Effect of Light/Dark cycle and carbon source on Lipid Production by *Chlorella pyrenoidosa* using Agro Waste Water Malaysia

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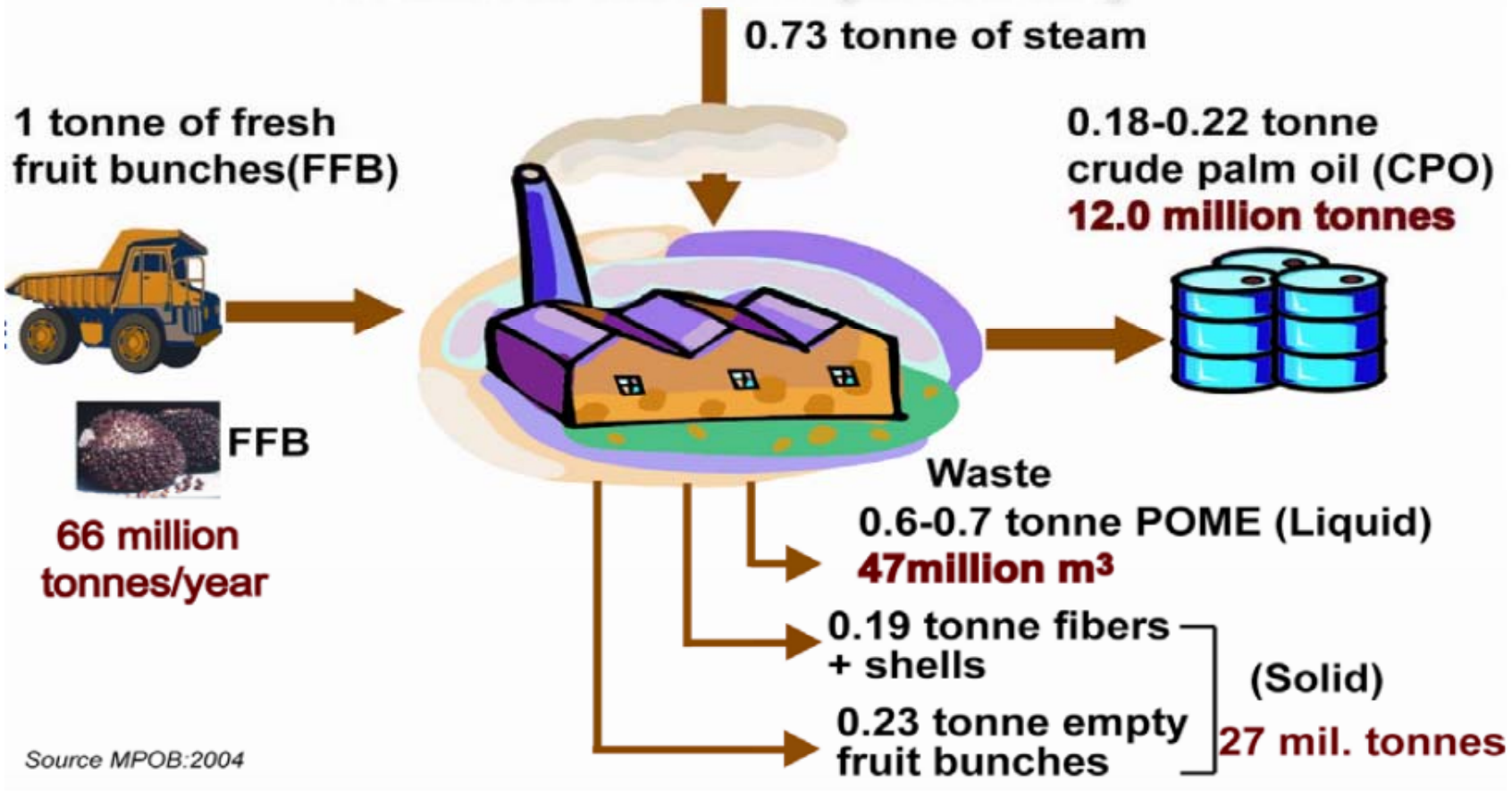
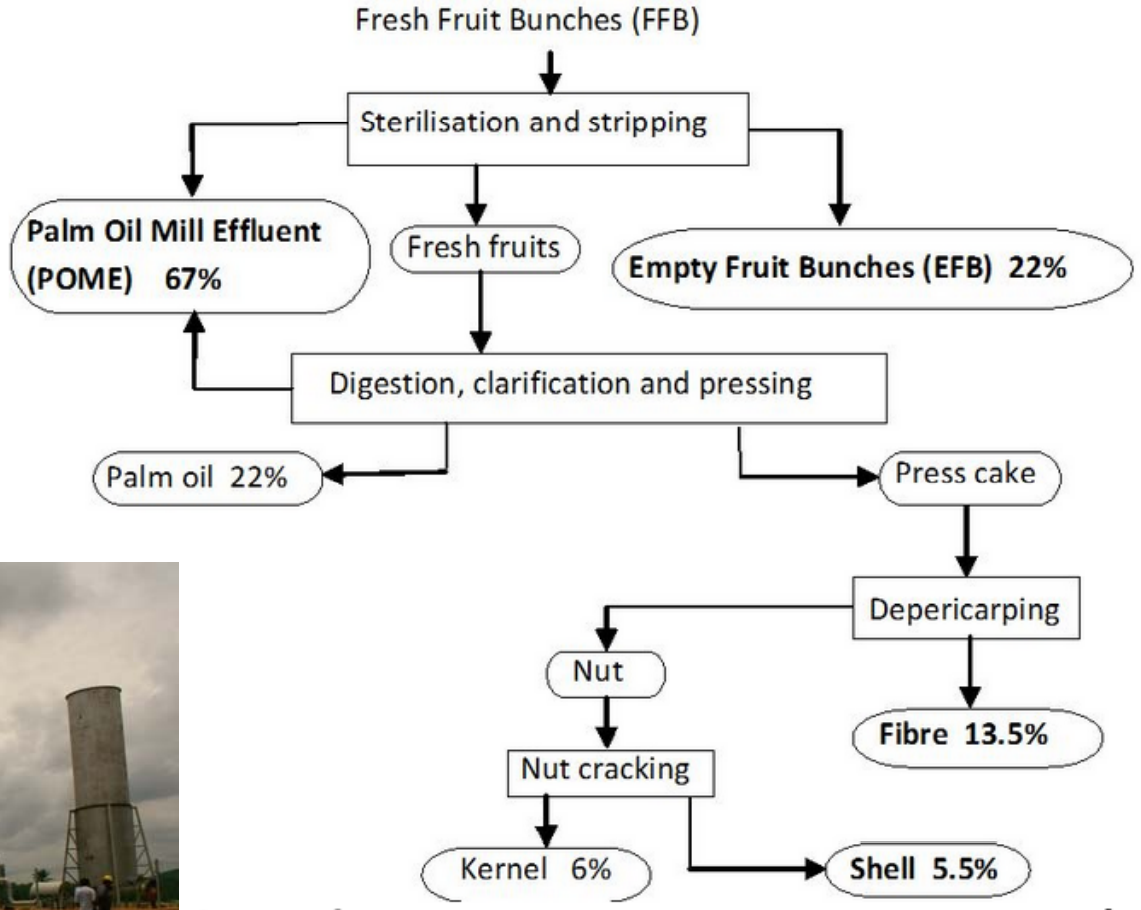
Overview of palm oil mill



