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Experimental Study of Native Macro Algae Species Identification for Open Water farming for Biofuel Plant Energy Feed stock

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Algae are organisms that grow in aquatic environments that use the light and carbon dioxide (CO2) to create biomass. Macro algae are larger algae that can grow in a variety of ways. Algae can be explored for a variety of other uses such as biofuels, fertilizer and pollution control. In addition, algae can also be used for reducing the emissions of CO2 from power plants. CO2 produced by the power plant could be utilized as a carbon source for algal growth, and the carbon emissions would be reduced by recycling waste CO2 from power plants into clean-burning biodiesel.

Key word: Algae, Energy sources, Biodiesel.

Biomass production from macro algae has been viewed as important mainly because of the need for pollution abatement and energy source. Environmental considerations will increasingly determine use of macro algae product and improve process acceptability that drive the next generation of economic opportunity. Some countries including Japan are actively promoting a macro algae 'green' technology that is many growing demand worldwide in the coming decades. In this context, biomass refer to any source of heat energy that is produced from non-fossils biological materials. Unlike fossil fuels, biomass is a renewable energy resource that is available where the climatic conditions are favorable for plant growth and production. Biomass is considered as an attractive alternative to fossil fuels as a source of energy. Different macro algae survive in different habitat. This paper describe qualitative and quantitative experimental analysis of the types of macro algae which are suitable cultivation in Malaysia water. This approach would identify the oceanic parameters that are most suitable for the macro algae and conduct species matching.

Background and Issues with Biofuel Energy Source

The use of algae include food production of useful compounds for food supplement, as bio filters to remove nutrients and other pollutant from wastewaters, to record water quality, as indicators of environmental change, in space technology, and as laboratory research systems. Algae can also be use to make biodiesel and biobutanol can produces vastly superior amounts of vegetable oil, it is prefer to compared terrestrial crops grown for same

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purpose. It also can be used to produce hydrogen. Marine macro algae are receiving increasing attention as an attractive renewable source for producing fuels and chemicals. Marine biomass energy sources although heavily subsidy as renewable energy sources. Macro algae species are very abundant in earth and they have high caloric energy value compare to other biomass sources. In addition to this, the biomass can also be used for carbon capture. The carbon capture is an approach to mitigate the global warming by capturing the carbon dioxide from the large point sources such as fossil fuel power plants and storing it instead of releasing it into atmosphere like technology for large scale capture of CO2 is already commercially available and fairly well developed.

There are several problems associated with the energy use in this country. First of all, there is required most to overcome the oil shortage problem. The reservoirs are about 2000 billion tones where as the daily is using about 71.7 million tones. It is estimates that about 1000 billion tones of oil is used and only have 1000 billion tones oil proven reserved in the whole world. (Asifa and Muneer). Besides, there is need to reduce the impact of global warming and climate change. The increasing of greenhouse gas emission such as carbon dioxide caused bad impact to the country. Based on estimation in 2000, more than 20 metric tonne of carbon dioxide was release to the atmosphere every year (Saxena*et al*, 2001). The macro algae cultivation can be reduces the released of greenhouse gas from the energy. Applied of macro algae as the marine biomass energy sources, the net emission of carbon into atmosphere through carbon capture may reduce. The economy of all of the countries depends on the guaranty of energy sources. The energy security involves ready energy which is produced in variety ways with the affordable prices. Malaysia needs to improve the energy security accordingly in order to put the country in good environmental friendly positioning.

Concerning current issues about the oil shortage and pollution caused by oil exploration, the contribution of this study is significant to expand the development of biomass species that are environmentally friendly in order to meet the oil demand. This study focuses on matching the macro algae species with the habitat in Malaysia water and identified the most suitable types of macro algae that can be for marine biomass energy source.

MATERIALAND METHODS

This work identify biomass species that can be grow in Malaysia water and to estimate the caloric energy value among carbon dioxide capture. The work access the species of biomass in Malaysia and geographical location of where to find the macro algae species. The assessment is conducted by analyzing the sea water in certain habitat of seaweed in Malaysia. Based on the assessment, quantification of the amount of caloric energy value of biomass species and the amount of net emission carbon and carbon sink of biomass species is carried out.

