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ANALYSIS OF THE REUSE OF COCONUT WASTE WATER FOR KANGKONG USING A VERTICAL CULTURE HYDROPONIC SYSTEM

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ABSTRACT

Coconut wastewater is the by-product of the coconut milk store. It contains BOD of 9.908,41 mg/L and COD of 38.264,73 mg/L. It can pollute as it is discharged into received water directly. Pollution can be prevented by wastewater treatment using phytoremediation method. Otherwise, wastewater is also reused as nutrition for hydroponic plant. This study aimed to determine the effectiveness of the vertical culture hydroponic system in reducing BOD and COD concentration of coconut wastewater, the effect of the reuse coconut wastewater on plant growth, and to analyze the suitability of coconut wastewater with hydroponic's standard nutrients. The plant selected in this study was Kangkong (Ipomoea reptans Poir*) with a vertical hydroponic system. The retention time was determined based on the Day After Planting (DAP). The DAP ranged in 0 day, 7 days, and 14 days. The plant parameters observed in this study are height, the number of leaves, and gross weight, compared to the controlled plants that use hydroponic's standard nutrients. The highest reduction of BOD (79,22%) and COD (82,76%) occurs on DAP of 7 days. Plant growth increased as BOD and COD decreased. Initial pollution concentration caused stunted growth, so that the measurement results of phytoremediation plants were below the controlled plants. Coconut wastewater is within the range of standard hydroponic nutrients with 6,16-7,62 pH value, 1.220-1.570 ppm TDS, 2.470-3.180 µS/cm EC, and 25-26°C temperature.*

Keywords: Coconut Wastewater, *Phytoremediaton*, *Hydroponic*, *Kangkong*, *Vertical Culture*

INTRODUCTION

Coconut waste water is waste water from processing coconuts into shredded coconut in the form of a mixture of remaining water from old coconuts, husks and rinsing water. According to research by Ekawati (2014), grated coconut traders can produce an average of 100 L/day of unused old coconut waste water. Further, old coconut wastewater contains high levels pollutants including BOD 750 mg/L, COD 2,222.1 mg/L, TSS 1,164 mg/L, oil and grease 172 mg/L and pH 3.82. Coconut wastewater which is left for long period will be fermented to be acetic acid and pollutes environment (Appaiah, 2014; Arifin, 2019; Valency, 2022).

Wastewater treatment is carried out by treated and reused for plant's nutrition (Waluyo, 2018). Utilizing wastewater is one way prevention of water pollution refers to Government rule of No. 22 of 2021. Apart from reducing the discharge of wastewater to water receiving bodies, can also be done using simple technology to be applied in processes or activities other. Utilization of waste water in the agricultural sector is one of the waste water management efforts that is being widely researched. Phytoremediation allows certain types of plants to reduce pollutant levels in wastewater (Rane et al., 2016; Pranata, 2018). Phytoremediation can be done by applying waste water as nutrients to hydroponic vegetables (Riski and Ramli, 2022; Setyawati et al., 2020).

Susianti's (2021) and Rao and Najam (2016) research results show that coconut water has a significant effect on the growth of hydroponic plants. A

hydroponic plant that is popular because of its fast growth is kangkong (Murti, 2006). Kangkong (Ipomoea reptans Poir) is an aquatic plant that is easy to grow in polluted environments besides genjer and water hyacinth (Hardian, 2007; Hapsari, 2018; Vidyanti, 2019), and is significant in reducing the content of turbidity parameters, BOD, COD, TSS and TDS (Novita, 2019; Nurliansyah, 2016).

Referring to research by Susianti (2021) and Novita (2019), further studies need to be carried out on the use of coconut waste water for hydroponic kangkong plants. Through this research, it is hoped that coconut waste water after the phytoremediation-hydroponic process will experience a reduction in pollutant levels. This research will also analyze the effect of using coconut waste water on the growth of hydroponic kangkong.