Source of Palm Oil Mill Effluent (POME)



Source: Biomethane Production from Palm Oil Mill Effluent (Pome) in a Semi-commercial Closed Anaerobic Digester

Characteristic of the sampled POME

No	Parameter*	Concentration range (mg/L)	Malaysia Standard (mg/L)
1	pH	4.15 – 4.4.5	6.0 – 9.0
2	COD	1,350 – 2,120	50-100
3	Soluble COD	20,500 – 24,500	------
4	BOD	300 – 400	20-50
5	Total volatile solid	27,300 – 30,150	100-200
6	Total Suspended Solid	15,660 – 23,560	50-100
7	Total phosphorus	200 – 600	-----
8	Total nitrogen	500 – 800	------

Can cause significant environmental effects like oxygen depletion if it is discharged without efficient treatment.

Conventional treatment method

- Anaerobic treatment:

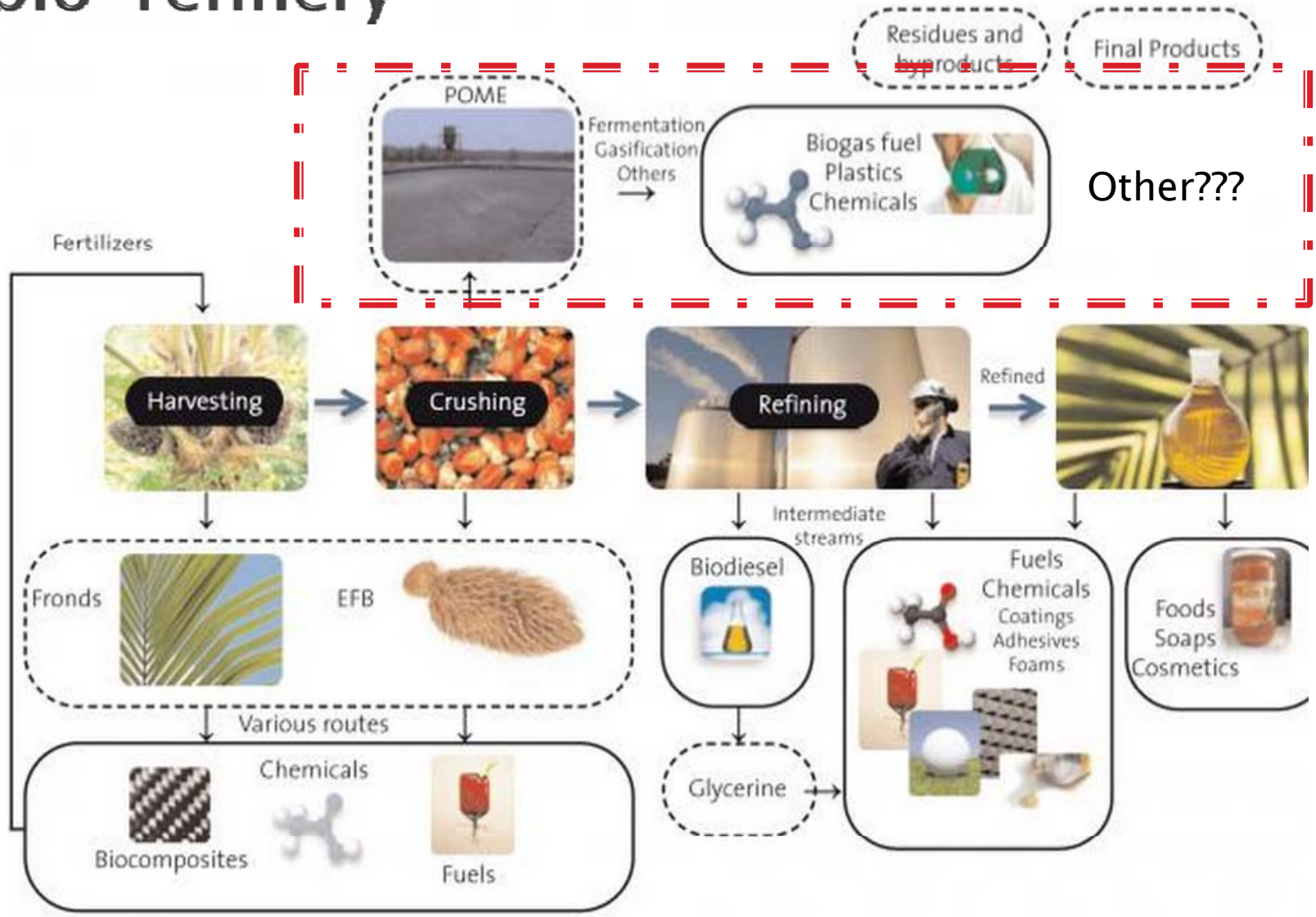
  Long retention time, large area required.
- Aerobic:

  High energy requirement.
- Membrane:

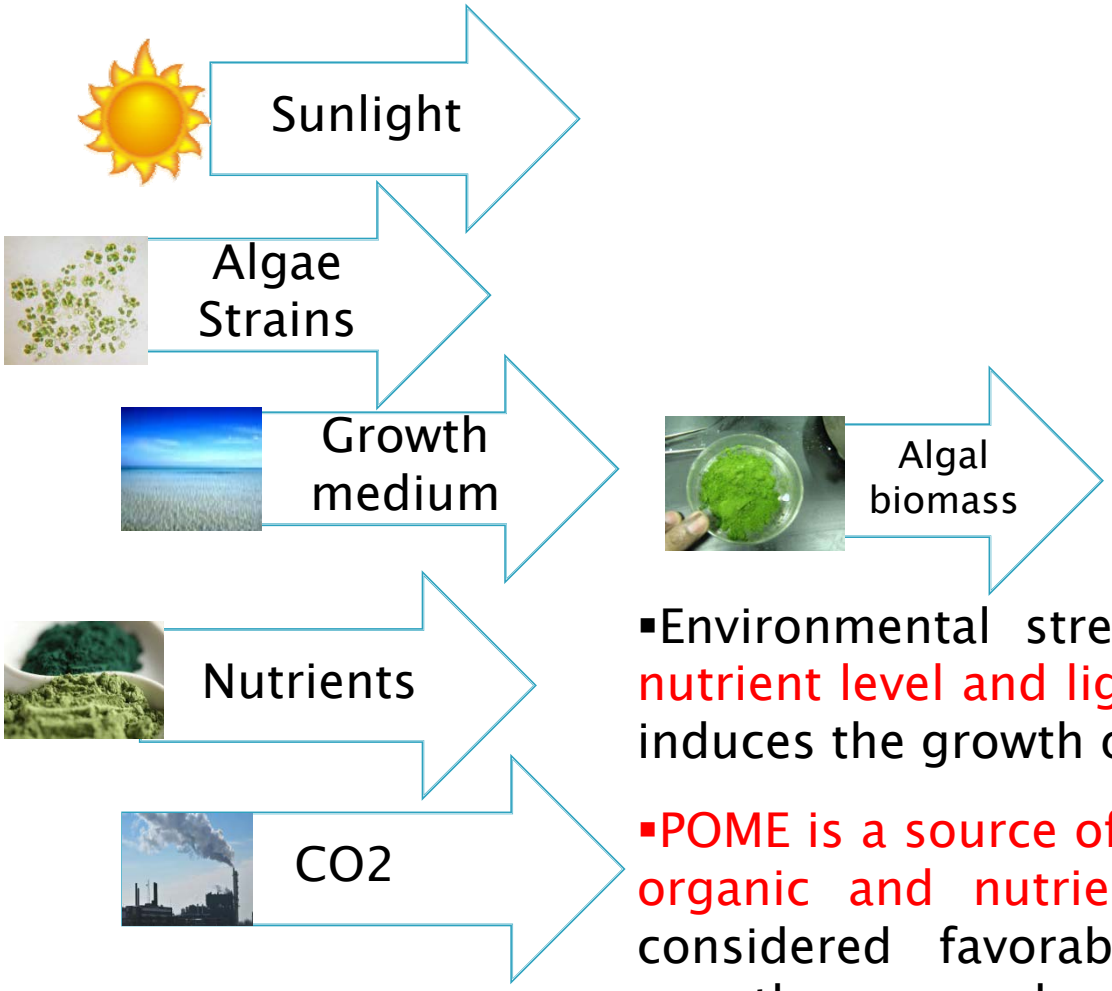
  Short membrane life, membrane fouling, expensive.
- Evaporation:

