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*by* Deni Novia

# Potential of Indigenous Microorganisms (IMO) from cow manure, elephant grass, *Aloe vera*, pineapple skin to the N, P and K content of organic cow manure



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# Potential of Indigenous Microorganisms (IMO) from cow manure, elephant grass, *Aloe vera*, pineapple skin to the N, P and K content of organic cow manure

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**Abstract.** The manufacture of organic fertilizers can be accelerated by adding indigenous microorganisms (IMO) which function as decomposers. The purpose of this study was to determine the effect of adding several types of IMO to the N, P, and K content of organic cow manure. This research used animal MOL, namely cow manure IMO and vegetable IMO, namely elephant grass IMO, Aloe vera IMO, pineapple skin IMO and dry cow manures. This study used an experimental method with a completely randomized design with five treatments and four replications. The treatments were A: addition of cow manure IMO, B : elephant grass IMO, C : Aloe vera IMO, D : pineapple skin IMO, E : combination IMO (A, B, C, D). The parameters were measured; the N, P and K content. The results showed that the addition of several types of IMO had a significant effect ($P<0.05$) on phosphorus content of organic cow manure but had no significant effect ($P>0.05$) on nitrogen and potassium content. The manufacture of organic cow manure with the addition of several types of IMO for 21 days gave the best results in the combination IMO treatment with 1.70% nitrogen, 0.65% phosphorus, and 1.78% potassium content.

**Keywords**: Organic cow manure, P content, decomposers, indigenous microorganisms, *Aloe vera*

## 1. Introduction

The livestock industry, which is currently growing rapidly, is like two sides of a knife, on the one hand it is very exciting as a source of nutrients that the body needs, but on the other hand it also has an effect on the environment, especially the waste products, one of which is manure. Cattle contributed the highest manure where the daily production of cow manure ranged from 8-10 kg per tail, or 2.6-3.6 tons per year or equivalent to 1.5-2 tons of organic fertilizer. Based on BPS data, West Sumatra with a cattle population of 568 960 tails in 2020 [1] will produce 853 440 – 1 137 920 tons of organic fertilizer. This means that if it is managed properly, cow manure, which was originally a very complicated problem, will be a solution in reducing the use of inorganic fertilizers and providing adequate fertilizers for farmers so that manure no longer damage the environment but can improve the environment.

The unstable price of inorganic fertilizers and their limited availability do not reduce the desire of farmers to use them. This was influenced by the long process of about 2-3 months although at a low

cost. The process of making organic fertilizers can be accelerated to three weeks by adding indigenous microorganisms (IMO) which function as decomposers.

IMO can be made from organic materials with the addition of sugar and water. Microorganisms do not need to be added because they already exist from the organic materials were used in the form of bacteria, yeast and fungi. Perishable organic matter so that the formation of IMO becomes faster. Commercially, IMO has been known to the public with various brands, one of which is Effective Microorganism 4 (EM4). Organic materials that can be used in the manufacture of IMO in this study were cow manure, elephant grass, *Aloe vera* and pineapple skin.

Raw cow manure is the most suitable place for the development of microorganisms. In livestock feces contained many microorganisms compared to agricultural waste [2]. Cow manure contains microbial decomposers, namely *Lactobacillus sp*, *Actinomycetes sp* and *Aspergillus sp* [3]. Raw cow manure contains high moisture and ash (P, K, Na, Ca, Mg, Fe, Cu, Zn) as well as more than 50% lignocellulose, and nitrogen [4]. After being made into IMO, cow manure has a high microbial content with total LAB 48.18±10.70`$\times 10^{8}$ CFU/ml and total fungus 38.16±5.96$\times 10^{11}$ CFU/ml [5].

Elephant grass is a superior grass that can increase the growth of livestock, especially cattle quickly. The protein content of elephant grass based on dry weight is 4.4-20.4% with an average of 12%, while NDF, ADF and ADL (lignin) are 67.42 and 6% [6]. SuMu No. 2 elephant grass contains 5.60 (log10CFUg-1) lactic acid bacteria, 4.97(log10CFUg-1) aerobic bacteria and 3.93 (log10CFUg-1) yeast [7]. The presence of indigenous microorganisms in elephant grass has the potential to be increased by the fermentation process.

