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Micro Nutrients (Fe, Mn, Zn, and pH) Effluent Digester Biogas Raw Material Water Hyacinth (*Eichornia crassipes*) as Raw Material for Organic Fertilizer

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ABSTRACT

Introduction: Water hyacinth (Eichhornia crassipes) which has the ability to grow very fast has turned into wild aquatic plants and causes losses, among others, accelerates silting of waters, reduces fish production due to taking up space and nutrients that are also needed by fish, complicating irrigation channels, blocking boat traffic and causes greater evaporation of water than in open water. The research objectives were: To utilize the effluent digester of biogas as raw material for water hyacinth (Eichhornia crassipes) as a liquid organic fertilizer by analyzing macro and micro nutrients. **Methods**: The study design was one group post test design. The research was conducted by taking samples in Bening Reservoir (PT.Jasa Tirta): Pajar Village, Saradan District, Madiun Regency, East Java. The research was carried out in the Laboratory of D-III Environmental Health Magetan Poltekkes of the Ministry of Health, Surabaya and the Laboratory of Soil Science, Faculty of Agriculture, Sebelas Maret University, Surakarta. The research was carried out with treatment for: 7 days, 14 days and 21 days by measuring: Micro nutrient elements. set and the pH at the end of the observation. Treatment activities and variations in research dosages were as follows: The number of research samples was: 6 samples with research parameters for micro nutrients: Fe, Mn, Zn and pH. The sampling technique was simple random sampling. Tools used: A set of fermentation tools in the form of a bucket with a lid equipped with a wooden stirrer, measuring cup and scale. The research materials include: biogas effluent digester (raw material for fertilizer), fermentation bacteria / fermenter (EM-4), molasses and water. Data were collected by conducting laboratory examinations of samples sent and examined with micro nutrient parameters according to variations in observation time. Data analysis was carried out by comparing the requirements for organic fertilizers. Minimum Technical Requirements for Organic Fertilizer, Biofertilizer and Soil Improvement. All micro nutrient parameters (Fe, Mn, Zn and pH) are in accordance with the required standards for fertilizers. **Results**: Micro nutrients (Fe): 192 ppm, without treatment as a control decreased to: 66.86 ppm, Mn nutrients, without treatment: 119.46 ppm, Zn analysis results, without treatment: 9.92 ppm, pH parameters have met the requirements, namely between 4-9 while the results of laboratory tests are in the range of 6.96 - 7.93. The results of the research on the treatment with the addition of EM-4 & Molasses with fermentation time of 7, 14 and 21 days, there was a decrease in the quality of micro nutrients, not according to the quality standards of liquid fertilizers. **Conclusion**: The conclusion of the results of this study is that the micro nutrient content before treatment (Fe, Mn, Zn) and pH, it turns out that some have met the requirements according to the Ministry of Agriculture, except that Zn nutrients are still below the standard. Micro nutrient content after treatment week 1 to week 3 and control, the nutrients (Fe, Mn, Zn) and pH were still below without treatment. The effluent of the biogas digester as raw material for water hyacinth without any treatment has met the requirements as an organic fertilizer as long as its use has exceeded 60 days in the digester.
Keywords: water hyacinth; biogas energy; micro nutrients; organic fertilizers

INTRODUCTION

Background

The development of alternative renewable energy becomes an opportunity and is getting stronger after the government issued Presidential Regulation No. 5 of 2006 concerning national energy policies to develop alternative energy sources as a legal umbrella[(1,2)]. Biogas as one of the most effective and efficient renewable biomass alternative energies to reduce dependence on fuel oil can be developed as well as inhibiting the rate of global warming through the use of methane gas (CH4). Eichornia crassipes (water hyacinth) is an aquatic plant whose existence can disrupt the balance of the aquatic ecosystem itself, this is due to its very fast growth and covering the surface of the water so that the growth of micro plangton is disrupted[(3,4)]. Until now, no control method has been found unless removed from the waters and no clear benefits have been found from the

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Eichornia crassipes (water hyacinth). Thus it is interesting for us to conduct research on the use of Eichornia crassipes (water hyacinth) as a raw material for making biogas. The results of the study concluded that the production of biogas using water hyacinth biogas as raw material began from the 10-day fermentation period to the 60-day fermentation period and the optimum fermentation period occurred on the 35th day [(4)].

The development of biomass energy by utilizing Eichornia crassipes (water hyacinth) as an alternative energy source of biogas has been proven that research was carried out in 2019 and the results were quite satisfying. New problems that need to be considered with the use of Eichornia crassipes (water hyacinth) as raw material for biogas effluent need to be managed so as not to pollute the environment. In the next activity, we will conduct further research on the utilization of the effluent as raw material for making liquid organic fertilizers[(5)].

