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Urinoir Model as Liquid Organic Fertilizer Producer of Nitrogen (N), Phospate (P) and Potassium (K)

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ABSTRACT

Environment plays role as transmission media for various kinds of environmental based diseases such as Acute Respiratory Infection (ARI), Pulmonary Tuberculosis, Diarrhoea, Poliomyelitis, Measles, Hepatitis, Thypus and Herpes. This kind of disease stills a health problem for Indonesia. The mortality survey conducted in ten provinces by Sub-Directorate of ARI of the MoH of Indonesia in 2005 found that Pneumoniae as a type of ARI diseases was the greatest cause of death among infants (22.3 %) and under-five children (23.6 %), and based on Surkesnas report in 2010, the number of Thypus cases in Indonesia increased by 20.73 %. Meanwhile, among those diseases, Thypus, Hepatitis and Herpes can be transmitted by human urine, as well.

On the other hand, urine can be processed becoming organic fertilizer because it consists of essential substances for plants growth, i.e. 80 % Nitrogen and Phospate and Potassium in the rest 20 %. 75 – 90 % of the Nitrogen is in form of Urea and only the small percentage of Ammonium and Creatinine. Meanwhile, 90 – 100 % of Phosphate and Sulphur are in dissolved inorganic form and can be directly absorbed by plants. The use of liquid organic fertilizer is able for improving soil fertility which is depraved due to the continuing use of chemical fertilizer.

The aim of the research was to understand the influence of the use of urinoir model in various urine detention times, on the concentration of the yielded Nitrogen, Phospate and Potassium (K) by conducting an experiment which employed post-test design.

The results showed that the various urinoir models (I, II dan III) had effect on the concentration of those three substances of the liquid fertilizer ($p < 0,001$), and Model I (i.e. 5 day detention time) is found as the most appropriate urinoir model in producing the N, P an K subtances in the fertilizer.

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1. INTRODUCTION

Environment is a transmission media for various environmental based diseases such as Acute Respiratory Infection (ARI), Pulmonary Tuberculosis, Diarrhoea, Poliomyelitis, Measles, Hepatitis, Thypus and Herpes. Surkesnas (2012) reported that this kind of disease still a health problem in Indonesia [1]. According to the results of mortality survey which was conducted in 2005 by Sub-Directorate of ARI of the Ministry of Health of Indonesia in 10 provinces, it was found that Pneumonia as one disease part of ARI was the greatest cause of death among infants (22.3 %) and under-five children (23.6 %). Meanwhile, the

National Health Survey in 2010, revealed that: Diarrhoea with the problem of it own, causing epidemics in 38 locations throughout 22 regencies/cities in 14 provinces, and the case catality rate of Diarrhoea in epidemic situation was around 1.74 %; fatality rate of Pulmonary TB reached 250 cases a day; the prevalence of worm diseases among elementary school children in the sampled regencies was 22.6 %; the incidence rate of DHF was 67/100.000 people with fatality rate of 0.9 %; the incidence of Chikungunya was reported as big as 83.533 cases with no death; and the percentage of Thypus cases was 20.73 %.

The percentage of Indonesian people who defecate carelessly was 47 %, and they do it in rivers, yards, rice fields, ponds and other open places. That misappropriate behavior would be harmful for people's health because the faeces might consists of various pathogenic bacteria such as E. Coli which is originated from human intestine and potential in causing Diarrhoea and other environmental based diseases. In 2006, 423 for every thousand people got Diarrhoea with fatality rate 2.25 % [2].

The careless defecation behavior among people has various reasons, for example: to build latrine is expensive, they feel more comfortable defecating on river, and the faeces can be utilized as fish feed. Subagyo (1994) said that all the reasons are ultimately affected by a long habit since they were children and inherited from their old fellows; and because up to now they do not have health problem experiences [3]. People ought to change those old paradigms into clean and healthy living behaviors which will bring them to a higher community health level. By altering their behaviors more hygienically according to health principles, many communicable disease cases can be prevented and declined. For instance, 32 % of Diarrhoea cases will be reduced by the improvement of people's access to basic sanitation facilities especially family latrine.

The advantages gained by do not defecate carelessly are as follows [4]:

a. Keep the environment clean, healthy, convenience and does not smell
b. No pollution occured in water sources which are used as raw water for drinking and other daily activities such as bathing and washing
c. Do not attract insects and animals which spread diseases, so that preventing communicable diseases

According to Directorate of the Land Rehabilitation and Development (1995), the use of chemical fertilizers, which constantly result in damage to the soil. The soil becomes acidic and loss of nutrient elements in it [5]. Defecation Haphazardly (in the form of feces and urine), it can also pollute the environment. Diseases which can be transmitted by faeces are Diarrhoea, Worm Diseases, and those for urine are Hepatitis, Thypus and Herpes. One of the utilization of faeces and urine if they are managed adequately, is can be used as organic fertilizer.