*Aloe vera* pulp has protein content of 0.17 ± 0.01%, very good water-soluble vitamins including (B1) 9.73 mg/g, (B2) 141.2 mg/g, and (B3) 4.63 mg/g as well as high content of maltose and fructose, as disaccharides and galactose which are needed for microbial growth so that the addition of 10% *Aloe vera* pulp in MRS media caused the proliferation of different lactic acid cultures for more than one log cycle [8]. In addition, *Aloe vera* contains minerals (N, P, K, Fe, Zn, Mn, Ca, S, Mg, Na) El Sherif, 2017) and the hormones auxin and gibberellins [9] which plants need and stimulate growth plant.

Pineapple skin is an agricultural waste that is not widely used by the community, because they do not know how to process or utilize the pineapple skin. In pineapple skin there are several kinds of nutrients including moisture, crude fiber, carbohydrates, protein, bromelain enzymes, reducing sugars, flavonoids and tannins [10]. Pineapple peel powder contains moisture 82.93±0.17%, ash 4.56±0.03%, protein 0.17±0.03%, lipid 0.99±0.16%, fiber 11.66±0.23%, carbohydrates 82.61±0.10%, besides that, pineapple peel can contribute as a bulking agent good and has a pleasant aroma [11].

Nutrients contained in raw cow manure, elephant grass, *Aloe vera* and pineapple skin can be utilized by microorganisms as a food source. Making IMO as a decomposer in the manufacture of organic fertilizer aims to increase the N, P, K content of the fertilizer. The content of N, P, K will make plant growth better, both in roots, fruit, leaf shape and in the resistance of the plant in the face of pests and diseases. Therefore, it is necessary to increase the N, P, K in the soil so that the growth of plants can be increased.

The purpose of this study was to determine the effect of adding several types of IMO and the best types of IMO in producing N, P, K content of organic cow manure.

## 2. Materials and methods

### *2.1. Materials*

The materials were used in this study included 2500 ml of coconut water, 500 ml of water, 100 g of raw cow manure (RCM), elephant grass (EG) 100 g, *Aloe vera* (AV) 100 g, pineapple skin (PS) 100 g, 250 g of granulated sugar, 10,000 grams of dry cow manure taken from the Experimental Laboratory of Andalas University. While the tools used in this study include shovels, buckets, mineral water bottles (1500 ml and 600 ml sizes), label paper, measuring cups, hoses, funnels, spoons, sprays, blenders, plastic cetik, rubber bands, plastic packing, dropper, analytical balance and AAS.

### 2.2. *Methods*

The method was used in this study; an experimental method, using a completely randomized design with five treatments and four replications where organic cow manure was treated with additions; A: raw cow manure IMO, B : elephant grass IMO, C : pineapple skin IMO, D : *Aloe vera* IMO, E : RCM, EG, PS, and AV combination IMO. Data were analyzed statistically using Anova and if significantly different ($P<0.05$), continued with Duncan's Multiple Range Test (DMRT) at 5% significance level. The variables were observed in this study were the availability of total nitrogen, levels of P, and K [12] of organic fertilizers.

Making IMO, namely cow feces (CM), elephant grass (EG), aloe vera (AV) and pineapple skin (PS) each weighed 100 grams while the modified treatment used 25 g CM, EG, AV and PS and mixed as much as 200 ml of coconut water, then blended for 3 minutes. Then place it in a bucket and add 300 ml of coconut water and 50 grams of sugar then homogenize, after that, put it in a modified 1500 ml bottle using a funnel, and close it tightly. Fermentation was carried out for 14 days in a shady place to produce IMO (Modification Mulyono) [13].

Making Organic Fertilizer were 1) fresh cow manure was taken at the experimental Laboratory of the Animal Science Faculty, Andalas University, then it was dried under the hot sun until the moisture content reaches below 50%. 2) The dried cow manures were sifted so that the manures obtained were smooth. 3) 500 grams of sifted cow manures each was placed in five different containers. 4) Then 10 ml of IMO was added and mixed with 100 ml of water (1:10 ratio), then homogenized. 5) IMO was introduced into the spray by means of a funnel. Spray onto the feces that have been placed on the fermentation container until evenly distributed. 6) Fermentation was carried out under facultative anaerobic conditions for 21 days. Every three days stirring was done. 7) The organic fertilizer produced was analyzed for the content of N, P and K (Modification of Mulyono) [13].

