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# The Use of Urine as Raw Material of Liquid Organic Fertilizer (LOF) in Producing Healthy Organic Food

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***Abstract***
*Human urine as a result of the human body's metabolic process is a human liquid wastes that are not considered useful and presence in the environment which causes the odor, and disturbs aesthetics. By using appropriate technology, urine can be used as raw material for Liquid Organic Fertilizer (Pupuk Organik Cair (POC)) that is environmentally friendly and can be used for agriculture. The research objective is to identify and analyze the characteristics of human urine, with aeration and fermentation process in the manufacture of Liquid Organic Fertilizer (POC). The type of this research was an action research with the raw material of human urine, bacteria fermenter (EM-4) and glucose which were processed by treatment of aeration and fermentation with parameters of Nitrogen (N), phosphorus (P) and potassium (K). The results showed the content of nitrogen before treatment (0.14%) and after treatment, it increased after 7 days (0.2%), 14 days (0.28%) and 21 days (0.29%). The usage of EM-4 that contained nitrogen-fixing bacteria in the maturation process of human urine POC (Urma) greatly helped an increase the content of nitrogen (Lartansuphaphol, 2009). Meanwhile, the content of phosphorus 0.17% before treatment and 7 days after treatment (0.03%), 14 days (0.01%) and 21 days (0.07%) showed the rate of decline. Decrease in phosphorus content during the fermentation process was occurred because the phosphorus in the phosphate salts as nutrients macro nutrients was required for bacterial growth (ningrum, F, gems, 2012). Decline was also due to the binding of phosphorus by microorganisms that derived from bio-activator of EM-4 when fermentation (Directorate General of SME, 2007). The content of potassium urma was 1.3% before treatment and (1.59%) After 7 days treatment, 14 days and 21 days (1.7%). The increase of potassium could be occurred as a result of weathering of K + ion release from cation exchange and decomposition of organic material dissolved in the urine liquid fertilizer. (Sumarno, 2011). Based on the content of nitrogen, phosphorus and potassium POC of urma which were mentioned above, could be used directly for plants and it qualified Indonesian Minister of Agriculture.28/permentan/SR.130/5/2009. Moreover, it also needed the further research on the exact composition among: EM-4, bacterial nutrients, vulume human urine, fermentation time, in order to increase the content of nitrogen, phosphorus, potassium. and also for the type and dose for plants.*

***Key words****: Liquid Organic Fertilizer, Human urine.*

## I. INTRODUCTION

In the past, some people thought that metabolism waste that was excreted from human body such as urine was considered useless so it was often thrown away even people still had to pay service charge such as toilet utilization services in public places.

Urine consisted of ammonia (NH3) which was smelled very stinking (stench) and when it was disposed in any kind of place, it could be an odor source in environment and cause aesthetic disturbance. With the ammonia substance, urine could be processed into a useful item by using Appropriate Technology (AT) into materials or goods that could be useful and could be used as raw material of Liquid Organic Fertilizer (LOF) in order to be applied as a plant fertilizer which was known as Urine Fertilizer. Human urine as a result of human body metabolism process was human's liquid waste that had been thrown away to environment because it was considered in having no benefit and its existence in environment caused stinking that disrupted aesthetics.

## II. METHODS

This action research aimed at developing a new approach to solve the problem of human urine waste management through direct application management of waste and entrepreneurship. Figure 1 showed applied research design. This research was conducted at Department of Environmental Health, Health Polytechnic of Surabaya Minister of Health in Magetan, Indonesia; from June to August 2013. The subjects of this research were students who were in semester II and IV.