Water hyacinth contains nutrients that can be used by plants. The results of the chemical analysis of water hyacinth in a fresh state consisted of 36.59% organic matter, 21.23% C-organic, 0.28% total N, total P 0.0011%, 0.016% total K, C / N ratio 75.8 % and 20.6% crude fiber 6. The high fiber content and C / N ratio resulted in the fermentation process both for making compost which took longer than other plants. Every plant needs macro nutrients including: C, H, O, N, P, K, Ca, Mg, S and Micro Nutrients Fe, Mn, Mo, B, Cu, Zn, and pH[(6,7)].

Purpose

The purpose of this study was to determine the micro nutrient content (Fe, Mn, Zn, and pH) of biogas digester effluent as raw material of water hyacinth (Eichhornia crassipes) as liquid organic fertilizer.

METHODS

The study design was a one group post test design. The research was conducted by taking samples in Bening Reservoir (PT.Jasa Tirta): Pajar Village, Saradan District, Madiun Regency, East Java. The research was carried out in the Laboratory of D-III Environmental Health Magetan Poltekkes of the Ministry of Health, Surabaya and the Laboratory of Soil Science, Faculty of Agriculture, Sebelas Maret University, Surakarta. The research was carried out with treatment for: 7 days, 14 days and 21 days by measuring: Micro nutrient elements. set and the pH at the end of the observation. Treatment activities and variations in research dosages were as follows: The number of research samples was: 6 samples with research parameters for micro nutrients: Fe, Mn, Zn and pH. The sampling technique is Simple Random Sampling. Tools used: A set of fermentation tools in the form of a bucket with a lid equipped with a wooden stirrer, measuring cup and scale. The research materials include: biogas effluent digester (raw material for fertilizer), fermentation bacteria / fermenter (EM-4), molasses and water. Data were collected by conducting laboratory examinations of samples sent and examined with micro nutrient parameters according to variations in observation time. Data analysis was carried out by comparing the requirements for organic fertilizers. Minimum Technical Requirements for Organic Fertilizer, Biofertilizer and Soil Improvement. All micro nutrient parameters (Fe, Mn, Zn and pH) are in accordance with the required standards for fertilizers.

RESULTS

The results of the research based on the analysis of macro nutrients in organic fertilizers carried out in the Chemical and Soil Fertility Laboratory, Soil Science Study Program, Faculty of Agriculture, Sebelas Maret University, are as follows'.

Table 1. Chemical laboratory analysis results and soil fertility

Code (total EM-4)	Degree of acidity (pH) Electrode glass	Fe (ppm) Extraction HNO_3 & $HClO_4$	Mn (ppm) Extraction HNO_3 & $HClO_4$	Zn (ppm) Extraction HNO_3 & $HClO_4$
Waste	*7.93*	*192*	*119,46*	*9,92*
P-0	7.13	66.86	62.56	2.44
P-1	7.08	75.96	59.94	4.12
P-2	6.99	119.60	50.14	12.22
P-3	6.96	143.00	45.64	9.54

Information: P-0 = Control: P-1 = Treatment 1 week (7 days); P-2 = Treatment 2 weeks (14 days); P-3 = treatment 3 weeks (21 days). Waste = examination before the study begins

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Comparison of the results of the analysis of micro nutrient content of organic fertilizers with the requirements of the decision of the Minister of Agriculture. Below are the results of the analysis of each organic fertilizer macro nutrient (research results) compared with the requirements, namely the Decree of the Minister of Agriculture of the Republic of Indonesia Number: 261 / KPTS / SR.310 / M / 4/2019 concerning: Minimum Technical Requirements for Organic Fertilizers, Biological Fertilizers and Soil Improvement.

Micro Nutrient (Fe)

Table 2. The results of the analysis of micro nutrients (Fe)

No	Treatment code	Fe (ppm)	Quality standards (ppm)
1	*Waste*	*192*	90 – 900
2	P-0	66.86	90 – 900
3	P-1	75.96	90 – 900
4	P-2	119.60	90 – 900
5	P-3	143.00	90 – 900

Information: K = Control: P-1 = Treatment 1 week (7 days); P-2 = Treatment 2 weeks (14 days); P- 3 = Treatment 3 weeks (21 days)

Table 2 laboratory test results show effluent waste without treatment for parameters for micro nutrients (Fe) obtained results: 192 ppm, which without treatment as a control decreased to: 66.86 ppm, with treatment for the first, second and third weeks there was an increase, but still below that without treatment, while the standard in MOA 261 of 2019 is 90 - 900 ppm, that is, without any treatment as long as the time exceeds 60 days, it meets the requirements.