The study focused on element which is sea water analysis, energy value and carbon sink test for power and emission from biomass species.

i. Sea water analysis: The water analysis was involved mapping the biomass species and identifies the location of their growth. Water samples were collected during the same month from different location that is BidongIsland, Setiu Wetland and PerhentianIsland. Since several places are involved, each water sample analysis is taken at different time. The water samples are stored in dark plastic bottles and kept at the sampling not longer that six hours before filtered by hand operated vacuum pump.

ii. Caloric energy value and carbon sink: Biomass energy extracts carbon to reduce the carbon stocks. The carbon sinks remove carbon dioxide from the atmosphere. The main natural sinks are absorption of carbon dioxide by the oceans via physicochemical and biological processes and also photosynthesis by terrestrial plants.

iii. Calculate for power efficient and emission from biomass species: The power efficient is identify by testing biomass oil in the engine. Biomass energy reduction in the emission of atmospheric pollutants compared to conventional power sources would be investigated.

Water sample and Case Study Area

The state of Terengganu is located on the east coast in Peninsular facing the South China Sea. Three location of sea water in Terengganu are taken as sampling site in order to identify the habitat species of algae which is Setiu Wetland, Bidong Island and Perhentian Island. Setiu Wetland is the part of Setiu River Basin and the larger Setiu-Chalok-Bari-Merang basin wetland complex lies in Terengganu. It is located at 05^{o} 40N and 102^{o} 43' E.

Water Sampling

The water samples were takes in Setiu Wetland ,Bidong Island and Perhentian Island. The 200 meter depth is marks on the rope at the vandorn water sampler. The latitude and longitude at the location was identified using the Global Positioning System (GPS). The GPS was set up assuming 500 meter distance from the shore. The water samples are transfer into immediately bottles after takes using vandorn water sampler to prevent the distruption of surrounding. The most suitable temperature for macro algae survive is about 29-32 ^{o}C.

Setiu Wetland

Two different times are taken which is at 11.00am and 3.00pm. So, four different of water samples are taken. The location of Setiu wetland are N 05^{o} 40.540' E102^{o} 43.080' and N 05^{o} 40.313 E 102^{o} 43.934'. Temperature of water samples was taken a moment after exchange the samples into the bottles.The water temperature is 32 ^{o}C. This figure show the location of Setiu Wetland where the water samples are taken (Figure 1).

Bidong Island

Bidong Island is one square kilometer in area and accessible from the coastal town of Merang. It is located at 05^{o} 36 N and 103^{o} 03 E. At the Bidong island also takes two times samples, in 11.00am and 3.00 pm. Four collected of water samples taken and the temperature were identified. It is located 05^{o} 36.828 N and 103^{o} 03.262 E. The water temperature is 31^{o}C. This figure show the location of Bidong island where the water samples are taken (Figure 2).

Perhentian Island

Perhentian Island is divided by two which is Perhentian Kecil and Perhentian Besar. The sampling site is at Perhentian Kecil with located at 05^{o} 51 N and 102^{o}44 E. Two different times are taken which is at 3.00pm and 10.00 am on the next day. The location of Perhentian Island is 05^{o} 21.26 N and 102^{o} 44.2 E and the water temperature is 29 ^{o}C. This figure show the location of Bidong island where the water samples are taken (Figure 3).

Figure 4 and 5 present methodology employed in the study. Subsequent publication shall be released to describe full detail. Table 1 present equipment used in the laboratory test.

Calorific Value and Power Efficiency

Cultivation system is designed to estimate quantitative analysis such as cost, calorific value, carbon sink and power efficiency. The macro algae are planting in the cultivation system. Water , carbon dioxide, minerals and light are immeasurably imperative elements in cultivation and distinctive growth have different necessities. The water temperature must be in a range that will support the particular algae species being become generally between 25 – 35 degree C.

Specific heat is the measure of kcals required to raise the temperature of 1 kg of oil by 10oC. The unit of specific heat is kcal/kg degree C. It fluctuates from 0.22 to 0.28 relying upon the oil specific gravity. The specific high temperature confirms what amount of steam or electrical vigor it takes to high temperature oil to a wanted temperature. Light oils have a low specific heat, in as much as heavier oils have a higher particular high temperature.

RESULTS

Sample collection and preservation

Water sample are collect using vandorn water sampler and transferred to the bottle samples. Generally, at least one liter of water sample is needed. Sample volume is depending on the sampling location. The water samples are kept from heat and light to avoid pigment decomposition and bacteria infect. The location of each sampling sites are marks using GPS and the temperature of sea water is taken immediately to prevent surrounding disturbance. Hence, the water samples are place in an ice chest at temperature 1-4 ^{o}C. Table 3shows the coordinate for Perhentian, Setiu and Bidon Highland.

The graph in Figure 1 and Table 2 showed the latitude against temperature of sampling site whereas the latitude is decrease inversely proportional to the temperature at first point.

