

Effect of Fermentation Time and Concentration of Local Microorganisms (MOL) of Rice Straw on Nitrogen Levels in Cow Biourine

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ABSTRACT

Biourine is urine taken from livestock, especially ruminants, which is fermented before being used. The purpose of this study was to determine the effective fermentation time and local microorganism concentration (MOL) of rice straw to produce the highest nitrogen content in bovine biourine. Biourine is obtained through the fermentation method and analysis of nitrogen levels using the Kjeldahl method. The fermentation treatment given to bioourine was for 10 and 15 days of treatment using 4 combinations of MOL concentrations of straw, cow urine and EM4 used. The results of the analysis of nitrogen levels in biourine fermented for 15 days were much higher than those fermented for 10 days. The total N levels in biourine fermentation for 15 consecutive days from K1, K2, K3 and K4 were 0.0828%, 0.1110%, 0.1074% and 0.0836%. It can be seen that the highest nitrogen content is at the second concentration with a combination of 50 grams of straw, 1000 mL of cow urine, and 5 mL of EM4. So that the use of the MOL concentration with a fermentation time of 15 days was able to increase total nitrogen levels significantly when compared to control urine which only contained 0.0399% nitrogen if done without fermentation.



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INTRODUCTION

Indonesia is an agricultural country with around 70 per cent of its population earning a living from the agricultural sector (Roidah, 2013). This is a cause for concern as Indonesians, when farming, will use chemical fertilisers which will increase the level of soil pollution and ultimately affect human health. The continuous use of chemical fertilisers causes soil hardening. Soil hardening is caused by the accumulation of chemical fertiliser residues that are relatively more difficult to decompose compared to organic fertilisers (Adiatma, 2016).

Organic fertiliser is a liquid or solid fertiliser composed of living materials such as decayed remains of plants, animals, and humans. Organic fertilisers that contain a lot of organic matter such as compost, green manure, manure, crop residues, livestock waste, and municipal waste (garbage) are used to improve the physical, chemical, and biological properties of soil, or in another sense, as soil fertilisers. Some of the advantages of chemical fertiliser over organic

fertiliser are that it is more practical to use because it has a predetermined dosage and has a high nutrient content. A comparison of the levels of manure, waste fertiliser and chemical fertiliser can be seen in Table 1.

Table 1. Comparison of Manure, Waste Fertiliser and Chemical Fertiliser Levels (Rini, 2011)

Nama	N (%)	P ₂ O ₅ (%)	K ₂ O (%)
Pupuk kandang	0,3	0,25	0,4
Pupuk sampah	1,09	0,15	1,24
Pupuk urea	42	-	-
Pupuk Z.A	20	-	-
Pupuk D.S	-	45	-
Pupuk Z.K	-	-	52

*Sumber: No.20/SNI/Permentan/OT.140/2/2009.

From the above comparison, urea fertiliser has a higher nitrogen content than manure, which has a low nitrogen content. Urea fertiliser is a chemical fertiliser that contains high levels of nitrogen. However, organic fertiliser is still superior because it is natural, environmentally friendly (does not cause soil pollution), cheaper, can be made at home and the yields are proven to be of higher quality.

Indonesia, besides being known as an agricultural country, is also known as a country rich in livestock products. One of the most widely recognised livestock farms is cattle farming (*Bibos banteng*). The main products of cows are meat and milk, therefore farmers always want a more effective way of fattening cows so that the growth of cows does not take a long time and can provide income with satisfactory profits. However, dairy farming with a scale of more than 20 heads and relatively localised will cause pollution to the environment. The population of dairy cattle in Indonesia continues to increase from 334,371 heads in 1997, to 368,490 heads in 2001, and the waste produced will also increase (Huda, 2013). Agriculture Minister Amran Sulaiman stated that in 2018, the cattle population in Indonesia has increased to 16.8 million heads (Deni, 2019).

One cow with a body weight of 400-500 kg can produce solid waste and liquid waste of 27.5-30 kg/head/day (Huda, 2013). As organic waste, if not handled properly, these big cities will drown in heaps of garbage along with all the environmental impacts such as water and air pollution, and sources of disease. One of the ways to overcome the above problems is to use the application of *zero waste management* which utilises liquid waste from cows which is processed into liquid organic fertiliser which is relatively efficient and good for soil fertility. Cow urine can be used as liquid organic fertiliser (POC) so that it can become a more useful agricultural product commonly referred to as *biourine*.