Table 3. Results of analysis of micro nutrients (Mn)

No	Treatment code	Mn (ppm)	Quality standards (ppm)
1	*Waste*	*119.46*	25 – 500
2	P-0	62.56	25 – 500
3	P-1	59.94	25 – 500
4	P-2	50.14	25 – 500
5	P-3	45.64	25 – 500

Information: K = Control: P-1 = Treatment 1 week (7 days); P-2 = Treatment 2 weeks (14 days); P-3 = Treatment 3 weeks (21 days)

Table 3 is the result of Mn analysis, without treatment: 119.46 ppm, both with control and with the first, second and third week of treatment, instead there is a decrease, while the standard in the MOA is waste without treatment, which is 25 - 500 ppm, meaning that also without any treatment it meets the requirements.

Table 4. The results of the analysis of micro nutrients (Zn)

No	Treatment code	Zn (ppm)	Quality standards (ppm)
1	*Waste*	*9.92*	25 – 500
2	P-0	2.44	25 – 500
3	P-1	4.12	25 – 500
4	P-2	12.22	25 – 500
5	P-3	9.54	25 – 500

Information: K = Control: P-1 = Treatment 1 week (7 days); P-2 = Treatment 2 weeks (14 days); P-3 = Treatment 3 weeks (21 days)

Table 4 is the result of Zn analysis, without treatment: 9.92 ppm, both with control and treatment in the first week there was a decrease, but in the second and third week of treatment, there was an increase almost the same as without treatment, meaning that for Zn nutrients, all of them both treatment and control, do not / have not met the requirements of the MOA, namely 25 - 500 ppm.

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Table 5.The results of the analysis of degree of acidity (pH)

No	Treatment Code	Acidity (pH)	Quality Standards
1	*Waste*	7.93	4-9
2	P-0	7.13	4-9
3	P-1	7.08	4-9
4	P-2	6.99	4-9
5	P-3	6.96	4-9

Information: K = Control: P-1 = Treatment 1 week (7 days); P-2 = Treatment 2 weeks (14 days); P-3 = Treatment 3 weeks (21 days)

Table 5 is the result of laboratory examination of both the waste as a control and treatment group in this study. The results of the examination of the pH parameters have met the requirements, namely the results of laboratory tests of 6.96 - 7.93.

DISCUSSION

Water hyacinth (*Eicchornia crassipes*) is a very fast growing aquatic weed. Water hyacinth is a type of water plant that has the ability to absorb and accumulate heavy metals[7]. Based on the research results, without treatment, control and with treatment, the results of each parameter were obtained. Inside the biogas digester is the most important part of the biogas manufacturing plant. This occurs due to the an-aerobic fermentation process which breaks down organic materials which in addition to producing gas and one of them is methane gas (CH4) which is known as biogas. The effluent digester produces liquid organic fertilizer, which contains macro and micro nutrients[8]. Water hyacinth can be used in the production of biogas because it has a relatively large hemicyculose content compared to other single organic components. Hemicellulose is a complex polysaccharide which is a polymer mixture which, when hydrolyzed to produce a mixture of derivatives that can be processed by anaerobic digestion method to produce simple compounds in the form of methane and carbon dioxide, commonly called biogas[9]. The principle of making organic fertilizers, which is to remodel the organic elements contained in organic matter into inorganic elements that are easily absorbed by plants with the help of microorganisms. This causes the micro nutrient elements (Fe, Mn, Zn and pH), actually has occurred when it comes out of the digester, because the fermentation process has already occurred perfectly, so by treatment with the addition of fermenter bacteria (EM-4) and molasses, the final result shows the micro nutrients actually happen less well. This means that the maximum fermentation process occurs when the water hyacinth is during fermentation in the digester, and is located in the effluent of the fermentation process. Water hyacinth contains nutrients that can be used by plants.6.10. According to Hadisuwito (2012) organic fertilizer is a fertilizer made from organic materials such as plants, livestock manure and dead living things[11]. Furthermore, Yuniwati et al. (2012) stated that without organic fertilizers, the efficiency and effectiveness of absorption of plant nutrients will not run smoothly because the effectiveness of nutrient absorption is strongly influenced by organic fertilizers which play a role in maintaining soil function so that the nutrients in the soil are provided by chemical fertilizers are easily absorbed by plants. One of the plants that can be used as organic fertilizer is water hyacinth. Water hyacinth is a plant whose existence is considered a weed in the waters[6]. Organic fertilizers as stated in MOA No.2 of 2006, are defined as fertilizers which partly or entirely consists of organic material derived from plants and / or animals that have gone through an engineering process, can be solid or liquid which is used to supply organic matter, improving properties physical, chemical and biological soil. Fertilization aims to increase the nutrients needed by plants, because the nutrients contained in the soil are not always sufficient to optimally stimulate plant growth.

