

# The Utilization of Wastewater from Palm Oil Industry As Culture Medium for Microalgae (*Chlorella* sp) That Can be Used As Supplement Food for Calves in Riau Province

Tengku Dahril<sup>1</sup>, Aras Mulyadi<sup>2</sup> and Efawani<sup>3</sup>  
{dahril2011@gmail.com<sup>1</sup>}

<sup>1,3</sup>Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science, University of Riau, Pekanbaru, Riau, Indonesia.

<sup>2</sup> Department of Marine Science, Faculty of Fisheries and Marine Science, University of Riau, Pekanbaru, Riau Indonesia.

**Abstract.** Palm oil industries has been developing quickly in Riau Province. Right now, at least, 246 palm oil industries present in through around of district in Riau Province. They discharges not only liquid waste in vast amount but also solid and gas. Thy liquid waste is rich in micro and macro nutrient that can be used as culture medium of microalgae (*Chlorella* sp). The study of utilization of wastewater from oil palm industry as culture medium for microalgae (*Chlorella* sp) that can be used as supplement food for calves in Riau Province was conducted from July to August 2017. Result of this study indicated that supplement food of Chlorella powder can promote the growth and production of calves in Riau Province. After 12 weeks calves cultured in the cattle, the mean weight of them increased from 125,0 kg to 150,0 or increased as much as 25 kg compared by without supplement food was 115.6 kg in initial study to 129.0 kg after 12 weeks or increased only 13.4 kg. based on this study, it concluded that wastewater from palm oil industry can promote the growth and production of *Chlorella* sp that can be used as supplement food for calves in Riau Province

**Keywords:** Palm Oil waste, *Chlorella* sp., Supplement food, Calves.

## 1. Introduction

Riau is a large number of palm oil plantations in Indonesia with areas of 2.399.173 ha in 2014. The production of Crude Palm Oil (CPO) reached 7.047.221 ton in 2014 produced by 246 of Palm Oil Industries. The Palm Oil Industry generates large quantity of wastes whose disposal is a challenging task. They also gives rise to highly polluting waste-water, known as Palm Oil Mill Effluent (POME), wise is often discharge in disposal ponds, resulting in the leaching of contaminants that pollute the groundwater and soil, and release of methane gas into the atmosphere. POME could be used for biogas production through anaerobic digestion.

In a conventional Palm Oil Mill, 500-700 kg of Pome is generated for every ton of processes fresh fruits bunches (FFB). Most of the Biomass residues from Palm Oil Mills are either burnt in the open or disposed off in waste ponds. The Palm Oil Industry, therefore contributes significantly to global climate change by emitting carbon dioxide and methane

Wastewater production from all palm oil industries in Riau is estimated to be 29.250.000 ton/year (Riauapos, Sunday, 30 August 2015). This wastewater contain biological oxygen

demand (BOD) estimated to 8,200-35,00 mg/l, Chemical Oxygen Demand (COD), 15,103 – 65,100 mg/l, Total Solid Suspended(TSS) estimated to be 1,220-50,700 mg/l, oil and lipid estimated to 150 -14,700 mg/l (Dirjen PPHP, 2006). Therefore, it is very important to conduct a research to eliminate the effect of wastewater Oil Palm Industry in Riau province.

*Chlorella* is a potential supplement food source for calves because it is high protein and other essential nutrients when dried, it is about 45 % protein, 20 % fat, 20 % carbohydrate, 5 % fiber, and 10 % minerals. It is also abundant in calories and vitamins. *Chlorella* is also suggested as an inexpensive protein supplement to human and animal diet. Under certain growing condition, *Chlorella* yields oils that are high in poly saturated fats

*Chlorella* is a pioneer organisms living in the ocean for long periods of time. They are (sun) light driven cell factories that transform carbon dioxide (CO<sub>2</sub>) into ingredient for feed and food, free Oxygen (O<sub>2</sub>), and biomass for feed stock and bio-fuels. They can grow fast under extreme condition (salt, freshwater, alkaline, hot etc, yield up to 10 times that of traditional crop and do not compete with traditional crops for food, and can be used marginal land. They can absorb many in-organic materials from wastewater such as nitrogen, phosphore, kalium, magnesium, ferum, and others so they can be able to clean the dirty water (purify). In this study we use wastewater from palm oil industries to grow and produce *Chlorella* sp in order to used as supplement food for calves in Riau Province.

## 2. Material and Methods

This study was conducted in three steps. Step one we call a initial study with high concentration of palm oil wastewater, and the second steps with low concentration of wastewater. Wastewater from Palm Oil Industry belong to PTPN 5 Tandun, Kampar, Riau was collected and filtered with Dahril Filter. Dahril filter is a tool specially designed to filter the palm oilmill effluent (wastewater). Dahril filter was made by a plastic drum with gravel, sand, coal and palm fibres inside. The Dahril filter was filled with wastewater through filter substrate than the wastewater was boiled as long as 20 minute to kill bacteria and fungi. This filtered wastewater was put in 400-ml plastic bottle, that call it Dahril Solution 2, that can be used in this experiment. This wastewater was diluted by adding distilled water with the concentration of 0,0 %, 25 %, 50 %, 75 %, and 100 % as preliminary study in 400 ml- culture medium.