Biourine can be used as a liquid organic fertiliser through a fermentation process involving the role of microorganisms, so that it can become a more useful agricultural product. The presence of organic matter in Biourine can improve the physical, chemical, and biological properties of the soil (Shinta, 2013). Biourine is an alternative fertiliser that contains microorganisms that can increase the availability and efficiency of nutrient uptake for plants so as to reduce dependence on inorganic fertilisers (N,P,K) and increase crop yields (Sofiana, 2017). The nutrient content of urine can be increased through fermentation. Cow urine fermented with microorganisms has increased nutrients including Nitrogen and other nutrients (Huda, 2013).

The use of microorganisms in making liquid organic fertiliser usually uses EM4 (*Effective Microorganism 4*) which can be obtained at farm shops. Microorganisms can also be produced from natural (local) materials to reduce production costs. Local microorganisms (MOL) can be produced from plant and animal materials. Plant-derived

microorganisms use rice straw, and animal microorganisms use livestock faeces. The utilisation of local microorganisms (MOL) has the advantage of being relatively cheap and easily available (Adiatma, 2016).

The function of rice straw in the fermentation process is as an additive that functions for microbial fertilisation, because in rice straw there are many microbes that are tasked with destroying organic material in cow urine and of course they also need nitrogen (N) in large quantities for their nutrition. Nitrogen (N) will unite with microbes during the destruction of organic material (Huda, 2013). To increase the Nitrogen content in cow urine, it is necessary to study how long the fermentation time is and what concentration of local microorganisms is effectively used in increasing the Nitrogen content of biourine.

METHOD

Preparation of Rice Straw

The rice straw is first dried in the sun and aerated before milling. The dried straw is taken to the milling machine to be finely ground to a length of approximately 3-5 cm for easy packing and mixing with other materials. The chopped straw is packed into sacks for easy handling.

MOL Preparation

Rice straw that has been cut into pieces is weighed for the mixture, and mixed with cow urine and EM4 according to the variation of MOL concentration into the container. The variations of MOL making are presented in Table 2.

Table 2. MOL Concentration Variation for biourine mixture

Variasi Konsentrasi	Kombinasi Campuran		
	Jerami (g)	Urine sapi (mL)	EM4 (mL)
K1	0	1000	5
K2	50	1000	5
K3	75	1000	5
K4	100	1000	5

Biourine fermentase

After the biourine mixture is ready, stirring is carried out until the mixture is evenly distributed. Then the biourine container is closed tightly using plastic and a container cover. The mixture that is stirred evenly will produce a more efficient fermentation. The mixture is fermented for 10 days in the first treatment and 15 days in the second treatment. The lid of the container was opened every day for stirring with a record time of between 2 to 3 minutes, in order to release the gas formed from the fermentation process. After the fermentation process is complete with a predetermined time, the liquid organic product is ready to be analysed.

Nitrogen content analysis

The sample was taken as much as 0.5 mL into the kjeldahl flask, then concentrated H_2SO_4 was carefully added as much as 7.5 ml, the kjeldahl flask and its contents were deconstructed in a fume hood until clear without smoke for approximately 45 minutes, after the cold deconstruction results were diluted with 100 ml of cold distilled water, then 50 ml of cold 40% NaOH was added carefully, then the kjeldahl flask is installed in a distillator device which has previously been installed in a 250 ml container erlenmeyer containing H_3BO_3 3% as much as 25 ml, then the distillation process takes place and is stopped after the container erlenmeyer has reached 100 ml, the distillate is immediately titrated with 0.1 NH_2SO_4 standard solution, and titration is stopped when the colour of the solution changes to the end point (the colour of the

solution changes) from green to pink / original colour. Nitrogen content is calculated using the following formula:

$$\% N = \frac{\text{ml titrasi} \times 0.1000 \times 0,014}{\text{gr sampel}} \times 100\%$$

RESULTS AND DISCUSSION

The results of the fermentation process of cow urine resulted in changes in the characteristics of cow urine. After fermentation. Cow urine which originally had a brownish colour with a pungent smell turned into a black biourine liquid and the pungent smell was slightly reduced replaced by the smell of straw even though at higher concentrations the smell of straw was followed by the pungent smell of urine.