  High energy consumption.

Concept of integrated palm oil based bio-refinery



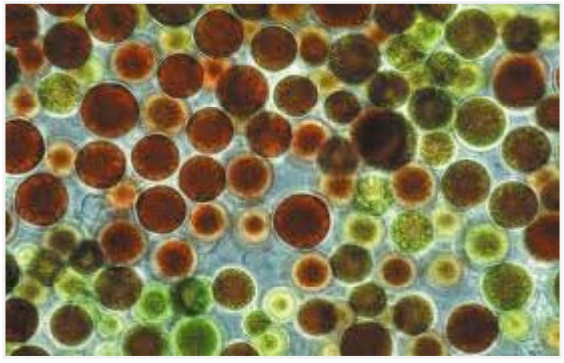
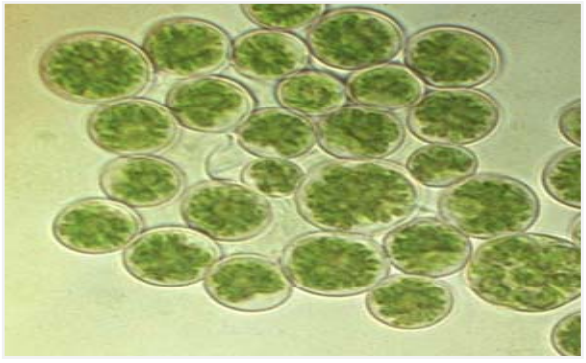
FACTOR OF GROWTH: MICROALGAE



- Environmental stress such as nutrient level and light intensity induces the growth of algae
- POME is a source of enormous organic and nutrient content, considered favorable for the growth several types of microalgal species to produce lipid.

MICROALGAE

- Microalgae are the primary producers of oxygen on the planet, generating 40-50% of the world's atmospheric oxygen.
- 30,000 known species of microalgae and more are being discovered and categorized, however only a few hundred are actively being investigated and very few produce industrially.
- Depending on species, microalgae produce many different kinds of lipids, hydrocarbons and protein.