The relatively high and continuous use of inorganic fertilizers can cause negative impacts on the soil environment, thereby reducing the productivity of agricultural land. The use of organic fertilizers is able to maintain land balance and increase land productivity and reduce the environmental impact of the soil [10]. Water Hyacinth POC Nutrient Content. The liquid fertilizers used in this research are organic water hyacinth liquid fertilizer combined with coconut husk and banana stalks. It aims to increase the content of organic N, P, K and C needed by plants[8].

Compared with the nutrients N, P, K water hyacinth, the nutrients N, P, K, the combination of liquid water hyacinth fertilizers increased respectively by 0.24%, 0.0007% and 0.082%. In previous studies it was found that the N, P, and K content of water hyacinth was 0.28% total N, 0.0011% total P and 0.016% total K[8,10-12].

Biogas is a flammable gas that is produced from the fermentation process of organic materials by anaerobic bacteria (bacteria that live in airtight conditions. Organic material is put into an airtight closed chamber (called a digester) so that the anaerobic bacteria will decomposing the organic material which then produces gas (called biogas). The biogas that has been collected in the digester is then flowed through the gas supply pipe to the gas storage tube or directly to the location where it is used[13-16].

Biogas in the application of Waste Utilization Engineering plays an important role, because biogas with its chemical name Methane (CH4) is one of the Greenhouse Gases (GHG) group which is more dangerous in global warming when compared to Carbon Dioxide (CO2) gas. This is because the carbon that makes up biogas is carbon taken from the atmosphere by plant photosynthesis, so that when it is released into the atmosphere again it will not increase the amount of carbon in the atmosphere when compared to burning fossil fuels1[4,17,18].

Organic fertilizers as stated in MOA No.2 of 2006, are defined as fertilizers which partly or entirely consists of organic material derived from plants and / or animals that have gone through an engineering process, can be solid or liquid which is used to supply organic matter, improving properties physical, chemical and biological soil. Fertilization aims to increase the nutrients needed by plants, because the nutrients contained in the soil are not always sufficient to optimally stimulate plant growth. The relatively high and continuous use of inorganic fertilizers can cause negative impacts on the soil environment, thereby reducing the productivity of agricultural land. The use of organic fertilizers is able to maintain land balance and increase land productivity and reduce the environmental impact of the soil [10,19]. Effective liquid organic fertilizer for water hyacinth (*Eicchornia Crassipes*) Fermentation of Trichoderma spp. Against the growth of slada (*Lactuca sativa L*) The conclusion of this study is: Provision of fermented water hyacinth liquid organic fertilizer has a significant effect on the growth of lettuce (*Lactuca sativa L*) 20. Ervinda Yuliatin, Yanti Puspita Sari, Medi Hendra. 2018. Effectiveness of liquid organic fertilizer from water hyacinth (*Eichornia crassipes*) for growth and brightness of the red leaves of *Aglonema lipstick*. From this research it is concluded that: Liquid organic fertilizer of water hyacinth has a significant effect on the brightness of the red leaves. Utilization of biogas effluent digester (Polyethilene) as raw material for cow dung as liquid organic fertilizer in the village of Janggan, Poncol District, Magetan Regency in 2015. From this research it was concluded that: the results of the analysis of the biogas effluent digester raw material for fresh cow dung showed: C-organic, Nitrogen, Phosphate and Kaliun and C / N ratio meet the minimum technical requirements of liquid organic fertilizer as required in According to MOA Number: 261 / KPTS / SR.310 / M / 4/2019 regarding the technical requirements of organic fertilizer oil, biological fertilizers and soil empowerment [15,21,22].

CONCLUSION

The conclusion of the results of this study is the micro nutrient content before treatment (Fe, Mn, Zn) and pH, it turns out that some of them have met the requirements, except the Zn nutrient is still below the standard. Micro nutrient content after 1 to 3 week treatment and control, the nutrients (Fe, Mn, Zn) and pH were still below without treatment. The effluent of the biogas digester as raw material for water hyacinth without any treatment has met the requirements as an organic fertilizer as long as the usage has exceeded 60 days in the digester.

The recommendation of this research is the biogas effluent digester as raw material for water hyacinth, after being used for biogas, the effluent that has come out can be directly used for plants as liquid fertilizer, because the nutrients have met the requirements. If fertilizer users / farmers are accustomed to using solid fertilizers, it can be used process by making granule fertilizer, so that its use is easier.

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