Initial Characterization of Bio-Slurry as Liquid Fertilizer

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Abstract. The demand for organic fertilizers in Indonesia is currently in a critical state. In 2015, it was noticed that the demand of Indonesia for NPK fertilizers reached over 6.5 million tons per year. Given the current state of demand for organic fertilizers in Indonesia, it is imperative to have alternative organic fertilizers that are environmentally friendly and readily available raw materials. One alternative is to use biogas waste that contains essential plant-based nutrients such as NPK (nitrogen, phosphorus, potassium) and additional nutrients such as magnesium (Mg), calcium (Ca) and sulfur (S). The composition of Bio-Slurry after fermentation consists of 25% ± 5 dry matter and 75% ± 5 water. If the dry substance is decomposed, it contains 18-27% organic matter. The production of liquid organic fertilizers from BioSlurry requires some anaerobic fermentation process lasting 20 days. During the fermentation process it is necessary to add additional raw materials such as cow urine, banana stalk and banana peel to add the N, P and K values to BioSlurry. In the initial characterization test, BioSlurry liquid (after pressing) showed an NPK value of <1% and a C-Organic value of 0.04.

1. Introduction

Data collection in 2015 shows that Indonesia's NPK fertilizer needs reach more than 6.5 million tons per year. In the same year, Indonesia continued to import fertilizers to meet Indonesia's fertilizer needs. Indonesia is currently in a critical condition for fertilizer application. The availability of subsidized and unsubsidized fertilizers has a significant impact on agricultural production. The application of fertilizer at the time of planting can support plant growth by increasing the nutrient content in the soil and accelerating the growth of stems, leaves and roots.

The Government of Indonesia is currently planning the BIRU (House Biogas) program. This is a program that supports the use of renewable energy sources in rural households. Biogas is the gas produced by the activity or fermentation of organic matter, including animal waste, under anaerobic conditions. In the process, biogas also produces products or products from the rest of the biogas production process, namely biogas slurry (BioSlurry), which can be used as organic fertilizer for plants.

BioSlurry is the final product of solid and liquid cow manure processing which is very useful as a source of nutrients for plants. The growing public awareness of the importance of environmental protection raises the question of converting BioSlurry biogas into a more beneficial product, namely liquid organic fertilizer. The resulting BioSlurry fertilizer will contain "probiotic" microbes that have role to increase fertility and health of agricultural land. Therefore, is expected to have an impact on the quality and quantity of crop yields.

According to the analysis of the BIRU team in 2012, The composition of BioSlurry after fermentation is 25% ± 5 dry matter and 75% ± 5 water. In the other hand, BioSlurry contains essential
plant-derived nutrients such as NPK (nitrogen, phosphorus, potassium) and additional (micro) nutrients such as sulfur (S), calcium (Ca), and magnesium (Mg).

This study became performed in Galeng Dowo Village, Wonosalam District, Jombang Regency, East Java. This looks at ambitions to decide the potential of BioSlurry, especially the N, P, K content material of biogas received from cow manure. Another intention is to raise public awareness of the significance of protective the environment. These elements had been investigated due to the fact preceding research have proven that BioSlurry could have one-of-a-kind characteristics in every area which results in waste of various quality. Depends on in where the cows are fed. This study introduced this innovation to the improvement of a liquid fertilizer primarily based totally on biogas, in which cow manure is usually simplest used as solid fertilizer.

2. Research method

2.1. Material and methods
This study used a 20-liter drum, 20-liter plastic container, used water bottles, faucet, 1-inch clear tube, knife, scale and measuring cup. The material used in this research is BioSlurry which is compacted and then combined with cow dung, molasses, banana stems and peels. The research stages are presented in the following:

![Workflow diagram]

**Figure 1.** Workflow diagram

This study used a randomized block design (RBD) which separated into two procedures. Five times repetition needed each treatment, so there was a total of 10 experimental samples. The following treatments are planned:
Determining the N, P, K values analysed as observational data that were best for organic liquid fertilizers. It was important to observe several parameters during the fermentation process. These parameters included colour, odor, pH, and temperature on days 0, 5, 15, and 20.