Basically, the temperature is depending on the latitude because of water circulation patterns modify the direct effect of the amount of energy received from the sun. But, the graph proof that not all of the temperature caused by latitude where at Setiu Wetland has highest temperature while their latitude is lower than Bidong Island. This is happening because the Setiu Wetland water has low salinity which is there are mixed of sea water and river

Table 1. Equipment of water analysis

Equipments	Function / pictures
Vandorn water sampler	 Use to take water samples
Ice chest	 Use to keep the water samples at temperature 1-4°C
Bottles sample	 Use to keep water samples
Thermometer	 Use to determine the sea water temperature
Global Positioning System (GPS)	 Use to set the latitude and longitude of the location
GF/C filter paper	 Use to filter the dirt in water samples
Vacuum Pump	 Use to filter and pump the water samples

The Table 2 showed the results from water analysis that conducted to analyze the nutrients of sea water in each sampling site which is Setiu Wetland, Bidong Island and Perhentian Island. The values of total nitrogen at all sites are highest compare to others because there is more than 65 % of nitrogen in sea water. Setiu Wetland has the

Table 2. Location of sampling site physical parameters

	Perhentian Island	Bidong Island	Setiu Wetland
Latitude (N°)	05 °52.46	05 °36. 828	05 °40. 540
	52.46	36.828	40.54
Temperature (°C)	29	31	32

Table 2. Experimental results of sample taken from sites

	Sampling Site		
Parameters	Bidong Island	Setiu Wetland	Perhentian Island
Temperature °C	31	32	29
Salinity (ppm)	32.34	24.1	35.13
pH	5.8	5	6
Ammonia	0.034	0.035	0.0665
Total Nitrogen	0.391	0.46	0.3265
Nitrate-N	0.002	0.002	0.003
Total phosphorus	0.045	0.045	0.031

Table 3. Macro algae species with their parameters values

	Macro algae species			
Parameters	*S. cristaefolium*	*Ulva Lactuca*	*E. Intestinalis*	*G.Conferoides*
Temperature °C	24-34	22-34	20 - 33	31 - 34
Salinity (ppm)	30-33	19-22	8.2-25	15-32
pH	4.0 - 6.0	7.1 - 8.5	6.9-9	7.0-8.0
Ammonia	0.029 – 0.039	0.01 - 0.04	0.02 – 0.04	0.001 – 0.005
Total Nitrogen	0.2 – 0.5	0.65 – 0.9	0.10-0.38	0.5 – 0.8
Nitrate-N	0.001 – 0.003	0.002 – 0.008	0.001 – 0.009	0.001 – 0.004
Total phosphorus	0.03 – 0.08	0.04 - 0.09	0.04 – 0.10	0.02 – 0.09

highest values of nutrients caused the higher population of macro algae that need more nutrients to survive such as *ulva* species.

There are four species of major species of macro algae found at sampling site based on matching of their physical and chemical characteristic such as temperature, salinity and nutrients contents in macro algae. The species in Setiu Wetland are *ulva lactuca* and *entermorpha intertanalis* while in Bidong Island is *sargassum cristaefolium* and in Perhentian Island are *sargassum cristaefolium* and *glacilaria confervoides (Figure 2).*

Table 4. Location of sampling site

Bil	Parameter	Setiu wetland (11.00 am)	Setiu wetland (3.00pm)	Bidong (11.00am)	Bidong (3.00pm)
1	COD	110	188	68	100
2	Total nitrogen (N)	39	24	8	15
3	Total phosphate (P)	0.04	0.03	0.03	0.02
4	Total Phosphate ($P0^{3-}_4$)	0.14	0.09	0.09	0.06
5	Ammoniacal nitrogen (NH_3-N)	1.03	0.95	2.98	3.35

All in mg/L

Sample Laboratory Analysis

The GF/C filter paper is set up onto the vacuum pump. The water sample is gently poured into the vacuum pump trough GF/C filter paper after switch on the vacuum pump. The sediment in water sample is ensure filtered with checking the filter paper if there is has clog or not. Experiment was set up in the laboratory to identify the nutrient contains in the seawater which suitable for types of macro algae. There are four nutrients that may identify using these experiments which is nitrate, phosphate, nitrogen and ammonia (Figure 3, 4, and 5).

