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Potency of biodiesel from sediment of coagulation-flocculation-sedimentation process using *Moringa oleifera* as coagulant

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ABSTRACT

Coagulation and flocculation process is always ended up with sedimentation process. The success of settling process depends on quantity of settled floc. Appropriate concentration, pH, and velocity become important factors for the performance of the coagulant. *Moringa oleifera* is organic coagulant, cheap, and easy to produce it. Settled floc has been observed the biomass, and lipid ingredient for its potency as biodiesel. The aims of this research were to determine the influence of concentration, pH and flocculation speed, rapid mixing time variation on the results of biomass and lipid harvesting using *Moringa oleifera* as coagulant in Bozem Morokrembangan. Jar tests experiment were carried out at different concentrations of *Moringa oleifera* of 0-100 mg/L and pH variation were 4.5-6.5. The next step was to determine the optimum variation of the flocculation speeds were 0-50 rpm. Data analysis in this research was descriptive analysis presented with graphs, as well as statistical analysis using Anova One-Way test. The optimum coagulant concentration with *Moringa oleifera* for harvesting biomass and lipid of sediment was obtained in this study of 60 mg/L and pH 6.5. The optimum speed of flocculation was obtained in this study at 0 rpm of rapid mixing is optimum for settling flocculation using *M. oleifera*.

Key words : *Biomass, Lipid production, Jartest, Rapid mixing, Slow mixing*

Introduction

Boezem Morokrembangan is the one of the biggest boezem at Surabaya, Indonesia. Unfortunately, this boezemreceives various kinds of nutrients from untreated sewage from houses around boezem. High nutrient in fresh water causes eutrophication and inbalance in ecological function. Eutrophication influences water quality especially suspended solid content. High suspended solids can be removed with several technics, such as filtering, coagulation-flocculation-sedimentation process. This research only focuses on coagulation-flocculation-sedimentation process.

In order to reduce negative effect using chemical coagulants, natural coagulants are interesting solution. Several materials from microorganisms, animals, or plants, canbe used as natural coagulants, such as chitosan (Zemmouri *et al.*, 2012), Jatropha curcas seeds (Abidin *et al.*, 2013), *Moringa oleifera* (Oladoja, 2015). African and South Asian countries used *M. oleifera* seed as coagulant for water and wastewater treatment. Cationic protein is composition in *M. oleifera* that bounded particle in water and then floc easily precipitate (Madrona *et al.*, 2012). Usually, sediment after coagulation process only disposal. Otherwise, sediment from those process contain settled microorganism such as microalgae, bacteria, or yeast. Each living microorganism has lipid in their cell. Therefore, it needs to be explored its potency from sediment of coagulation process. Lipids content from microorganism can be used

This research due to observed sediment from coagulation-flocculation-sedimentation process about biomass and lipid concentration. High lipid concentration in sediment has potency to be used as energy alternative. Lipid concentration can be resulted from microorganism biomass.

Methods

Moringa oleifera preparation

Moringa oleifera (MO) seeds was usedfrom East Java, Indonesia. MO seeds was dried using sunlight and manually peeled the husk covering the MO seeds. Peeled MO was grinded using blender until powder size. Powdered size of MO seed was filtered using a mesh size of 100 to obtain a homogeneous powder.

Water Samples

Contaminated water was collected from Boezem Morokrembangan, Surabaya Indonesia. This boezem receive untreated sewage from houses at its neighborhood. Eutrophication also occurred in this boezem. Sampling was conducted in entrance, middle, and exit of boezem.

Experimental Design

Jar test experiment was conducted for treated boezem water using coagulation-flocculation-sediment process. This research was divided in 3 steps. First step was observed influence of MO concentration. MO concentration varied in 0, 20, 40, 60, 80, 100 mg/L. Second step. MO treated boezem water with variation of pH condition 4.5; 5; 5.5; 6; 6.5; control (without pH adjustment). Third step was flocculation speed 0, 10, 20, 30, 40, 50 rpm.

In every step, 500 mL of boezem water is used and treated using Coagulation-Flocculation-Sedimentation Process. This research used 150 rpm of mixing velocity in 1.5 minutes and flocculation 10 rpm in 10 minutes and sedimentation in 30 minutes. At step 3, application of flocculation mixing time according its variation. Sample for biomass and lipid analysis was taken from sediment after sediment process.

Biomass Analysis

Dry Cell Weight (DCW) was used as biomass analysis method. 10 mL volume of treated water from the Jar test process was centrifuge at 3000 rpm for 5 minutes. The collected biomass was rinsed with distilled water. The biomass was then filtered on weighed filter paper and dried at 105 ^{o}C for 2 hours and then weighed.