3. Result and discussion
The initial characterization result of the raw material for the production of liquid organic fertilizers (BioSlurry) are presented in the table below:

**Table 2. BioSlurry N, P, K, C-Organic and water content value before pressing**

| No | Parameter             | Result (%) |
|----|-----------------------|------------|
| 1  | Water content         | 82.54      |
| 2  | Nitrogen              | 0.11       |
| 3  | Total of P₂O₅         | 0.17       |
| 4  | Potassium oxide (K₂O) | 0.04       |
| 5  | C organic             | 4.76       |

**Table 3. BioSlurry N, P, K, C-Organic and water content value after pressing**

| No | Parameter             | Result (%) |
|----|-----------------------|------------|
| 1  | Water content         | <1         |
| 2  | Nitrogen              | 0.04       |
| 3  | Total of P₂O₅         | 0.03       |
| 4  | Potassium oxide (K₂O) | 0.11       |
| 5  | C organic             | 2.56       |
Figure 2. Raw material of Organic Fertilizer

Figure 3. Mixing and 20-days fermentation process

Figure 4. Regular inspection of the pH, temperature, color and odor

During routine inspection, Table 1 indicates that the N, P, K content material in BioSlurry appears to be nevertheless low earlier than pressing, on average < 1%. After squeezing, the content material of C in organic materials on average < 2%. Meanwhile, this indicates that the raw material for BioSlurry nevertheless requires additional substances to increase the N, P, K values in liquid natural fertilizer. The components as an example stems and banana peels which each contain phosphorus and potassium. Cow urine is in mixture to increase the value of N.

Temperature, pH, color, and smell need to be monitored frequently throughout the fermentation process as signs to decide whether or not the liquid organic fertilizer is fermenting well. In this experiment, the fermentation process of liquid organic fertilizer changed into completed under anaerobic conditions. On days 6 and 10, the pH in the samples coded PA and PU had an average value of four this means that acid. On the 15th day, there has been no unexpected change in temperature or color. While the temperature among 29-31°C produces a totally smelly sour scent with the darkish brown sample. However, the pH of the PU-coded samples confirmed an average value of 5. The scent at the fifteenth day changed into greater acidic than the previous day.
After 20 days of fermentation, it was important to have characterization of all samples to see the ratio of N, P, K, C / N and C-Organic to determine the composition of the higher quality of liquid organic fertilizer. Liquid manure produced an NH3 concentration of 402.9 g / m3, while the production of carbon emissions decreased by 58.5 kg CO2 / m3 compared to unfiltered manure [1]. The accumulated emissions of CO2 and N2O from the soil fertilized with biological fertilizer emitted 92.8 g CO2 / cm2 and 162.4 mg N2O / Nm2. In contrast, commercial fertilizer emitted 87.8 g CO2 / cm2 and only 38.9 mg N2O / Nm2 [3]. The ammonia, which evaporates during the formation of the biogas, was caused by meteorological factors, as well as the high pH value of the liquid manure and the high concentrations of NH3+ and NH4+ [2].

In the production of liquid fertilizer, the addition of microalgae at temperatures of 15°C & 23°C and the lighting duration of 11 & 14 hours is essential to trigger biomass growth [5]. Adding microalgae to BioSlurry on the above lights temperatures and times has been proved to enhance the growth of the biomass required for fertilizer production [6]. The application of concentrated liquid biological sludge has the ability to significantly enhance tomato yields by increasing organic matter such as N, P & K; the number of N & P; DHL; the number of amino acids; proteins; carotene; soluble sugar; tannins; Vitamin C in tomatoes and the number of actinomyces; bacteria; and fungi [7]. Any alternate in pH in the slurry will have an effect on modifications in the production of carbon dioxide in the slurry. BioSlurry isn't always appropriate for liquid fertilizers because of its exceptionally unstable substance, complicated composition and pungent odor. However, this example may be overcome by eliminating excess nitrogen and ozone [4].