Nutrient elements contained in urine are quite high, i.e. 80 % Nitrogen [6] and the remaining is comprises of Phospate and Potassium. All the three elements are categorized as essential substances for plants growth. Definitely, the urine will be very useful if it is converted into fertilizer, certainly after passing through a prior fermentation process for dispersing the urinal smell.

Urine fermentation is very well used as liquid organic fertilizer because it has complete nutrient composition. N is approximately 1.5 – 2 % and P and the remaining is about 0.15 – 0.2 %. The N element, 75 – 90 % is in the form of Urea and the rest small percentage is of Ammonium or Creatinine. Meanwhile, for P and S, almost 90 – 100 % is formed as dissolved inorganic and can be directly consumed by plants.

The use of liquid organic fertilizer can improve soil fertility which was damaged by a continuing use of chemical fertilizers on it. The addition of urinal substances as a liquid fertilizer can provide the best growth on plants [7]. The excessive use of inorganic or chemical fertilizer can make soil becoming acid, neutral or alcaline as the results of the reaction of chemical fertilizer and soil. The use of inorganic or chemical fertilizer remaining on the ground (residue) can pollute the environment so that it will harm the entire organisms which exist in the surroundings sphere [8].

Based on that background, for handling the carelessly disposed urine, it is necessary to use an efficient and effective technology which can yield benefits. One of the efforts to tackle and address the urine waste problems is to make urinoir models which can produce liquid organic fertilizer.

2. RESEARCH METHOD

The research was carried out in Sukunan Village on 1-16 April 2013. Three urinoir models were used with 5, 6 and 7 day detention time variations. Each urinoir model consists of: urinal tub made of waste bin, anaerobic tub made of used plastic drums, and aerobic tub made of 9 inch PVC pipe which is featured by ventilation hole and aerator. Function test was needed to check if there was any leakage and decide whether the device is suitable to be used. Biostater was added to the model because it was needed to accelerate the process of urine fermentation. The biostater was mixed with sugar solution. Biostater volume was 1 % of the total volume of the anaerobic and aerobic tubs. The examination of urine sample for Nitrogen, Phospate, and

Potassium parameters were held after the fermentation process inside the urinoir in 5, 6 and 7 day detention time.

The data of Nitrogen (N), Phosphate (P), and Potassium (K) concentration as examination results from the laboratory are tabulated in Table 1, Table 2 and Table 3. The average levels of those substances at various detention times are presented in Figure 1.

The type of research was an experiment study with post-test only design. The concentration difference of the three substances were tested for data normality by using Kolmogorov-Smirnov Test, and it was found that the data were normally distributed ($p<0,001$), so that Multivariate Anova test as the subsequent test can be used in 95 % level of significance ($\alpha = 0.05$).

3. RESULTS AND ANALYSIS

Data analysis of N, P, and K concentration resulted from laboratory examination was conducted descriptively and analytically. In descriptive manner, the data were analyzed for each parameter in each model. Graphic was constructed to present, compare and analyse the data between parameters and detention times.

The laboratory examination results of N concentration after the urine has gone through the urinoir model with various detention times are presented in Table 2.

Table 1. Results of Laboratory Examination on Concentration of N in Urine after Pass through Urinoir Models at Various Detention Times

No	N Concentration (%) at Detention Time		
	5 day	6 day	7 day
1	0,2200	0,1753	0,1509
2	0,2210	0,1770	0,1514
3	0,2199	0,1765	0,1521
4	0,2225	0,1769	0,1522
5	0,2197	0,1759	0,1519
Sum	1,1031	0,8816	0,7585
Average	0,22062	0,17632	0,1517

Data on Table 1 shows that the highest average of N concentration is at 5 day detention time i.e. 0.22062 %, and the lowest is at 7 day detention time i.e. 0.1517 %. The laboratory examination results of P concentration after the urine passed through the urinoir model with various detention times can be seen in Table 2 as follows.