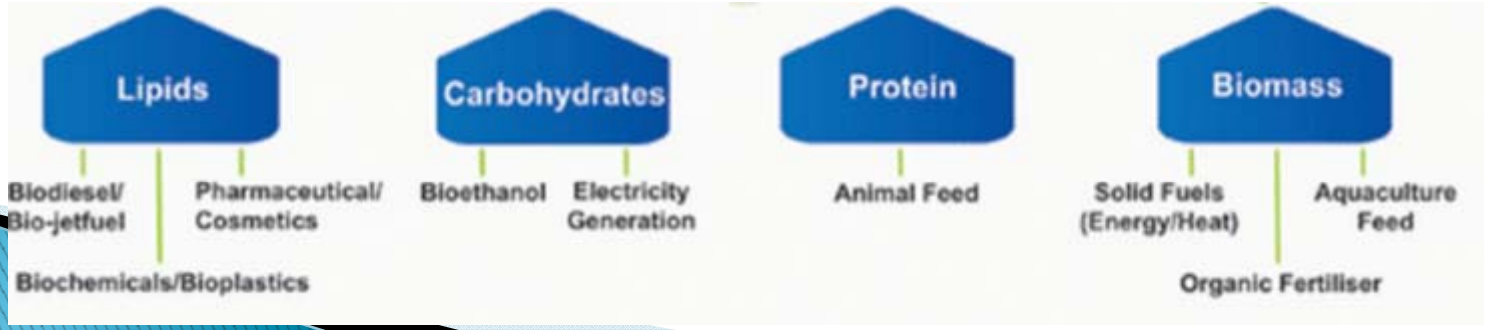
POTENTIAL OF MICROALGAE IN WASTE WATER TREATMENT

Inhibit the microalgae growth

Promoting the microalgae growth

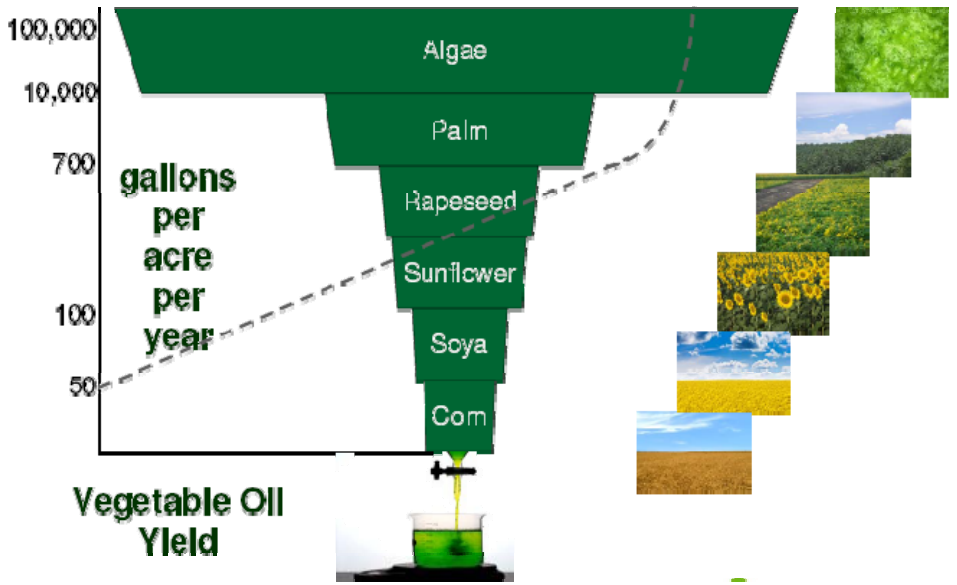
Waste water treatment

Waste-to-wealth opportunities



ADVANTAGEOUS OF MICROALGAE

- Faster grow
- CO2 Capture
- High lipid &fatty acid
- Use saline, brackish, waste waters, seawater
- Do not compete with feed crops
- Wastewater treatment
- Oil from algae is 7-31 times greater than palm oil



Sources :(Lam and Lee, 2011).

