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# Influence of addition of chicken manure and tithonia on quality of liquid fertilliser made from organic waste

# Influence of addition of chicken manure and tithonia on quality of liquid fertilliser made from organic waste

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**Abstract.** Indonesian's waste production continues to grow as the population increases. Organic waste such as leaves and food waste generally decomposes and can be composted simply with the use of barrels and buckets. Effective Microorganism 4 bioactivator can accelerate this process. This research was conducted to discover if addition of Tithonia diversifolia and chicken manure could increase the nutrients from liquid fertilizer and solid compost. Complete randomized design with 4 treatments and 4 replications was used as follows: A = 100% organic waste (control), B = 60% waste + 28% tithonia + 12% manure, C = 60% waste + 32% tithonia + 8% manure and D = 60% waste + 36% tithonia + 4% manure. The results showed that the addition of manure and tithonia increased N, P and K in liquid fertilizer. The highest increase in N and P occurred with treatment D, and K with treatment C.
**Keywords** – composter, liquid fertilizer, Manure, Tithonia diversifolia

## 1. Introduction

Indonesian's waste production continues to grow as the population increases. Organic waste such as leaves and food waste generally decomposes and can be composted simply with the use of barrels and buckets. The manufacture of solid or liquid organic fertilizers is a decomposition process using microbial activity and so the speed of decomposition and quality of compost depends on the condition and types of microbes that are active during the composting process [11]. These microbes may be aerobic bacteria or fungi [9]. The optimum conditions for microbial activity include aeration and provision of adequate growing media and food sources for microbes. One technology to accelerate the fermentation process is the use of Effective Microorganism 4 (EM4) bio-activator which consists of a culture of decomposing bacteria. EM4 is applied as an inoculant to increase the diversity and population of microorganisms in soil and plants and also increase growth and improve the quality and quantity of crop production. It can also be added to composting organic waste to hasten the composting process [8].

Liquid organic fertilizer (LOF) is a decomposition product from organic waste. It can be used to quickly overcome nutrient deficiencies in the soil and is not subject to nutrient leaching. Compared to liquid fertilizers from inorganic materials, LOF are generally less likely to damage soil and plants even though they are used frequently. In addition, this fertilizer contains a binding material, so that the fertilizer solution applied on the soil surface can be directly absorbed by plants. LOF types include liquid manure, biogas-making liquids, and liquid fertilizers from organic waste [1].

Tithonia is a common weed found throughout the tropics that has a high nutrient content including 3.50% N, 0.37% P, and 4.10% K and is good for increasing crop production (Hartatik, 2007). These three chemicals along with calcium (Ca), magnesium (Mg) and sulfur (S) are important plant nutrients that are abundant in chicken manure [2].

In this study the effectiveness of addition of Tithonia diversifolia and chicken manure to LOF is investigated.

## 2. Materials and methods

Organic waste from the market was used along with EM4, chicken manure and Tithonia. Completely randomized design with 4 treatments (A = 100% organic waste (control), B = 60% waste + 28% tithonia + 12% manure. C = 60% waste + 32% tithonia + 8% manure. D = 60% waste + 36% tithonia + 4% manure) was used with 4 replications, one in each of 16 composters. The variables measured were N content (determined by the Kjedahl method), P (extraction method) and K (Flame photometer).

**Table 1.** Composition of materials used in treatments A, B, C and D.

| Material | Treatment (%) | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Organic waste | 100 | 60 | 60 | 60 |
| *Tithonia* | 0 | 28 | 32 | 36 |
| Manure | 0 | 12 | 8 | 4 |

## 3. Results

### *3.1. Nitrogen (N) content*

Nitrogen in a fertilizer is important in the production of plant proteins [5]. The content of N in LOF after 28 days of fermentation is seen in Table 2.

**Table 2.** Average LOF nitrogen content from each treatment.

| Treatment | Average Nitrogen Content (%) |
|---|---|
| A | 3.04 $^{b}$ |
| B | 3.29 $^{b}$ |
| C | 3.01 $^{b}$ |
| D | 4.76 $^{a}$ |

Description: Different superscripts show significant differences (P <0.01).