The study was checked similar analysis conducted in the same water sample at University

Table 6. Seaweed habitat characteristics

Environmental parameter	*G. edulis*	*U. lactuca*
Temperature (ºC)	28.9± 2.1	28.9± 2.0
Salinity (ppt)	22.15± 2.20	19.5± 1.5
Dissolved oxygen (mg/L)	3.58± 0.05	3.19± 0.02
pH	8.43± 0.2	7.85± 0.3
Turbidity (NTU)	9.74± 0.04	8.68± 0.03
Ammonium (mg/L)	1.0± 0.03	1.25± 0.02
Total nitrogen (N) (mg/L)	3 0± 1.5	4.2 ± 0.5
Nitrate (mg/L)	0.02± 0.01	0.23± 0.02
Total phosphate (P) (mg/L)	0.2± 0.06	0.5 ± 0.1
Phosphate (mg/L)	1.04± 0.05	2.22± 0.04

Table 7. Calorific value and ash percentage of macro algae

Species	CV	% ash
Phaeophyta	9 - 11	25 - 45
Rhodophyta	8 - 12	24 - 42
Chlorophyta	8 - 13	24 - 40

Table 8. Moisture content

	Moist Fuel	Dry Fuel
C	83.95	84.45
H	4.23	4.25
O	3.02	3.04
N	1.27	1.28
S	.91	.91
Ash	6.03	6.07
Moisture	.59	.59

Table 9. Market price of macro algae

Species	Price
Ulva lactuca	$500 - $ 700/ton 1ton = $ 600 360 ton = $ 216 000
Sargassum cristacfolium	$600- $ 800 / ton 1 ton = $ 700 360 ton = $ 252 000
Glacilaria confervoides	$5800-$6800/1 ton 1 ton = $ 6300 360 ton = $ 2 268 000
E. Intestinalis	$5000- $ 6000 / ton 1 ton = $ 5500 360 ton = $ 1980 000

Technology Malaysia. The result is shown in Table 4 and 5, which show respective nutrient condition of the water sample collected the sites. Table 6 shows typical seaweed identifies at Setiu location.

Calorific Value

The calorific value is the amount of heat released during the combustion of a specified amount of it. The energy value is a characteristic for each substance. It is commonly determined by using a bomb calorimeter. The calorific value is

Fig. 1 . Setiu Wetland

Fig. 2. Bidong Island

Fig. 3. Perhentian Island

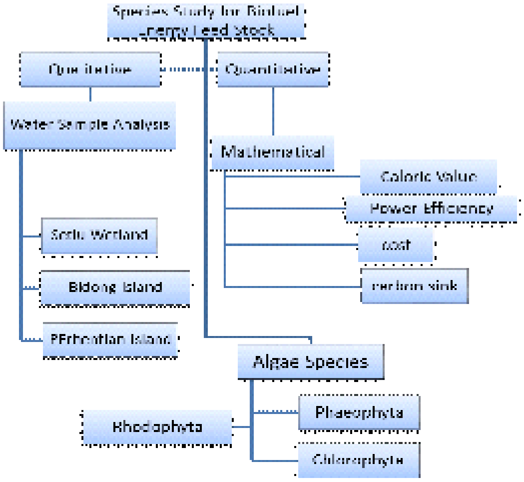

Fig. 4. Methodology Flowchart

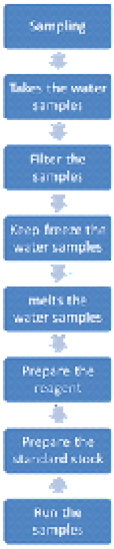

Fig. 5. Water Sampling

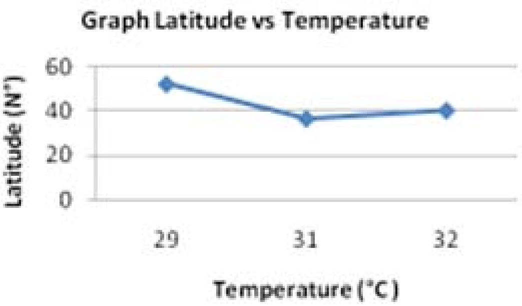

Fig. 6. Graph Latitude against temperature

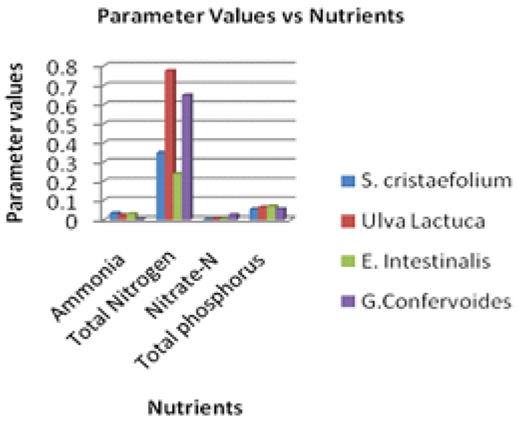

Fig. 7. Graph parameter values against nutrients

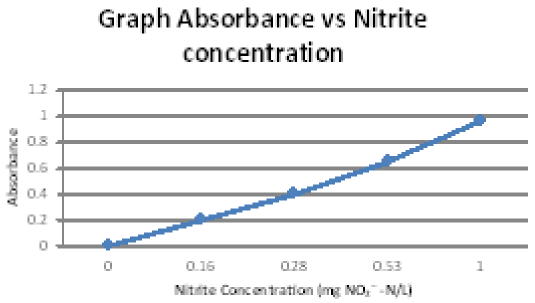

Fig. 8. Ammonical - Nitrogen Concentration (mg NH„ { N/L)