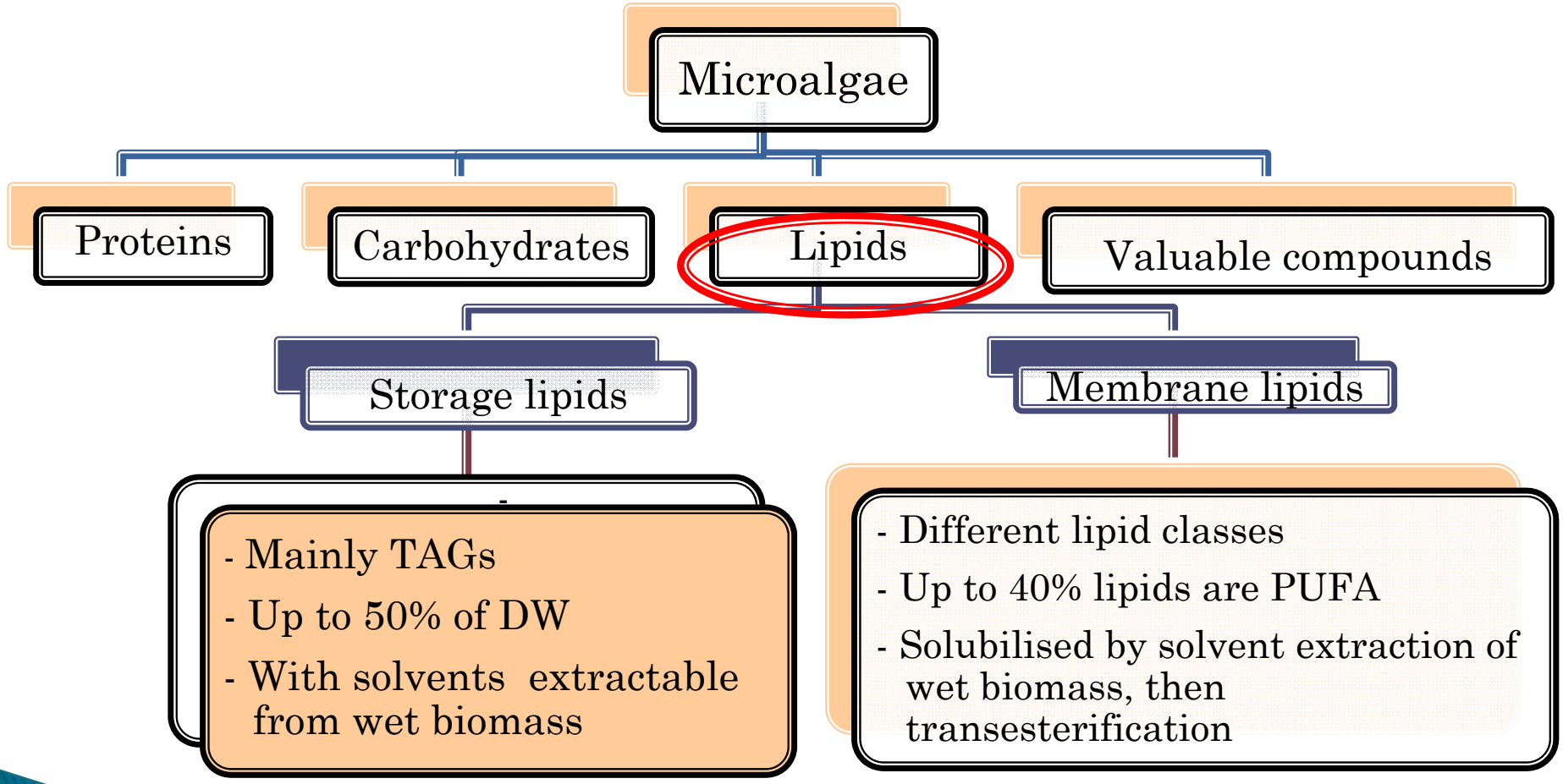
LITERATURE

Most abundant microalgae studied

- **1. diatoms (*Bacillariophyceae*)**
- **2. green algae (*Chlorophyceae*)**
- **3. blue-green algae (*Cyanophyceae*)**
- **4. golden algae (*Chrysophyceae*)**

Chlorella pyrenoidosa

COMPONENT OF TYPICAL MICROALGAE



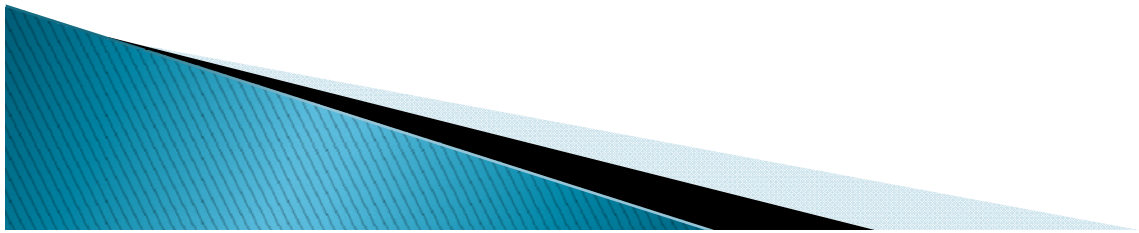
Sources :Barsanti, L. & Gualtieri, P. 2006. Algae: Anatomy, Biochemistry, and Biotechnology.

Research review

- Most studies reported that under intermittent illumination, higher specific light absorption together with the lower specific growth rate most probably contribute to the reduction of the biomass production of *C. pyrenoidosa*.

- However, with *C. reinhardtii*, the amount of chlorophyll a content was doubled under the intermittent illumination in comparison to continuous illumination. Due to the increase of chlorophyll a content under light/dark cycles , and lead to the increase of its specific light absorption. (Janssen et al. ,1999)

- Whether the continuous illumination is beneficial to promote the growth of biomass and/or chlorophyll a, it could be varied based on specific strain of microalgae and possibly the combination of operating conditions including growth medium.



Aim of the study

- To evaluate the growth of of microalgae species, i.e., *Chlorella pyrenoidosa, a* locally isolated species in POME
- To evaluate effect of light regime (photo period) and C/N ratio on the biomass and lipid production