From these results it can be concluded that the application of approximately 70 kg of organic fertilizer / ha increases biomass production and the nutrient content in cow manure [8]. The effects virtually display that Vermedit's technology has the ability to convert secondary products along with BioSlurry on a domestic scale into numerous value-added products. [9]. The production of okra fruits increases after uses of BioSlurry in combination with NPK fertilizer by percentages reached 25% to 36% of fruits in growth per plant; 12 to 14% additional branches per plant; 14 to 31% increase in plant height; and 13 to 45% of the increase in root length [11]. Field trials have tested the useful outcomes of organic fertilizers in growing the production of shallots, potatoes, cabbage, eggplant, tomatoes and papaya. BioSlurry fertilizer additionally has the capacity to supply better gross margins at the soil of Gray Terrace, Gazipur [10].

Plant examination revealed that the total content of Zn, Cu, Fe, Mn and N, P, K, increased significantly with the use of BioSlurry with integrated fertilizer [12]. Organic compost offsets the NPK needs of vegetation and suggests its benefits over different processing methods. Therefore, fertilizer dosage (five tons/ha BioSlurry) is a great opportunity to maximize production yields [13]. Organic fertilizers up to 20 ton/ha give better yields. This indicated that the increase in plant height, maize and cereal production, weight per 1000 grains, and N, P, K content was significant compared to control plants with manure [14]. The average biogas production from dairy producers is around 620.41 m3 per year, which is equivalent to 285.39 kg of liquefied gas (LPG). By using 100.80 kg of biogas per year in each farm household, the government can save Rs 589,664 per year per household.

Inspiring farming households to apply the biogas and manure they produce; the authorities must offer incentives for the usage of biogas and natural fertilizers [15]. Thinking approximately the principle nutrients contained in white cabbage, it is able to be concluded that organic composts and inorganic fertilizers, not have a primary effect on potassium and phosphorus levels. However, BioSlurry in mixture with inorganic fertilizers has been proven to have an amazing effect at the growth of nitrogen content. This component additionally confirms that BioSlurry contributes substantially to the growth capability adjustments in the soil's organic carbon, phosphorus, and cations. [16]. Fertilizer value in terms of NPK gradually increased, but the value remained below 1%, except for the K value, which reached 1.22%. Average gas production (per kg) of fresh waste was around 60 liters. Initially, the share of methane exceeded carbon dioxide. However, the methane content gradually exceeded carbon dioxide and reached an average of 56.43%. [17].

A field study was developed at Egerton University over two seasons for a better comparison. In the first season, the use of bio-sediment fertilizers increased the production of carrots by 8.8%, and in the
second by 23.5%. The total amount of dissolved minerals in the plant roots was 12.7% higher in the first season and 13.2% higher in the second season compared to the control plants. Overall, this study recommends 7.8 t / ha of bio-sediment fertilizers to improve carrot quality and productivity [18].

Anaerobic procedure gave by Bio Slurry may be utilized in fish tank to supply plankton for fish feed. It also can be used on fertile and reasonably fertile soils, even as pyrolysis biochar is greater suitable for soil remediation in fertile soils. [19].

4. Conclusion
The production of liquid organic fertilizers from BioSlurry requires an anaerobic digestion process, to support fermentation, lasting 20 days. During the fermentation process, it is also necessary to add auxiliary raw materials such as cow urine, banana stems and peels to add the N, P, K values in BioSlurry. Composition of BioSlurry after fermentation is 20-30% solid substance and 70-80% water. The decomposed dry substance contains 18-27% organic matter. In the initial test, the BioSlurry characteristics of the liquid (after pressing) showed an NPK value of less than 1% and C-Organic value of 0.04.

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