Table 2. Results of Laboratory Examination on Concentration of P in Urine after Pass through Urinoir Models at Various Detention Times

No	P Concentration (%) at Detention Time		
	5 day	6 day	7 day
1	0,01811	0,01141	0,009350
2	0,01820	0,01146	0,009395
3	0,01810	0,01141	0,009351
4	0,01909	0,01200	0,009400
5	0,01905	0,01090	0,009410
Sum	0,9255	0,05718	0,046906
Average	0,01851	0,011436	0,0093812

Data on Table 2 shows that the highest average of P concentration is at 5 day detention time i.e. 0.01851 % and the lowest is at 7 day detention time i.e. 0.0093812 %. The laboratory examination results of K concentration after the urine passed through the urinoir model with various detention times is delivered in the following Table 3.

Table 3. Results of Laboratory Examination on Concentration of K in Urine after Pass Through Urinoir Models at Various Detention Times

No	K Concentration (%) at Detention Time		
	5 day	6 day	7 day
1	0,01413	0,008479	0,006217
2	0,01526	0,009609	0,005652
3	0,01469	0,008914	0,005078
4	0,01524	0,009610	0,005645
5	0,01475	0,008965	0,006225
Sum	0,07407	0,045577	0,028817
Average	0,014814	0,009154	0,0057634

Data on Table 3 shows that the highest average of P concentration is at 5 day detention time i.e. 0.014814 %, and the lowest is at 7 day detention time i.e. 0.0057634 %. The average concentration of N, P and K among the various detention times is presented in Figure 1.

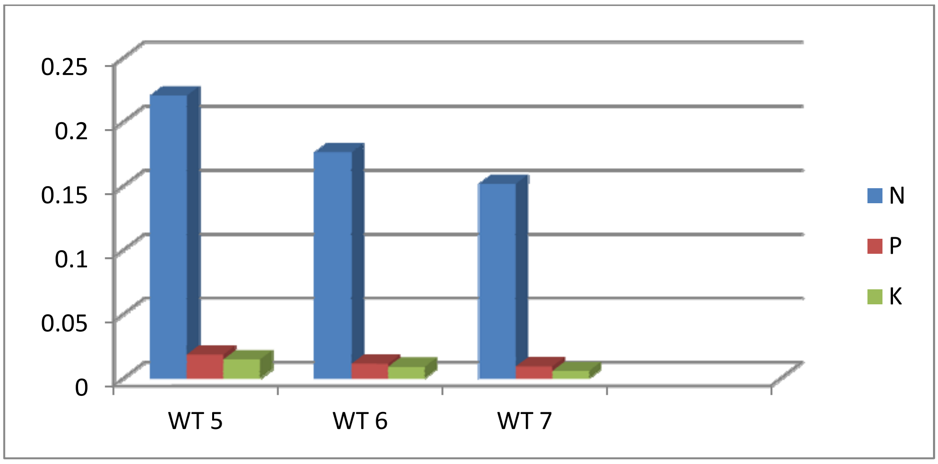

Figure 1. Concentration of N, P and K after Passed Through Urinoir Models

Figure 1 shows that the average of N, P, and K after the urine has gone through the urinoir model with 5 day detention time were the highest results, where the lowest were yielded on detention time of 7 day. Fertilizing using fertilizer containing N, P, and K which appropriate with the need of plants and the corresponding land supporting power is important to be considered carefully [9]. Completing nutrient elements especially those which were needed by the plants in large amounts, affect the quality of plants [10].

The results of statistical tests revealed that concentration of N, P and K of the organic fertilizer among 5, 6 and 7 day detention time in the urinoir were significantly different, as well as after passed thorugh the urinoir model ($p<0,001$). Nutrient elements contained in urine were relatively high i.e. 80 % nitrogen [6] and the rest which are comprises of phosphate and potassium, are essential elements in plant growth.

Fermented urine is best used as liquid organic fertilizer because it has complete nutrient content. Content of N approximately 1.5 to 2 %, and P and the remaining about 0.15 to 0.2 %. 75 - 90 % of N is in the form of urea and the remaining is in the form of ammonium or creatinine. On the other hand, for P and S substances, almost 90-100 % were formed in dissolved inorganic and can be consumed directly by plants. The fermentation process of urine with the addition of biostarter, accelerating the process in 4-6 days. Fermentation time for urine is needed to degrade the macro elements existing in it becoming micro elements (nutrient elements) which can be absorbed by plants. The function of biostarter in the fermentation process of the urine is to accelerate the dispersing process of the microorganisms.

The excessive use of inorganic or chemical fertilizer can cause the soil becoming acid, neutral or alcaline as a result of the reaction between chemical fertilizer and the soil, as well as producing residue which may disturb all organisms in the surrounding environment. The use of liquid organic fertilizer can improve soil fertility which was damaged by a continuing use of chemical fertilizers on the soil [8].