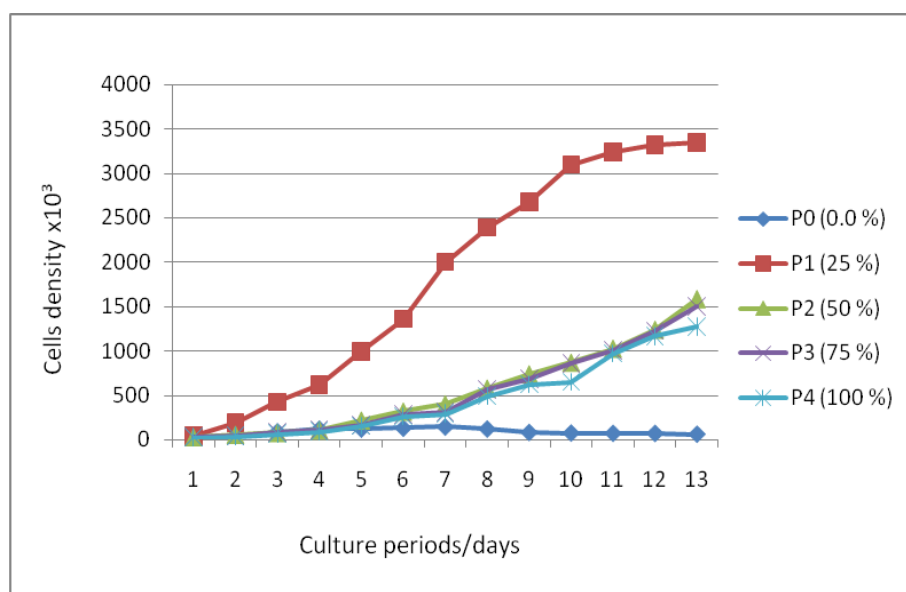
*Chlorella* sp. Obtained from Freshwater Aquaculture Research Center, Depok, West Java, was inoculated with initial density of  $5 \times 10^4$  cells/ml in 600 ml flasks for each treatment. All growth studies were conducted in triplicate. Algae were cultured in a simple incubator with continuous aeration, illuminated by two daylight fluorescent lamps with a light intensity of 4000 lux and temperature between 23 to 28°C. The algae density was enumerated daily for 15 d using a thomacytometer under a binocular microscope.

Based on the result of the study in treatment I, the study was continued with low concentration of wastewater namely 10 %, 20 % and 30 %, and 0 % as control. The study was conducted in 6 l-plastic bottle with culture medium 4 l each treatments and continuously aerated in outdoor room. The light come from sunlight directly with room temperature about 28 to 33° C.. *Chlorella* was inoculated with initial density of  $5 \times 10^4$  cells/ml. The number of algae cells was enumerated daily for 22 d using thomacytometer under binocular microscope. After 22 days culture periods, all biomass of *Chlorella* were harvested and dry weight of algae were measured using a balanced (weighing). Concentration of nitrate and phosphate before and after algae culture were also measured.

All biomass that collected from the second study was used to make cow biscuit as supplement food for calves in the third step of this study. This biscuit it call LOMAK was made by, 3 % Chlorella powder mix with 50 % of sago powder, 20 % wheat flour, 20 % green pea powder, 5 %, white sugar powder, 2 % of Pandanus leaf with local name daun pandan wangi, butter, vitamin (BECOM-C) and 2 eggs. One biscuit of this supplement food with average weight about 12,5 gram each, was given to three calves daily in the morning, before their eat normally, and three of them none as long as 12 weeks during the period of this study. Mean weight of each calf was measured weekly to know the effect of supplement food to growth and production of calves.