Lipid analysis

Lipid extraction of biomass was conducted with adding 20 mL of N-Hexane and centrifuge for 10 minutes in 3000 rpm. Two layers were is silbe after centrifuge process, oil and water phase. Only oil phase after centrifugation was treated with ultrasound 10 kHz for 10 minutes (Lee, 2010) and then centrifuge again to make 2 phases. Only oil phase was evaporated at 80 ^{o}C to eliminate N-hexane using weighed evaporation flask.Lipid content was determined using equation (1)

Mass of Lipid (gr) = Mass of total sample after evaporate flask - Mass of empty flask
(1)

Results and Discussion

Effect of *Moringa oleifera* concentration

Figure 1 showed the mean value of biomass after using *Moringa oleifera* (MO) seed powder as a coagulant. Results showed that adding MO seed powder reduced biomass significantly. MO interacted with suspended solid became floc This experiment was conducted with different concentrations of 0, 20, 40, 60, 80, and 100 mg $L^{-}1$ in 30 min settling time and results showed that the biomass was decreased from 0.2433 g/L to 0.1033; 0.0800; 0.1133, 0.1300, 0.050g/L with the 0, 20, 40, 60, 80, 100mg L^{-1}, respectively, of coagulant dose (Fig. 1).

Even, protein in MO seed powder contain water soluble dimeric cationic proteins. Therefore MO has capability as coagulant (Vunain *et al.,* 2019). MO seed powder accepted hydroxyl group as reaction from protein in MO as natural polyelectrolytes (Hendrawati *et al.,* 2016). In this experiment presented that without MO, suspended solid precipitate by weighed of its particle. Combination process of adsorption as charge neutralization and particle bridging of destabilized particle as reaction of protein existence (Camacho *et al.,* 2017) also showed in process between boezem water and MO.

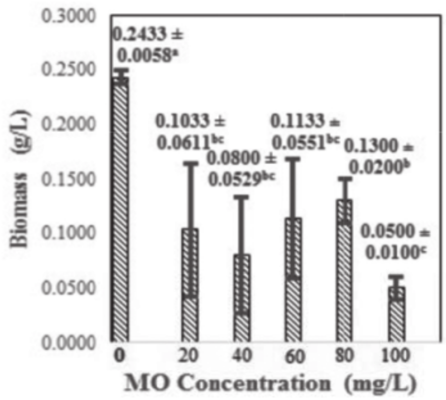

Fig. 1. Biomass Content from MO concentration

The highest lipid of suspended solid was with the use of 60 mg/L coagulant (28.69 ± 9.10 g/L) significantly different from the use of 0 mg/L coagulant (2.53 ± 1.69), 20 mg/L (5, 12 ± 2.62), 40 mg/L (14.39 ± 4.0), and 80 mg/L (15.18 ± 2.21), but did not show a significant difference with the use of 100 mg/L coagulant (22.39 ± 2.68) (Fig. 2). This shows that it was an influence of the concentration of coagulants with *Moringa oleifera* on suspended solids.

Optimum MO concentration for Biomass and lipid has different value. This research is using total biomass method. Which, suspended solid was contained living and not living thing. Boezem water sample has many diversities of living organism. Each organism has different lipid content in their cell. Therefore, 0 ppm concentration had the highest biomass.

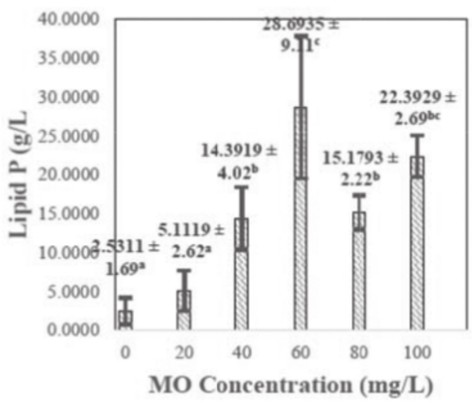

Fig 2. Lipid Content with Variation of MO Concentration

Effect of pH adjustment

Based on Figure 3, the results of harvesting microalgae biomass based on variations in pH control; 6.5; 6; 5.5; 5; and 4.5, respectively, 1.115 ± 0.158 g/L; 1.703 ± 0.005 g/L; 0.573 ± 0.158 g/L; 0.290 ± 0.102 g/L; 0.733 ± 0.222 g/L; and 0.717 ± 0.273 g/L. The most harvested microalgae biomass occurs when using pH 6.5, that is 1.703 ± 0.005 g/L and the least harvested microalgae biomass occurs when using pH 5.5 i.e. 0.290 ± 0.102 g/L. The initial biomass obtained was 1.75 g/L.