## 3. Results and discussion

**Tabel 1.** N, P, and K content of organic cow manure.

| Treatments | N Content (%) | P Content (%) | K Content (%) |
|---|---|---|---|
| A | 2.02±0.30 | $0.40\pm0.02^{b}$ | 1.55±0.80 |
| B | 1.87±0.13 | $0.47\pm0.04^{b}$ | 1.27±0.23 |
| C | 2.31±0.25 | $0.35\pm0.04^{b}$ | 1.35±0.22 |
| D | 1.83±0.09 | $0.39\pm0.04^{b}$ | 1.96±0.29 |
| E | 1.71±0.09 | $0.65\pm0.03^{a}$ | 1.78±0.09 |

Note: Superscripts with different letters were significantly different ($P<0.05$)

From Table 1, it can be seen that the mean levels of N ranged from 1.70±0.09 – 2.31±0.25%, P levels were 0.35±0.04 - 0.65±0.03% and K levels were 1.27±0.23 - 1.96±0.29%. The results of the analysis of diversity stated that the addition of several indigenous microorganisms (IMO) had a significant effect on P levels but had no significant effect ($P>0.05$) on N and K levels of organic cow manure produced.

### 3.1. *N content*

The difference was not significant in the treatment of the addition of several IMO, because the effectiveness of the remodel of microbes contained in all IMO was the same. The N content in organic fertilizers comes from organic compost that is degraded by microorganisms, so that the ongoing degradation process (composting) greatly affects the N content in fertilizers [14]. The N content of Aloe vera is 81 mg/100ml f.w [15].

This insignificant difference was also caused by the presence of lactid acid bacteria (LAB), which were organisms that break down cellulose, hemicellulose and protein. According to Novia, *et al*. In the IMO of goat and quail feces, there are LAB in the form of a rod (bacil), where rod-shaped bacteria will remodel carbohydrates in the material [5]. Followed by [3] stated that in cow manure there are bacteria, namely Lactobacillus sp and Actinomycetes sp and fungus Aspergillus sp which function as decomposers [3]. In accordance with the opinion of Aditiwati *et al.* stated that bacteria from the genus Bacillus play a role in breaking down organic matter and dead bodies into chemical compounds

(mineralization of organic matter) and producing several enzymes, namely lipase, amylase and protease [16]. The existence of this LAB was believed to be due to the facultative anaerobic fermentation process, because according to Salminen *et al.* that LAB is a facultative anaerobic bacterium and produces lactic acid from carbohydrate fermentation (glucose, fructose, and sucrose) [17].

In this study, the N content of organic cow manure was added with several types of IMO was found to be in the range of 1.71 - 2.31%, while the N content of dry cow feces without treatment was 1.27%, this means that the N content increased from 46 - 80%. The results of this study meet the quality standard of organic fertilizer SNI 19-7030-2004 which is greater than 0.40% [18], from all treatments given the higher N content than research Novia, *et al*. who made organic cow manure fertilizer with the addition of IMO from several types of cow feces with N levels of 1.20 – 1.58% [5] and also lower than the research of Murni *et al.* who made organic fertilizer from cow dung using effective microorganisms 4 with N levels of 0.99 – 0.87% [19].

### *3.2. Phosphate content (P content)*

The lowest P value was found in treatment C (Aloe vera IMO) which was 0.35±0.02% and the highest in treatment E (combined MOL) which was 0.65±0.03%. Duncan's further test results showed that the P value of organic cow manure from treatment A was not significantly different ($P>0.05$) with treatments B, C and D but significantly different ($P<0.05$) with treatment E.

Treatment E (combined IMO) was the treatment that had the highest P (phosphorus) value, this was due to the organic matter used having different P and nutrient content which made the microbial food needs contained in the IMO fulfilled and made microbial growth faster. According to Shen *et al.* cow manure has a P content of 0.607±4.12% [4]. Elephant grass has a fairly high ash content of 9.28% as a mineral source [20]. The ash content in aloe vera is 16.88 ± 0.04% (Raina and Naik, 2020) and the phosphorus content is 7 mg/100ml f.w [8]. The nutritional content of pineapple skin according to Nuraini is water, crude fiber, carbohydrates, protein, bromelain enzymes, reducing sugars, flavonoids and tannins [10].