RESEARCH METHODS

Research stages include literature review; wastewater sampling; experiment preparation; initial characterizatics of coconut waste water and initial plant's conditions; experiment of phytoremediation process; results of experiment by measurement of BOD and COD parameter of coconut wastewater and plant growth, measurement of coconut waste water parameters and plant growth and conclusions of experiment results.

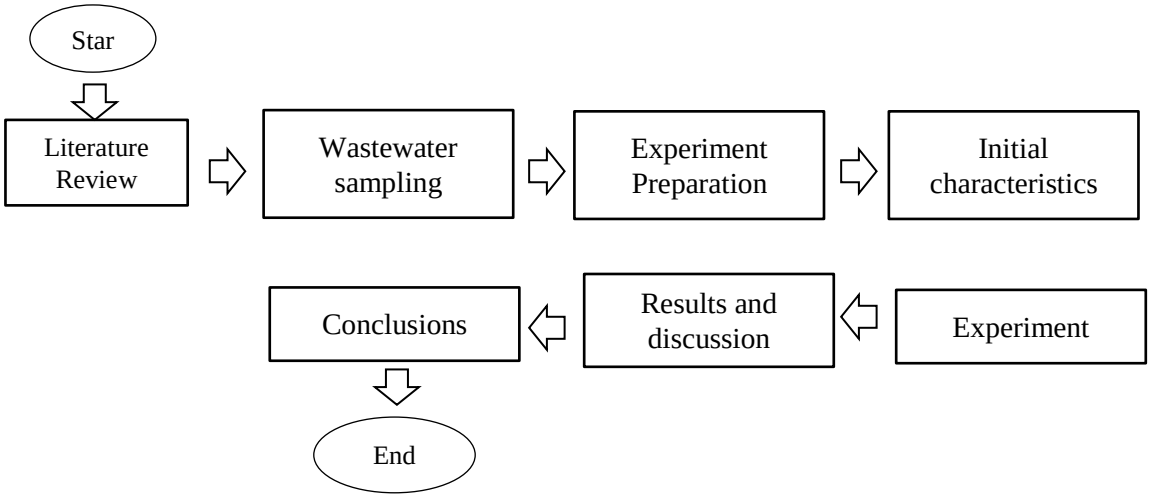

Figure 1. Research stages

Materials

Some equipments used in this research include TDS meters, pH meters, vertical culture hydroponic installations. The hydroponic installation used consists of 6 of 4 inch pipes designed vertically with 14 planting holes in each pipe. It has a wooden frame, equipped with 2 water tanks with a capacity of 25 liters each and a 38 watt circulation pump. In this experiment, each tub was filled with a different water medium. The first tank is filled with coconut waste water which is connected to 3 pipes for phytoremediation plants and the second tank is filled with AB mix nutrient solution with 3 pipes for control plants.

The layout of the verticulture hydroponic installation can be seen in Figure 2.

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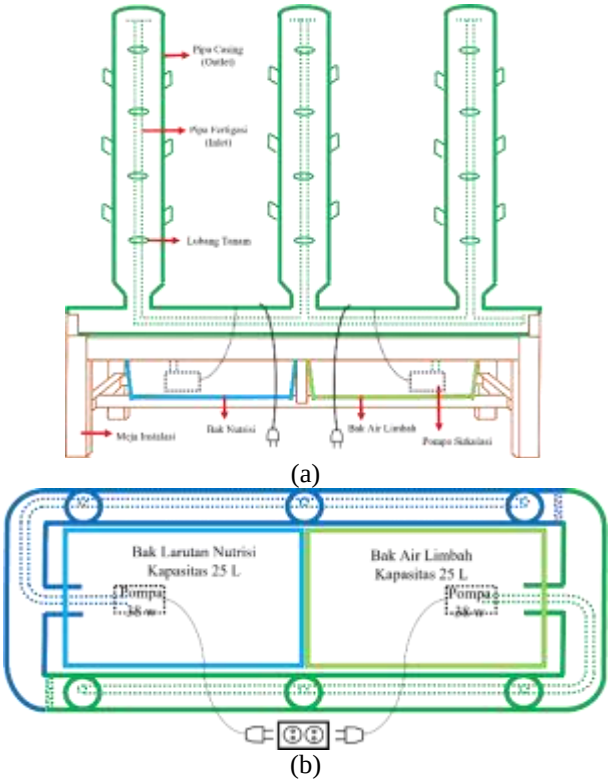