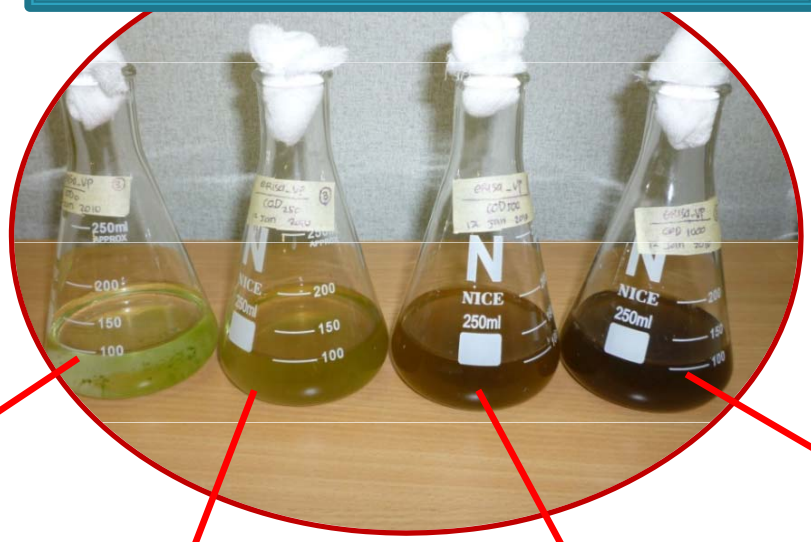
RESEARCH METHODOLOGY

Culture medium and source of POME

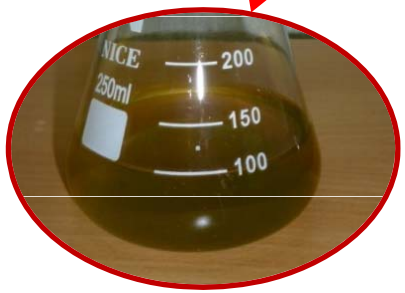
- *C. pyrenoidosa* was isolated from a POME pond located in Johor Palm Oil Mill, Kahang, Johor, Malaysia.
- Cultivated and maintained in a 10-fold diluted POME provided with cultural conditions of 24°C- 26°C, with photoperiod of 8h:16h (in Light: in Dark), pH ranging between 6.5-7.5, and light intensity of 150 mol m^2 s^{-1}
- POME was diluted 10 times to reduce the shadings effect on the microalgae growth. The growth of *C. pyrenoidosa* was assessed by optical density (OD) at a wavelength of 600 nm, chlorophyll content.

RESEARCH METHODOLOGY

Chlorella + BBM + POME



BBM and *Chlorella*



250 mg COD/L of POME and BBM with *Chlorella*

500 mg COD/L POME and BBM with *Chlorella*

1000 mg COD/L POME and BBM with *Chlorella*

RESEARCH METHODOLOGY (CONT'D)

To characterize the produced lipid content from biomass using conventional techniques in order to find lipid Production

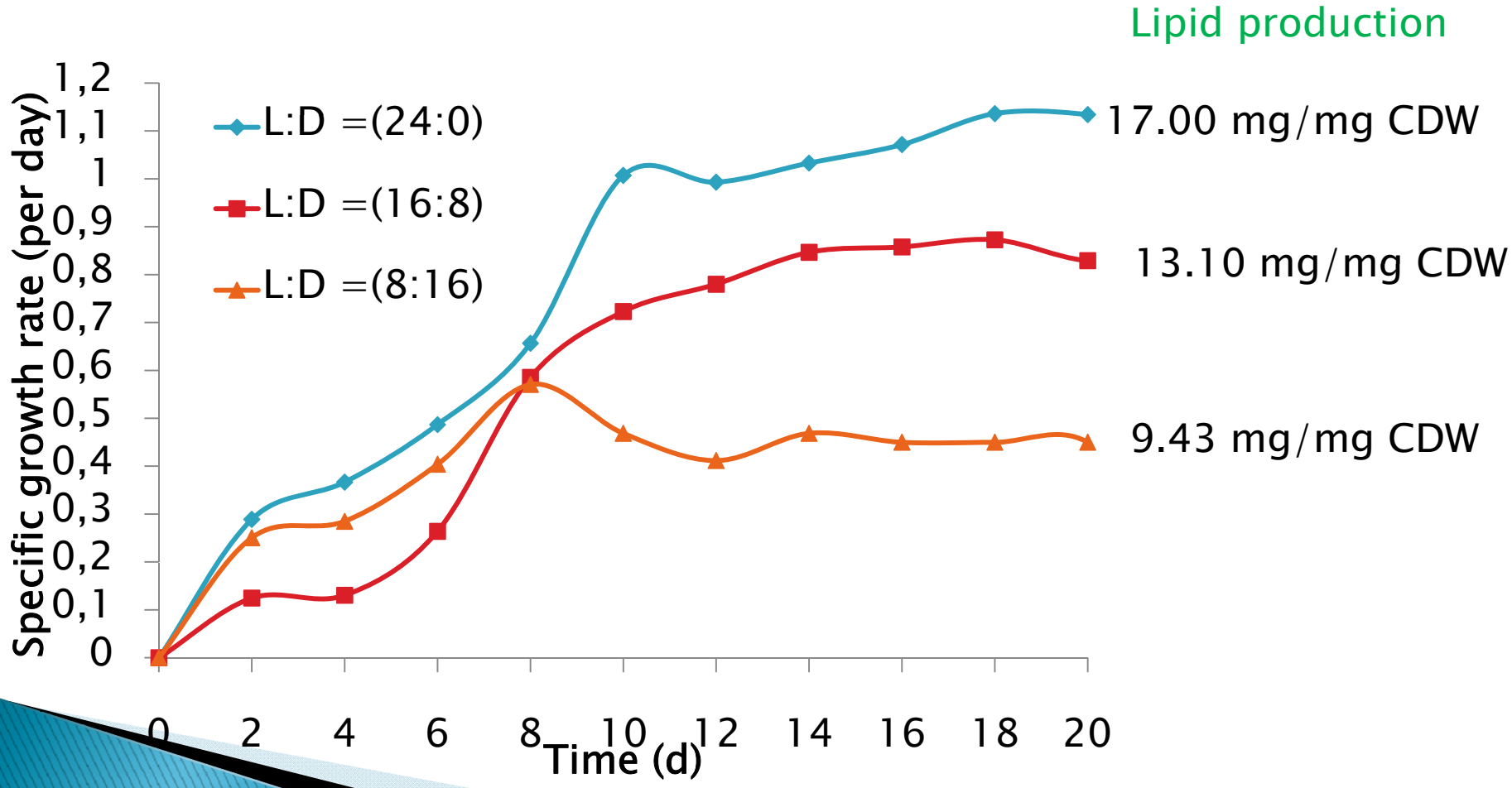
Expand cultivation of *chlorella*

Cultivate algae individually in raw POME with different dilution and light regime