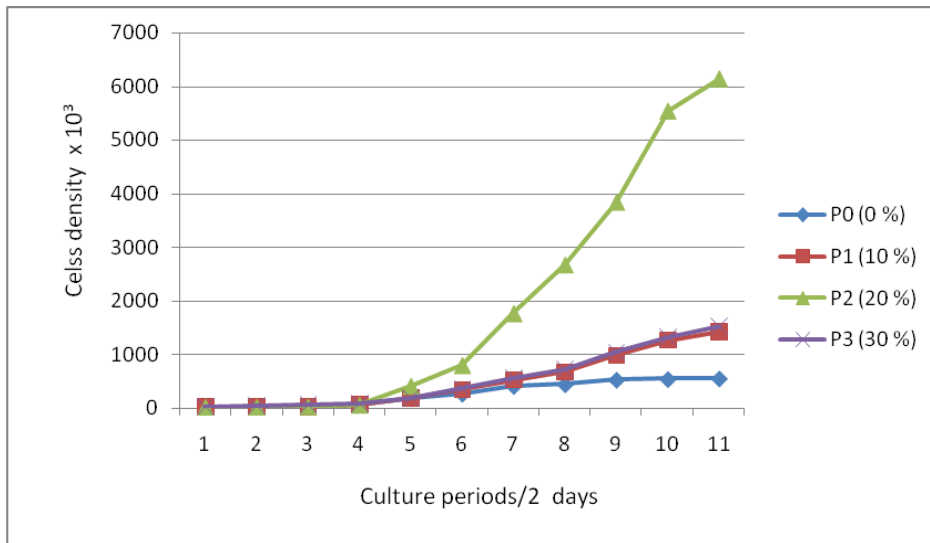
### 3. Result and Discussion

It was founded that wastewater from palm oil industry in Riau Province supported the growth of *Chlorella* sp. The best growht of Chlorella was founded in the low concentration of wastewater (25 %) compared with high concentration (50 %, 75 % and 100 %), with total density of  $3,3 \times 10^6$  cells/ml at day 13 (fig 1)



**Fig 1.** Growth of *Chlorella* sp with high concentration of palm oil wastewater

Based on the result of this preliminary study, the experiment was continued with the concentration of 10 %, 20 %, and 30 %. The result of second experiment, it was founded that concentration of 20 % of wastewater was better compare with concentration of 10 % and 30 %. High concentration of *Chlorella* sp was found in 22 days with total density of  $6.6 \times 10^6$  cells/ml as shown in fig 2.



**Fig 2.** Growth of *Chlorella* sp with low concentration of palm oil waste water.

At the end of this second study, the total density and biomass of *Chlorella* were also found higher in the concentration of 20 % with total number of  $6.6 \times 10^6$  cell/ml and biomass, 0.36 gr/l as shown in tabel 1.

**Table 1.** Total cell density and biomass at the end the study

Treatmens	Cell density (Cells/ml)	Biomass (gr/l)
P0 (0 %)	550.667	0.05
P1 (10 %)	1.422.000	0.17
P2 (20 %)	6.145.333	0.36
P3 (30 %)	1.524.000	0.18

The biomass of *Chlorella* that collected from the second study has been used as supplement food for calves. Result of this study indicated that supplement food with 3 % of *Chlorella* contain can promote the growth and production of calves in Riau Province. After 12 weeks calves cultured in the cattle with supplement food given every day, the mean weight of calves increase from 125.0 kg to 150.0 kg or added as much as 25.0 kg compared with without supplement food was 115.6 kg in initial study to 129.0 kg or added only about 13.4 kg. Based on this research result, it can be known that wastewater from Palm oil industry can promote the growth and production of *Chlorella* sp, that can be used as supplement food for calves in Riau Province.

**Table 2.** The weight (kg) of calves without and with supplement food before and after cultivated for 12 weeks

	Without	With supplement food
Before	115.6	125.0
After	129.0	150.0
Added	13.4	25.0

Many studies have been reported that nitrogen and phosphore are the two main nutrients that can influence phytoplankton growth (Finenko and Akinnina 1974; Febregas et al 1986. Dahril, Ahmad and Iizuka, (1995 and 1998) reported that human manure and animal manures with contain high concentration of nitrogen and phosphore can support the growth and production of freshwater green algae (*Chlorella* sp) in bath culture medium. In this study, we also found that green algae, *Chlorella* sp can growth properly in palm oil wastewater and it can be also used as supplement food for calves. They can also decreased nitrate and phosphate in wastewater contain,. Theyfore, *Chlorella* sp can be used efectively to decrease nitrogen and phosphore in wastewater of palm oil industry in Riau province. The concentration of nitrate and phosphate before and after chlorella growth in many concentration of wastewater from plam oil industry can be shown in tabel 3 follows.

**Table 3.** Mean concentration of nitrate and phosphate before and after Chlorella cultured in each treatments.

Treatments	Nitrate (mg/l)			Phosphate (mg/l)		
	Before	After	Decreased	Before	After	Decreased
P0 (0 %)	4.1	0.4	3.7	0.40	0.09	0.31
P1 (10 %)	7.7	3.3	4.0	0.83	0.11	0.72
P2 (20 %)	13.8	2.4	11.4	1.16	0.17	0.99
P3 (20 %)	18.4	11.8	6.6	1.38	0.64	0.74

#### 4. Conclusion

Based on this study we can conclusion that wastewater from Palm Oil Industry can promote the growth and production of microalgae *Chlorella* sp. That can be used as supplement food for calves. High growth and biomass production of Chlorella was found in the concentration of 20 % of wastewater with cell density of  $6.6 \times 10^6$  cell/ml and biomass, 0.36 gr/l. Than, Chlorella biomass can be used as supplement food to increase the growth and production of calves. The utilization of *Chlorella* sp in wastewater from palm oil industry also can decrease the concentration of nitrate from 13.8 to 2.4, and phosphate from 1.16 to 0.17 mg/l. Therefore, *Chlorella* sp beside can be used as food supplement for animal husbandry, they can also eliminate water pollution from palm oil industry wastewater in Riau Province

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