Figure 2. Vertical Culture Hydroponic Installation (a) side view; (b) top view

The materials used in this research included samples of coconut wastewater taken from the shredded coconut shop at Pasar Kebon Kopi Jambi, land kangkong seeds (Ipomoea reptans Poir), clean water and AB Mix nutrients.

Experiment

Plant kangkong seeds at 7 DAP in a hydroponic vertical culture installation until harvest at 14 DAP. Testing for BOD, COD, pH, TDS, EC and temperature of coconut waste water, as well as measuring height and number of leaves at 0 DAP, 7 DAP and 14 DAP. The wet weight of plants was measured at 0 DAP and 14 DAP.

RESULTS AND DISCUSSIONS

BOD Parameters

The results of the phytoremediation-hydroponics experiment showed that the greatest decrease in BOD occurred at 7 DAP and reached 99.29% at 14 DAP. The decrease in BOD at 14 DAP was accompanied by good plant growth.

Table 1
BOD Test Results for coconut waste water

Contact Time (DAP)	BOD (mg/L)	Efficiency (%)
0	9.908,41	-
7	2.059,06	79,22%
14	70,51	99,29%

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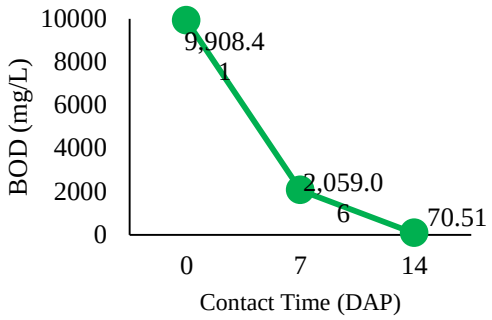

Figure 3. BOD Concentration

Oxygen diffusion from the aeration of the hydroponic vertical culture system and the plant photosynthesis process increases the dissolved oxygen levels needed by microorganisms for aerobic decomposition of organic matter. Plants then utilize elements and energy from the respiration process of microorganisms for vegetative growth and photosynthesis (Effendi et al., 2015). Thus, organic matter in wastewater is reduced and BOD levels decrease.

COD Parameters

The results of the phytoremediation-hydroponics experiment showed that the largest reduction in COD occurred at 7 DAP and reached 99.18% at 14 DAP. The decrease in COD at 14 DAP was accompanied by good plant growth.

Table 4
COD Test Results for coconut waste water

Contact Time (DAP)	COD (mg/L)	Efficiency (%)
0	38.264,73	-
7	6.596,67	82,76%
14	314,64	99,18%

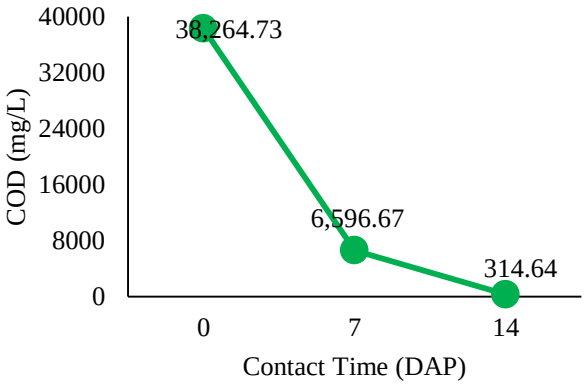

Figure 4. COD Concentration

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Plant Growth Condition

The results of plant growth observations showed that phytoremediation kangkong did not experience a significant increase in height at 7 DAP. Height growth increased at 14 DAP to an average of 28.50 cm, this number was close to commercial standards but quite far below control plants.