Harvesting biomass using conventional techniques, mainly centrifuge

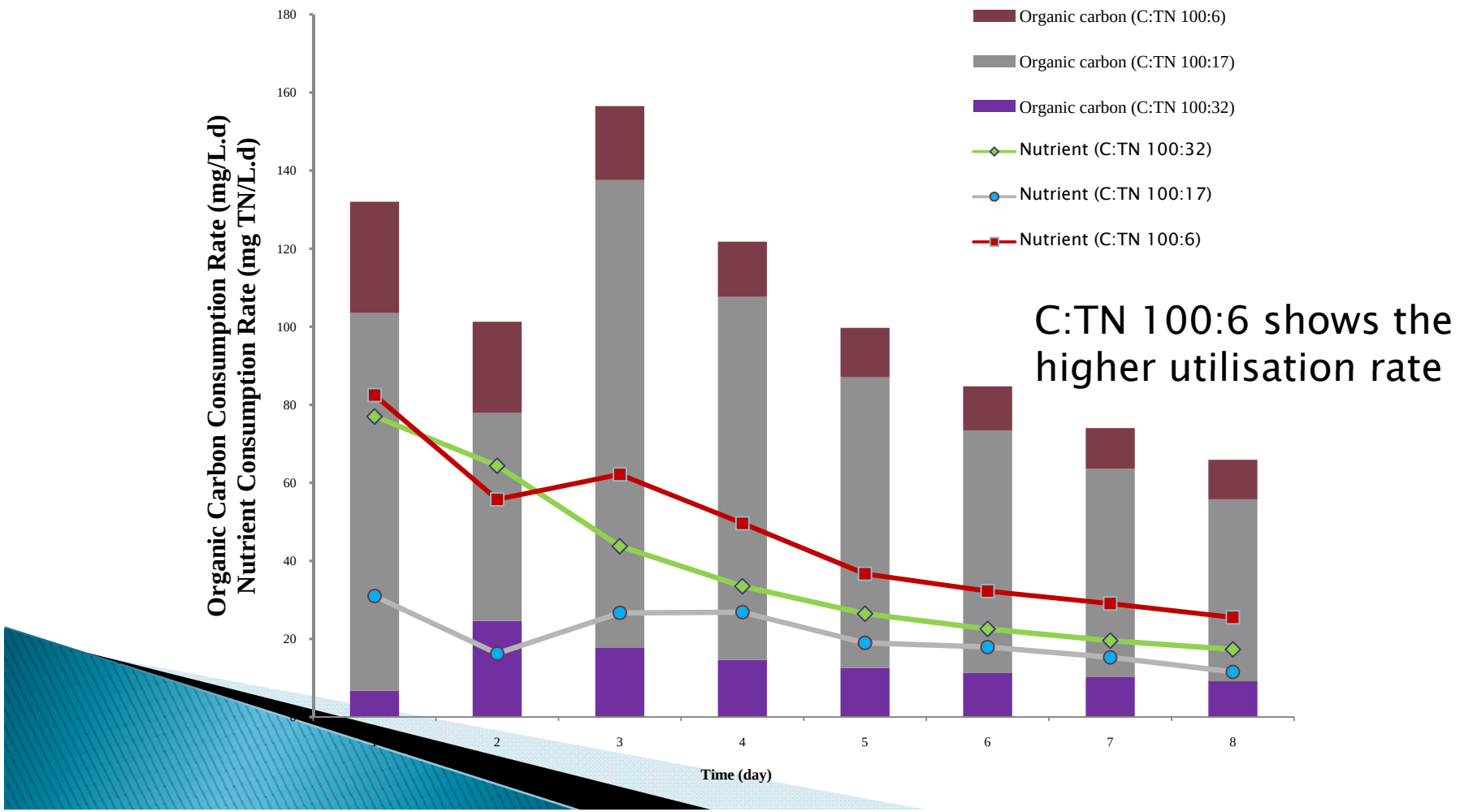
RESULTS AND DISCUSSION

Effect of photo period for the production of biomass and lipid by *Chlorella Pyrenoidosa* in POME



RESULTS AND DISCUSSION

- Organic Carbon Substrate and Nutrient Utilization Rate *via C. pyrenoidosa* from Settled Raw Palm Oil Mill Effluent (POME) for Lipid Production



C:TN 100:6 shows the higher utilisation rate

CONCLUSION

- The highest lipid content achieved when *C.pyrenoidosa* cultured under continuous light (24 hr) at 18.00 mg lipid/mg CDW.

- In conclusion, *C. pyrenoidosa* was found to produce highest lipid when grown under C:TN ratio of 100:6, under continuous illumination and with OLR of 36 kg COD/m^3.d.

THANK YOU

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