Treatment C (Aloe vera IMO) which was the lowest level of P, this was because the element P contained in the IMO material does not contain phosphorus. The phosphorus test has been carried out in cow manure without the addition of IMO, which is 0.58%, while in treatment C the phosphorus content has decreased to 0.35%. The decrease occurs because microorganisms will take advantage of existing nutrients if their food needs are not met. The decrease in P cow manure levels over time (53% less) after fermentation was due to higher microbial activity [21]. In addition, the effects of phosphate dissolution caused by phosphate solubilizing bacteria are the formation of acetic acid, formic acid, lactic acid, oxalic acid, malic acid and citric acid [22].

The results were obtained have met the quality standard of organic fertilizer SNI 19-7030-2004, which is 0.10% [18]. This study has a higher P level than the study of Karyono *et al*. regarding the addition of banana weevil IMO and EM4 to a mixture of beef cattle manure and coffee skin with P levels of 0.25 – 0.34% [23]. The manufacture of organic fertilizer using cow manure with EM4 activator was fermented for 14 days to produce a P content of 0.93%. The high level of P compared to this study is due to the addition of dolomite in the manufacturing process [24].

### *3.3. Potassium content (K content)*

In Table 1 it can be seen that the range of K levels in this study is 1.27-1.96%. In fact, the K (potassium) content in each treatment with the addition of several types of IMO in organic cow feces was caused by the same composting material used, namely cow manure. There is an insignificant difference in K content between the types of animal manures used during the fertilizer manufacturing process[21]. Potassium content of Aloe vera is 61 mg/100ml f.w [15].

This study also tested the K content in dry cow manure without fermentation with K levels obtained that was 1.68% and in dry cow manure with fermentation was obtained K levels; 1.74%, this means that the addition of several types of IMO in the manufacture of organic fertilizers did not affect K content. The results of this study met the quality standard of organic fertilizer SNI 19-7030-2004, which was

greater than 0.20% [18], from all treatments given the K levels were higher than the research of Novia, *et al*. which makes organic cow manure fertilizer with the addition of IMO from several types of cow feces with K levels, namely 0.85 – 1.21% [5]. Organic fertilizer from cow manure with EM4 activator with a fermentation time of 14 days also produced a lower K content of 0.76% [24].

The potential of several different types of IMO on the levels of N, P, and K of organic cow manure produced can be seen in Figure 1. The treatment given only had a significant effect on the P levels of organic fertilizer produced, while the levels of N and K had no significant effect. The combination of IMO from cow manure, elephant grass, *Aloe vera* and pineapple skin has the potential to produce the best organic cow manure fertilizer with the highest P content.

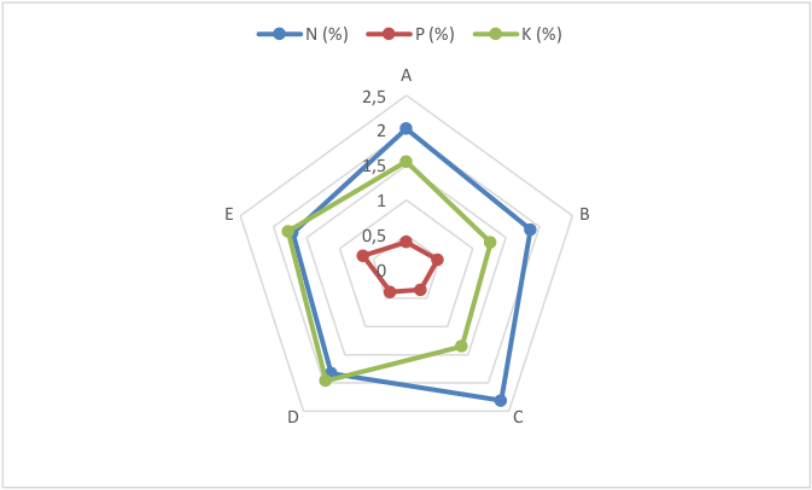


**Figure 1**. Radar diagram of N, P, and K levels of organic cow manure

## 4. Conclusion

The conclusion from the study that the addition of several indigenous microorganisms (IMO) to the N, P, K content of organic cow manure had a significant effect on P levels but had no significant effect on N and K content. P content (phosphorus) ranged from 0.35 – 0.65% and K content (potassium) ranged from 1.27 -1.96%. For the best treatment, the combined IMO treatment with levels of N, P and K were 1.70%, 0.65% and 1.78%, respectively.

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