Table 5.
Average of Plant Height

DAP	Average of Plant Height (cm)		
	Phytoremediation	Control	Standard
0	9,31	8,88	
7	9,42	18,80	
14	28,50	36,00	30,00

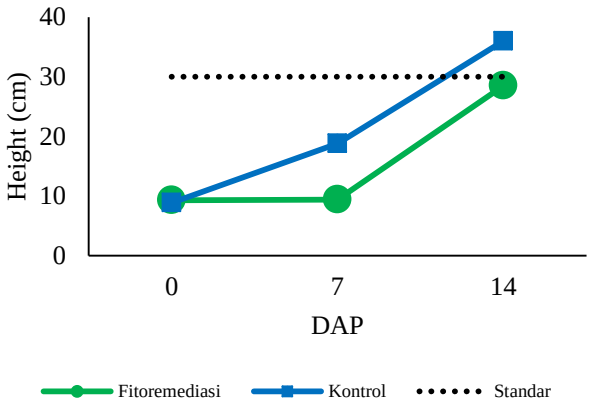

Figure 5. Growth of Plant Height

Wastewater pollutant levels affect the ability to absorb plant nutrients. When BOD and COD are high and the pH is below standard, the growth of kangkong is hampered. Increased new growth is seen as BOD and COD decrease and the pH approaches neutral.

Number of Leaves

The results of plant growth observations showed that phytoremediation kangkong did not experience a significant increase in the number of leaves at 7 DAP. Leaf growth increased at 14 DAT to an average of 7.07 strands, this number was below commercial standards and control plants. Leaf growth is greatly influenced by the nutritional content of the water, especially the availability of nitrogen in the form of nitrate ions. In the initial conditions, the mineral content of coconut waste water has not been decomposed so it cannot be absorbed by plants, and results in yellowish leaves.

Table 6.
Average of Number of Leaves

DAP	Average Number of Leaves		
	Phytoremediation	Control	Standard
0	3,00	3,00	
7	3,05	5,95	
14	7,07	12,00	12,00

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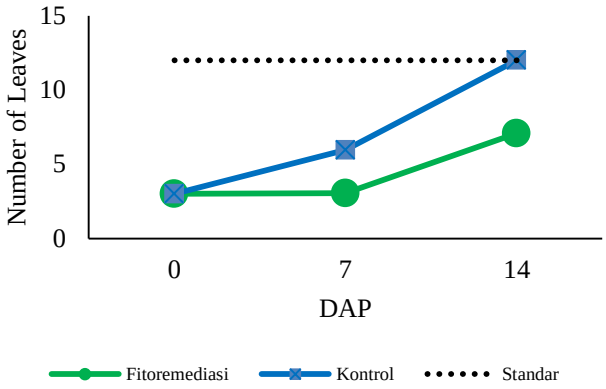

Figure 6. Growth of Number of Leaves

A significant increase in the number of leaves was only seen after decreasing BOD and COD and the pH approached neutral. It can be assumed that the glutamic acid from coconut waste water has decomposed into nitrate which is easily absorbed by plants.

Plant Wet Weight

The results of plant growth observations showed that phytoremediation kale had a fresh weight below commercial standards and was lighter than control plants at harvest.

Fresh weight is influenced by height, number of leaves, stem and root volume. The growth of phytoremediation kangkong was hampered at 7 DAP so that its wet weight was not the same as the control whose growth rate was not inhibited.