Analysis of variance showed that only treatment D showed significantly higher levels of nitrogen than the control treatment. A post hoc test with DMRT confirmed that there was no significant difference between treatments A, B, C. The activity of microorganisms during the fermentation of organic materials reduces the nitrogen content of LOF so a more efficient fermentation process may lead to lower nitrogen content (Notohadiprawiro, 1999). Micro-organisms contained in the chicken manure will aid in this fermentation process. However, Wulandari et al. (2015) states that an increase in nitrogen as a protein decomposition product can result from the decomposition process. These N values are significantly higher than those the study by [3] who found 0.10% at day 10 and 0.07% on day 42 from pure organic waste without additions.

The high levels of N in treatment D showed that this lower level of chicken manure was more effective in producing high nitrogen levels. These N levels are within the Indonesian Government standards for organic fertilizers, biological fertilizers and soil enhancers, namely N macro nutrient quality standards of 3-6% [6].

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

The highest average phosphorus was found in the LOF after treatment D (2.37%) and the lowest after treatment A (1.32%) as shown in table 3.

**Table 3.** Average phosphorus level in LOF after each treatment.

| Treatment | Average Phosphorus (%) |
|---|---|
| A | 1.32 [b] |
| B | 1.69 [ab] |
| C | 1.98 [a] |
| D | 2.37 [a] |

Description: Different superscripts show significant differences (P <0.01).

Analysis of variance showed that treatment had a very significant effect (P <0.01) on phosphorus levels. A post hoc test with DMRT showed significant differences between A and D, and, B and D but not between A and B, B and C, or C and D. Higher levels of Tithonia and lower levels of chicken manure resulted in higher P content in the resulting LOF. The higher levels of P are associated with organic acids results from the decomposition of Tithonia. This improvement is due to the way the organic materials are broken down by microorganisms so releasing phosphorus. The carboxyl or hydroxyl (COOH / OH) functional groups in the organic acids in this plant act as competing anions to phosphorus anions in mineral exchange complexes so that available phosphorus increases (Supriadi,2003). High phosphorus content can be influenced by high nitrogen content, increasingly nitrogen will result in multiplication of microorganisms which leads to greater breakdown of phosphorus increasing available phosphorus content [10]. None of these phosphorus levels reach the government standard for organic fertilizers, biological fertilizers, and soil enhancers, namely 3-6% of P2O5 [6].

The highest phosphorus content, which came from treatment D, was 2.37% which is higher than that from [4] study (0.39% phosphorus) of a compost made from fresh leaves, possibly due to the materials being used. The amount of nutrients in organic fertilizers varies greatly depending on the raw material used [7].

### *3.3. Potassium content*

The average content of potassium depended on the treatment (Table 4).

**Table 4.** Average potassium levels in LOF after each treatment.

| Treatment | Average Potassium (%) |
|---|---|
| A | 2.94 [a] |
| B | 3.02 [a] |
| C | 3.11 [b] |
| D | 3.03 [a] |

Description: Different superscripts show significant differences (P <0.01).

Analysis of variance showed that treatment significantly affected potassium levels of LOF (P <0.01). a post hoc test with DMRT showed that C and B treatments, C and D treatments, C and A treatments, were significantly different, but no other differences between treatments were significant. Treatment C was clearly superior to the other treatments for K production. This difference is caused by different raw material content (manure, Tithonia diversifolia and organic waste) resulting in different potassium. All these LOF using manure and Tithonia with market waste fulfilled Indonesian government standards for organic fertilizers, biological fertilizers, and soil enhancers, namely K2O macro nutrient content of 3-6% [6].

## 4. Conclusion

The results showed that the addition of manure and tithonia increased the Nitrogen, Phosphorous and Potassium content of LOF. The highest increase in N and P elements occurred with treatment D (lowest manure content), while the highest increase in potassium with Treatment C (second lowest manure content). This suggests that while manure can increase the availability of these macronutrients in LOF, supplementation with sufficient tithonia may be even more important.

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