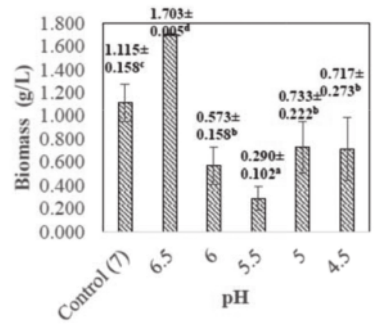

Fig. 3. Biomass Content with Variation of pH in Solution

According to Hamid *et al.* (2014), the reason pH can affect the coagulation-flocculation method is that pH can affect the zeta potential value, adding or reducing pH will trigger an increase in the zeta potential value. Zeta potential is the electrical potential that occurs between particles that causes suspended colloids and is a characteristic of a particle that is able to prevent agglomeration.

The high value of zeta potential has relation with the electrical repulsion between particles is very strong and when the values are close to zero, the particles will be attracted by the Van der Waals force and make aggregate and flocculate - coagulation can occur. pH range 4.5-6.5 and at pH <4.5 and > 6.5 the zeta potential value is very large. Therefore, sediment has high biomass using pH 6.5 has the largest yield it has the smallest zeta potential value that makes suspended solid easy to aggregate which then causes easy sedimentation and large yields. Fluctuations that occur in the pH range of 4.5-6 was caused by zeta potential values. According to Hamid *et al.* (2014), the zeta potential value in the pH range is 4.5-6 which is -20.00 to -20.90 mV.

Based on Figure 4, lipid harvesting also fluctuated as response of pH variations. Usually, biomass production and lipid composition have correlation. However, the treatment without pH adjustment has highest lipid production. This happens because the results of harvested lipids are also influenced by microorganism species inside suspended solid. Bozem Morokrembangan has various microorganism, and it is possible that microorganism in suspended solid from pH 6.5 has low lipid content.

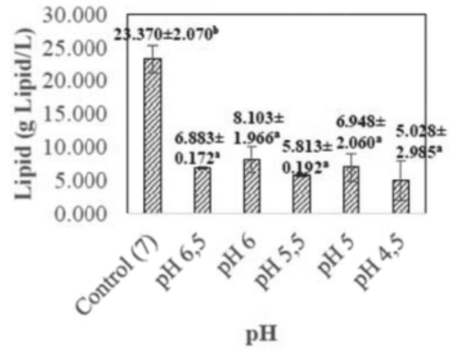

Fig. 4. Lipid Content with pH variation

Effect of flocculation speed

Based on Figure 5, the weight biomass using 60 mg/L coagulant shows fluctuating graphs. The highest biomass when using flocculation speed of 40 rpm with biomass weight. The yield of harvested biomass with the addition of coagulant at the use of a 50-rpm flocculation speed resulted in the weight of the least harvested biomass that is (0.42 ± 0.29) g / L.

According to Kan *et al.* (2001) this happens because the stirring time in the coagulation process will have an impact on colloidal destabilization and floc formation (aggregation) in the next process. The

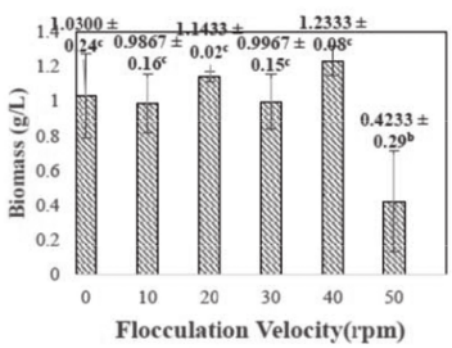

Fig. 5. Biomass Content with Flocculation Velocity variation

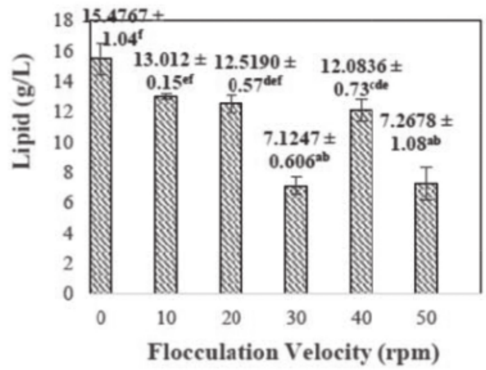

Fig 6. Lipid Content with Flocculation Velocity Variation

coagulant used in this study was seeds from *Moringa oleifera* which contained high protein which worked like cationic polyelectrolytes (Moreno *et al.*, 2015). According to Yukselen and Gregory (2004), for cationic polyelectrolyte coagulants it takes a longer time to stir quickly to form floc. Aktas *et al.*, (2013) also informed that a long fast stirring time (> 60 seconds) will increase the number of collisions between flocks that cause flocks to form easily, but if the mixing time is too fast, the surface properties of the flocks will change due to rupture and reunification of the fragment flock which then causes floc difficult to form again and finally the floc formed decreases.