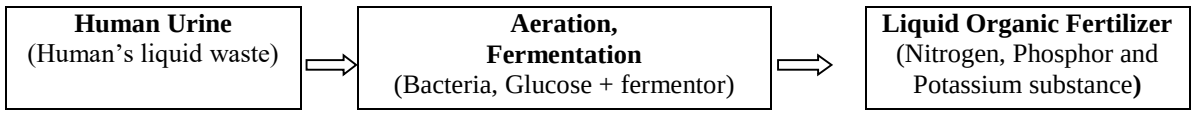


Figure 1: Research Design

**The followings were stages of this research:**

1. The preparatory stage included: research explanation to students, permissions, preparation and aerator treatment, fermentation, preparation of students' urine.
2. Implementation stage with details as followed:
   a. Preparation of tools and materials: 1) aerator and fermentation equipment, 2) students' urine, 3) bacteria, 4) glucose + fermentor
   b. Implementation procedure:
      1) Collected human urine in a drum, then, stirred evenly and checked Nitrogen, Phosphor, and Potassium substance.
      2) Added bacteria and fermentor 1:100 (1 for bacterium versus 100 for urine).
      3) Added glucose (molasses) 1:100 (1 for glucose versus 100 for urine).
      4) Closed the drum but being not sealed so that the air/gas could come out.
      5) Stirred every morning and afternoon in order to make fermentation being well.
      6) After 7 days, checked Nitrogen, Phosfor, and Potassium substance in the liquid organic fertilizer. Moreover, doing so (Checked Nitrogen, Phosfor, and Potassium substance in liquid organic fertilizer) after the process in 14 days and 21 days.
   c. Assesment of liquid organic fertilizer maturation
      1) Liquid organic fertilizer did not smell strong. To ensure fertilizer maturity, 500 ml of liquid organic fertilizer was taken, then, stored in a covered plastic for 2 x 24 hours. If the plastic bubbled, became hot, or when it was opened, the plastic smelled rotten, it meant that maturation process had not been completed.
      2) The texture was dark yellow brownish.
      3) pH: 6.5-7.5 (neutral).

## III. RESULT AND ANALYSIS

**Obsevation Results of Texture, pH, Temperature, and Odor**

Human urine volume that was collected in 2 days was 105 liters. Before treatment, urine was yellow brownish, the smell of urine was typically very stinking. The color of liquid organic fertilizer of urine after 7-14 days of treatment was relatively constant. However, after 21 days of treatment, the color of urine changed to be dark and strong.

Table 1: Observation Results Before and After Treatment

| Treatment | Indicator | Result | Note |
|---|---|---|---|
| Before Treatment | Texture | Yellow brownish | There was no treatment and showed real physical urine |
| | pH | 8,5 | |
| | Temperature | 29 $^0$ c | |
| | Odor | Stinking (typically urine) | |
| 24 hours aeration and 7 days fermentation | Texture | Yellow brownish | There was no color changes |
| | pH | 8,5 | Bases |
| | Temperature | 42 $^0$ c | Temperature increased, ongoing fermentation |
| | Odor | Less stinking | Maturity process had not been done yet |
| 24 hours aeration and 14 days fermentation | Texture | Yellow Brownish (Darker) | There was color changes |
| | pH | 7.8 | Bases |
| | Temperature | 38 $^0$C | Higher than room temperature ($29^0$C), ongoing fermentation |
| | Odor | Stinking decreased | Maturity process had not been done yet |
| 24 hours aeration and 21 days fermentation | Texture | Yellow brownish (darker and stronger) | Decreased fermentation process and approximated maturity process |
| | pH | 7.5 | Neutral pH |
| | Temperature | $32^0$C | Approximated room temperature ($29^0$) |
| | Odor | Stinking decreased and appeared fermentation odor | Ongoing fermentation, LOF approximated maturity and ready to be used |

**Laboratory Test Results**

LOF (Liquid Organic Fertilizer) measurement before and after 7 days, 14 days and 21 days of treatment showed that the Nitrogen substance increased, Phosphor decreased, and Potassium increased.

Table 2: Assesment Result of LOF Material Substance Before and After Treatment

| **LOF material Assesment** | **Level** | | | | **Note** |
|---|---|---|---|---|---|
| | **Before Treatment** | **After 7 days of treatment** | **After 14 days of treatment** | **After 21 days of treatment** | **Analysis Method** |
| Nitrogen (%) | 0,14 | 0,20 | 0,28 | 0,29 | SNI-02-2801-1998 |
| Phosphor (%) | 0,17 | 0,03 | 0,01 | 0,07 | SNI-02-3769-2005 |
| Potassium (%) | 1,3 | 1,59 | 1,70 | 1,70 | SNI-02-2803-2000 |

After aeration and fermentation process in 7 days, N level increased from 0.14% to 0.20% (increased 42.86%), Potassium levels also increased 22.31%. Meanwhile, Phosphor level decreased drastically 82.45%. Physically, the color of urine had not changed.