Nitrogen which is absorbed into soil is in form of nitrate or ammonium ion. Furthermore, the nitrate inside the plants reacts with carbon and forms amino acid which then turned into protein. Nitrogen is categorized as an element which is most needed by plants because 16-18 % of protein are composed of nitrogen. Phosphorus substances in plants is needed in the amount less than that of nitrogen. Phosphorus is absorbed by plants in the form of apatite calcium phosphate, FePO4, and AlPO4. Meanwhile, one function of potassium is it can affect the order and circulation of carbohydrates inside plants, accelerate the metabolism of nitrogen and prevent flowers and fruits to not easily fall.

The results of examination show that the highest average of N concentration was at 5 day detention time, i.e. 0.2203 %, while the lowest was at that of 7 day, i.e. 0.1515 %. Similarly, for P concentration, the highest average was at 5 day detention time i.e. 0.01814 %, and the lowest was at that of 7 day, namely 0.009365 %. Meanwhile, for K concentration, the highest and lowest average were recorded at 5 day and 7 day detention time as well, with 0.001469 % and 0.005649 % respectively.

4. CONCLUSION

The use of urinoir model in various urine detention times influence the concentration of Nitrogen (N), Phospat (P), and Potassium (K) of the yielded liquid fertilizer ($p<0.001$). The highest concentration average of N was at 5 day detention time i.e. 0.2203 %, while the lowest was at 7 day detention time i.e. 0.1515 %. The highest concentration average of P was at 5 day detention time i.e. 0.01814 %, and the lowest was at 7 day detention time i.e. 0.009365 %. The highest concentration average of K was at 5 day detention time i.e. 0.001469 %, and the lowest was at 7 day detention time, i.e. 0.005649 %

Concentration of N, P and K of liquid fertilizer after the urine was fertilized in various types of urinoir model (I, II and III) were significantly different ($p<0,001$).

The most appropriate urinoir model in the production of liquid organic fertilizer N, P, and K from urine is Model I (5 day detention time). The detention time was affected by biostarter. The function of biostarter is to accelerate the creation of liquid fertilizer with the highest quality of N, P, and K elements.

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REFERENCES

[1] Depkes, “Survei Kesehatan Nasional”, *BPS,* Jakarta, 2010.
[2] Depkes, “Survei Mortalitas”, *Sub Dit ISPA, Dirjen PPM-PLP,* Jakarta, 2005.
[3] Subagyo, “Sumber Daya Lahan Indonesia dan Pengelolaannya”, *Tesis Doktor,* Institute Pertanian Bogor, 1994.
[4] Winatasismita, *Urologi Untuk Praktek Umum,* Jakarta: EGC, 1996.
[5] Departemen Pertanian, “Laporan Inventarisasi/identifikasi lahan marginal/kritis pada kawasan lahan usaha tani seluruh Indonesia”, *Direktorat Jenderal Tanaman Pangan,* Jakarta, 1993.
[6] Larsen, S.Eriyatno. Kirom, “Persepsi Multifungsi Pertanian: Studi kasus di Jawa Barat dan Jawa Tengah. Prosiding Seminar Multi Fungsi Pertanian”, *Pusat Penelitian dan Pengembangan Tanah dan Agroklimat,* Bogor, 2001.
[7] Hudori, “Pemanfaatan Urine Manusia Sebagai Pupuk Tanaman Tomat”, *Jurnal Lingkungan Tropis*, Universitas Islam Indonesia, Yogyakarta, 2012.
[8] Irawan, “Perumusan Model Kelembagaan Konversi Lahan Pertanian”, *Pusat Penelitian Sosial Ekonomi Pertanian,* Bogor, 2001.
[9] Ghozy, Achmad Manshuri, “Pemupukan N, P dan K Pada Kedelai Sesuai Kebutuhan Tanaman dan Daya Dukung Lahan”, *Jurnal Tanaman Pangan,* Balai Penelitian Tanaman Kacang-Kacangan dan Umbi-Umbian, Malang, 2008.
[10] Sudarmi dan Intan, “Kajian Dosis Pupuk NPK dan Macam Media Tanam Terhadap Pertumbuhan dan Hasil Sambiloto (Andrographis Paniculata Ness.),” *Seminar Hasil Penelitian dan Pengabdian Kepada Masyarakat*, Universitas Veteran Bangun Nusantara Sukoharjo, 2011.

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