Table 7
Average of Plant Wet Weight

DAP	Average Weight (grams)		
	Phytoremediation	Control	Standard
0	5,00	5,00	
14	22,31	35,12	30,00

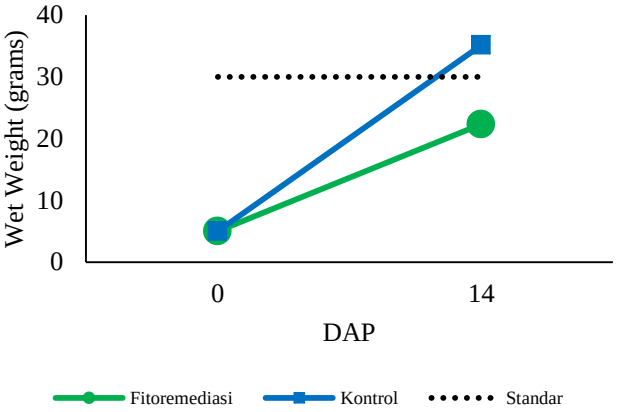

Figure 7. Growth of Wet Weight

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pH Value

The pH value affects the absorption of nutrients in plants and also the growth of decomposing microorganisms in water, where the standard pH value is 5.5-6.5. The results of checking the pH showed that the largest increase in pH value occurred at 7 DAT, namely from 2.88 to 6.16, this value is within the standard range for hydroponic nutrition. And then near neutral at 14 DAP.

Table 8
pH Measurement Results

DAP	pH		
	Coconut Waste Water	AB Mix Nutrient Solution	Standard
0	2,88	4,90	5,5-6,5
7	6,16	3,73	
14	7,62	3,58	

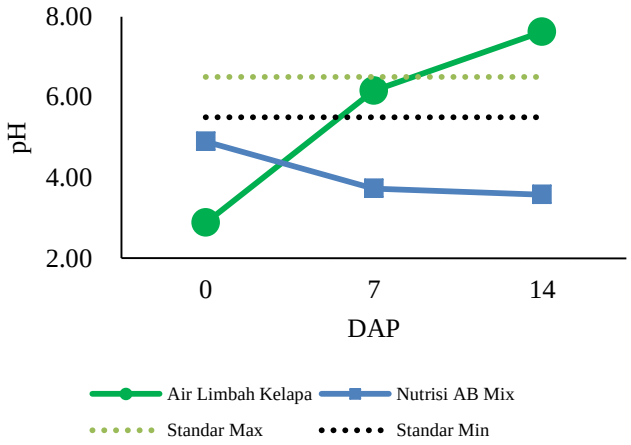

Figure 8. pH values

The increase in pH at 14 DAP was accompanied by good plant growth. The oxidation process of organic compounds can cause an increase in the pH value. In coconut wastewater, oxidative deamination occurs which breaks down glutamic acid into ketone acid and ammonia. Ammonia then goes through a nitrification process by Nitorosmonas and Nitrobacter bacteria that live in the standard pH range to become nitrate. The longer the contact time with the pH value of coconut waste water, the organic material content in coconut waste water decreases because it is decomposed by microorganisms. Coconut waste water at 14 DAP has a pH value close to neutral, which indicates that the decomposition process of organic material is going well.

TDS

The TDS checking results showed that the TDS concentration of coconut waste water was within the standard range for hydroponic nutrition at 7 DAP, and increased to exceed the standard at 14 DAP. The increase in TDS at 14 DAP was accompanied by good pgrowth.

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Table 9
TDS Measurement Results

DAP	TDS (ppm)		
	Coconut Waste Water	AB Mix Nutrient Solution	Standard
0	1.220	1.020	1.050-1.400
7	1.420	1.180	
14	1.570	1.250	

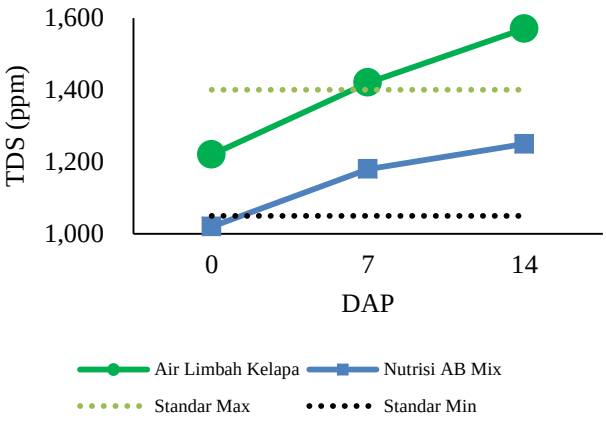

Figure 9. TDS

Electrical Conductivity

The Electrical Conductiviy checking results show that the EC of coconut wastewater is above hydroponic nutrient standards, and continues to increase. The increase in EC at 14 DAP was accompanied by good plant growth.