Table 3: Assesment Result of LOF Material Substance Before and After 7 Days of Treatment

| LOF Material Assesment | Level | | Increased Level | Decreased Level | Eficiency (%) | | Regulation of Indonesian Minister of Agriculture No. 28/Permentan/SR.130/5/2009 |
|---|---|---|---|---|---|---|---|
| | Before Treatment | After 7 Days of Treatment | | | Increased Level | Decreased Level | |
| Nitrogen (%) | 0.14 | 0.20 | 0.06 | - | 42.86 | - | < 2 |
| Phosphor (%) | 0.17 | 0.03 | - | 0.14 | - | 82.45 | < 2 |
| Potassium (%) | 1.3 | 1.59 | 0.29 | - | 22.31 | - | < 2 |

After aeration and fermentation process in 14 days, N level increased 100% and Potassium level also increased 30.77%. This condition indicated that the longer the fermentation process, the higher the Nitrogen and Potassium level in urine. Conversely, the longer the fermentation, the Phosphor level decreased 94.12%. The results of the complete laboratory assesment could be seen in Table 4.

Table 4: Assesment Result of LOF Material Substance Before and After 14 Days of Treatment

| LOF Material Assesment | Level | | Increased Level | Decreased Level | Eficiency (%) | | Regulation of Indonesian Minister of Agriculture No.28/ Permentan/SR.130/5/2009 22nd May 2009 |
|---|---|---|---|---|---|---|---|
| | Before Treatment | After 14 Days of Treatment | | | Increased Level | Decreased Level | |
| Nitrogen (%) | 0,14 | 0,28 | 0,14 | - | 100 | - | < 2 |
| Phosphor (%) | 0,17 | 0,01 | - | 0,16 | - | 94,12 | < 2 |
| Potassium (%) | 1,30 | 1,70 | 0,40 | - | 30,77 | - | < 2 |

After 21 days of fermentation, N level increased 107.14% and potassium levels also increased 30.77%. This condition indicated that the longer the fermentation, the higher the Nitrogen level, whereas, the Potassium levels did not increase. Meanwhile, the Phosphor level decreased 58.82%. The further laboratory results could be seen in Table 5.

Table 5: Assesment Result of LOF Material Substance Before and After 21 Days of Treatment

| LOF Material Assesment | Level | | Increased Level | Decreased Level | Eficiency (%) | | Regulation of Indonesian Minister of Agriculture No. 28/ permentan/SR.130/5/2009 22nd May 2009 |
|---|---|---|---|---|---|---|---|
| | Before Treatment | After 21 Days of Treatment | | | Increased Level | Decreased Level | |
| Nitrogen (%) | 0.14 | 0.29 | 0.15 | - | 107.14 | - | < 2 |
| Phosphor (%) | 0.17 | 0.07 | - | 0.10 | - | 58.82 | < 2 |
| Potassium (%) | 1.3 | 1.70 | 0.487 | - | 30.77 | - | < 2 |

## IV. CONCLUSION AND SUGGESTION

**Conclusion**

1. Total Nitrogen = 0.14%, Phosphor = 017%, and Potassium = 1.3% in urine was ready to be used as plant fertilizer.
2. Designs of aeration and fermentation in making Liquid Organic Fertilizer (LOF) from human urine in this research were:
   a. Fermentation tank from PVC with 200-liter volume, fermentation time = 21 days.
   b. Aerator: 1 submersible pump, 1 set of aeration pipe, 1 set of blower, 24-hour operational time.
   c. Starter: EM-4 (product of PT Songgolangit Persada, Jakarta), 1 kg of brown sugar

**Suggestion**

1. It was needed to know the further research about the effective and the efficient fermentation time in making LOF (Liquid Organic Fertilizer) from human urine.
2. It was needed further research on the correct composition between: EM-4, bacterial nutrients, and the volume of human urine in order to increase Nitrogen, Phosphor, Potassium and other parameters in accordance with the regulations.
3. It was needed further research on the plant which was in accordance with the LOF of human urine either in dosage or in composition.

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