Kolo and Oladimeji, (2004)

The bio-diesel extracted from the micro algae was of good quality but the quantity (27.92g) was not much which could be attributed to the harvesting of many different oil strain algae and temperature used in dry the wet algal biomass to dry algal biomass was between 65 – 75^{0}C this is very low compared to the over 300^{O}C and above required, the higher the temperature use in the drying the more the extent of moistures removal and the increase in the oil yields.
It can be concluded that these water bodies favours the growth of micro algae because of the favourable physic-chemical parameters.

It was also discovered that bio diesel could be extracted from these micro algae.

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