Conclusion

Sediment from Coagulation-Flocculation-Sedimentation process contains of deposit of living or unliving organism. Each living organism has lipid in their cell, which it has potency to use for several purposes such as energy, medical, etc. This research observed biomass and lipid in lipid after Coagulation-Flocculation-Sedimentation process using Moringa oleifera (MO). Suspended solid from Boezem has high lipid using 60 mg/L of MO in Ph 6.5 and using 0 rpm of flocculation.

References

Abidin, Z.Z., Mohd Shamsudin, N.S., Madehi, N. and Sobri, S. 2013. Optimisation of a method to extract the active coagulant agent from *Jatropha curcas* seeds for use in turbidity removal. *Ind. Crop. Prod.* 41: 319e323.https://doi.org/10.1016/j.indcrop.2012.05.003

Aktas, T. S., Fujibayashi, M., Maruo, C., Nomura, M. and Nishimura, O. 2013. Influence of velocity gradient and rapid mixing time on flocs formed by Polysilica Iron (PSI) and Polyaluminum Chloride (PACl). Des. Water. *6*. https://doi.org/10.1080/19443994.2012.751883

Camacho, F.P., Sousa, V.S., Bergamasco, R. and Ribau Teixeira, M. 2017. The use of *Moringa oleifera* as a natural coagulant in surface water treatment. *Chem. Eng*. 313 : 226-237. https://doi.org/10.1016/j.cej.2016.12.031

Hendrawati, Yuliastri, I.R., Nurhasni, Rohaeti, E., Effendi, H. and Darusman, L.K. 2016. The use of *Moringa oleifera*seed powder as coagulant to improve the quality of wastewater and ground water. *IOP Conf. Ser: Earth Environ. Sci*. 31: 012033. https://doi.org/10.1088/1755-1315/31/1/012033

Hamid, S.H.A., Lananan, F., Din, W.N.S., Lam, S.S., Khatoon, H., Endut, A. and Jusoh, A. 2014. Harvesting microalgae, *Chlorella sp*. by bio-flocculation of *Moringa oleifera* seed derivatives from aquaculture wastewaterphytoremediation. *Int. Biodet. Biodeg*. 1-3. https://doi.org/10.1016/j.ibiod.2014.06.021

Kan, C., Huang, C. and Pan, J.R. 2001. Time requirement for rapid-mixing in coaguation. *Col. Surfa.* 8. https://doi.org/10.1016/S0927-7757(01)01095-0

Lee, J. Y., Yoo, C., Jun, S. Y., Ahn, C. Y. and Oh, H. M. 2010. Comparison of several methods for effective lipid extraction from microalgae. *Bior. Tech*. S75-S77. https://doi.org/10.1016/j.biortech.2009.03.058

Madrona, G.S., Branco, I.G., Seolin, V.J., Alves Filho, B.D.A., Fagundes-Klen, M.R. and Bergamasco, R. 2012. Evaluation of extracts of *Moringa oleiferalam* seeds obtained with NaCl and their effects on water treatment. *Acta Sci. Technol.* 34. https://doi.org/10.4025/actascitechnol.v34i3.9605

Moreno, M. M. B., Heredia, J. B. and Gallardo, J. M. 2015. Microalgae removal with *Moringa oleifera*. *Toxicon.* 69. https://doi.org/10.1016/j.toxicon.2015.12.001

Oladoja, N.A. 2015. Headway on natural polymeric coagulants in water and wastewater treatment operations. *J. Water Process Eng.* 6 : 174e192. https://doi.org/10.1016/j.jwpe.2015.04.004

Vunain, E., Masoamphambe, E.F., Mpeketula, P.M.G., Monjerezi, M. and Etale, A. 2019. Evaluation of coagulating efficiency and water borne pathogens reduction capacity of *Moringa oleifera* seed powder for treatment of domestic wastewater from Zomba, Malawi. *J. Environ. Chem. Eng*. 7 : 103118. https://doi.org/10.1016/j.jece.2019.103118

Yukselen, M.A. and Gregory, J. 2004. The effect of rapid mixing on the break-up and re-formation of flocs. *J. Chem. Tech. Biotech.* 785. https://doi.org/10.1002/jctb.1056

Zemmouri, H., Drouiche, M., Sayeh, A., Lounici, H. and Mameri, N. 2012. Coagulation flocculation test of Keddara's water dam using chitosan and sulfate aluminium. *Proc. Eng.* 33 : 254e260. https://doi.org/10.1016/j.proeng.2012.01.1202.

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