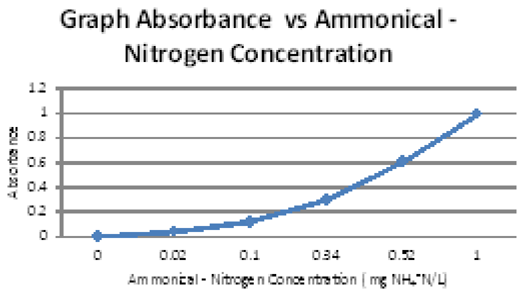

Fig. 9. Phosphorus Concentration (mg PO_4^{3-}-P/L)

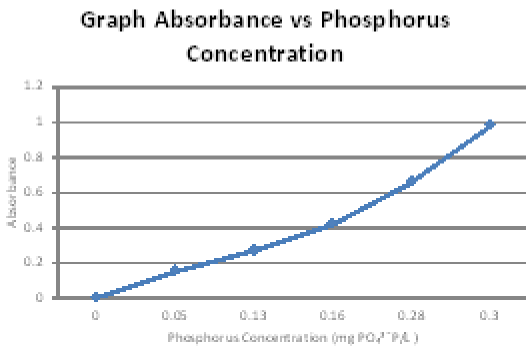

Fig. 10. Phosphorus Concentration (mg PO„ $^{3-}$-P/L)

affected by the ash and moisture contents of the biomass. This is because, the ash content may lower down the calorific value and may cause major problem at high temperature combustion. Ash related problems are including slagging, agglomeration, corrosion and erosion which can lower the availability and reliability of the energy sources. Hence, the calorific value decreases with the increasing of moisture. In macro algae, the ash content in Chlorophyta species is highest, follow by Rhodophyta species and Phaeophyta. It is because the highest calorific value in Chlorophyta species compare to the Rhodophyta species and Phaeophyta species. The formula for the calculation of heating values from the composition of a fuel as determined from an ultimate analysis is due to Dulong, and this formula, slightly modified, is the most commonly used to-day. Other formulae have been proposed, some of which are more accurate for certain specific classes of fuel, but all have their basis in Dulong's formula, the accepted modified form of which is is the heat units in B. t. u. per pound of dry fuel is given by:

$$14{,}600\ C + 62{,}000\left(H - \frac{O}{8}\right) + 4000\ S$$

Where C, H, O and S are the proportionate parts by weight of carbon, hydrogen, oxygen and sulphur. Table 7 and 8 shows the CV and moisture content value estimate for 3 major types of seaweed. This will be used to assess subsequent publication that will present result of analysis on species found at various cite. Table 9 show the market value for the algae seaweed.

Thermal Efficiency = (Net Electric Output + Net Thermal Output/2)/Fuel Heat Input (LHV)

1. Heat rate: HR= QB/W
2. Efficiency: $\eta TH=W/Qb$

3. Carnot Efficiency: ηC = (TB-TA)/TB = (QB-QA)/QB
4. Rational Efficiency: ηR=W/ the change in thermodynamic potential of the system
5 Overall Efficiency, ηO = W/Qfuel

Where: QFuel = Fuel mass flow rate X calorific value.

CONCLUSION

Macro algae may found in many types of habitat in Malaysia such as Bidong Island, Redang Island, Perhentian Island and Setiu Wetland. The use of macro algae as the marine biomass energy sources has the potential to offset substantial use of fossil fuels. The net emission of carbon into the atmosphere can be reducing due to use the macro algae as biomass energy sources. This research estimates the carbon capture energy value from deployment aquaculture system for seaweed farming. The water analysis is used to identify the mineral contents in sea water in order to matching the species. In order to identify the market price, the cost of macro algae are calculated by drawing the cultivation system in 100000 meters for 10 blocks. The use of macro algae as the marine biomass energy sources has the potential to offset substantial use of fossil fuels. The net emission of carbon into the atmosphere can be reducing due to use the macro algae as biomass energy sources. This research estimates the carbon capture energy value from deployment aquaculture system for seaweed farming. Based on the market price of macro algae, the *ulva lactuca* and *sargassum cristaefolium* are the lowest price compare to other species.

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