Table 10.
EC Measurement Results

DAP	EC (µS/cm)		
	Coconut Waste Water	AB Mix Nutrient Solution	Standard
0	2.470	2.020	2.300
7	2.840	2.360	
14	3.180	2.500	

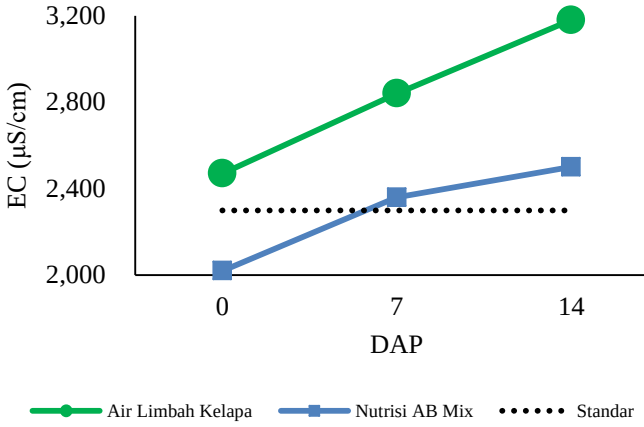

Figure 10. Electrical Conductivity

Water Temperature

The results of checking the water temperature showed that the temperature of the coconut waste water during the phytoremediation process was within the standard range for hydroponic nutrition.

Table 11
Water Temperature Measurement Results

DAP	Temperature (^{o}C)		
	Coconut Waste Water	AB Mix Nutrient Solution	Standard
0	25	25	20-30
7	25	25	
14	26	26	

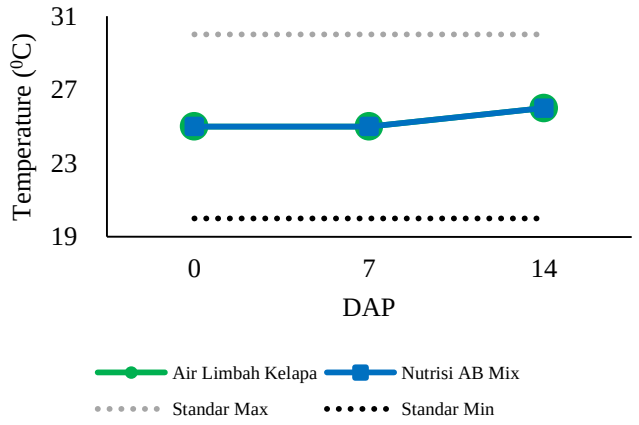

Figure 11. Water Temperature

CONCLUSION

The conclusions that can be drawn from this research are as follows:

1. Kangkong plants using a verticulture hydroponic system are very effective in reducing coconut waste water pollution parameters. The greatest parameter reduction efficiency occurred at 7 DAP including BOD 79.22% and COD 82.76%. The final

results at 14 DAP showed a reduction in BOD reaching 99.29% and COD 99.18%;
2. The pollutant content of coconut wastewater affects the growth of hydroponic kangkong plants. At 14 DAP, the phytoremediation plants produced an average height of 28.50 cm, 7.07 leaves and a wet weight of 22.31 grams. The three parameters of the phytoremediation plants were smaller than the control plants which had an average height of 36 cm, 12 of leaves, and a wet weight of 35.12 grams;
3. Coconut wastewater can be used as nutrition for hydroponic kangkong plants in the pH value range of 6.16-7.62, TDS 1,220-1,570 ppm, EC 2,470-3,180 µS/cm, and water temperature 25-26 ^{o}C.

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