Figure 1. Biourine sample after fermentation

During the fermentation process, the temperature and pH will change due to microbial activity during fermentation. At the beginning of fermentation, microorganisms will begin to decompose organic materials contained in the mixture, so that acids will begin to form which can reduce the pH of the mixture. However, over time, fermentation will also produce basic products resulting from the decomposition of protein or organic nitrogen in the mixture into ammonium which can raise the pH of the mixture again (suswatanti & Widiyaningrum, 2017). So that there are fluctuations in the fermentation process from the beginning of fermentation to the end of fermentation. In Figure 2, it can be seen that the pH value of the mixture at 15 days of fermentation is more alkaline compared to 15 days of fermentation, but still more acidic when compared to the control that was not fermented.

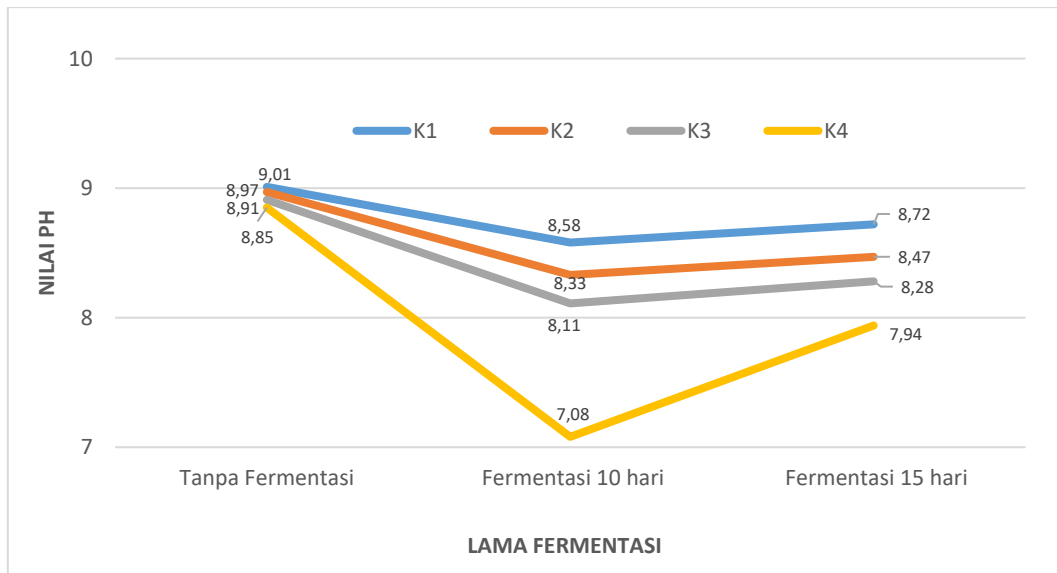


Figure 2. Fluctuation of pH value during fermentation

EM4 contains fermented and synthetic microorganisms consisting of lactic acid bacteria (*Lactobacillus casei*), photosynthetic bacteria (*Rhodospseudomonas Sp*), *Actinomyces Sp*, *Streptomyces Sp*, *R.bassillus/azotobacter* and yeast bacteria (Telaumbanua, 2023; Salmiyati, 2021). All microorganisms contained in EM4 play an active role in the fermentation process, namely converting cellulose into alcohol and converting alcohol into acetic acid. Alcohol is a carbon source that is indispensable for cell growth. While acetic acid is a metabolite product whose formation depends on the size of the acetic acid bacteria population and the availability of ethanol. It is this acetic acid that plays a role in reducing the acidity of the pH of the mixture during fermentation (Prasetio & Widyastuti, 2020).

In addition to the pH value, the temperature of the mixture will also be affected during the fermentation process. If seen in Figure 3, the temperature of the mixture fluctuates where the initial temperature of fermentation is lower with the final temperature of fermentation. The highest temperature reached during the fermentation process was 32.5°C. This temperature is quite low when compared to the temperature at which thermophilic bacteria can grow, which is at 45°C to 60°C. If thermophilic organisms are able to grow under these conditions, they can assist in the breakdown of organic matter (Juliasih, 2017). However, when compared to the initial temperature, there has been an increase in temperature. This indicates that there has been microorganism activity that is able to produce fluctuations in the temperature of the mixture.

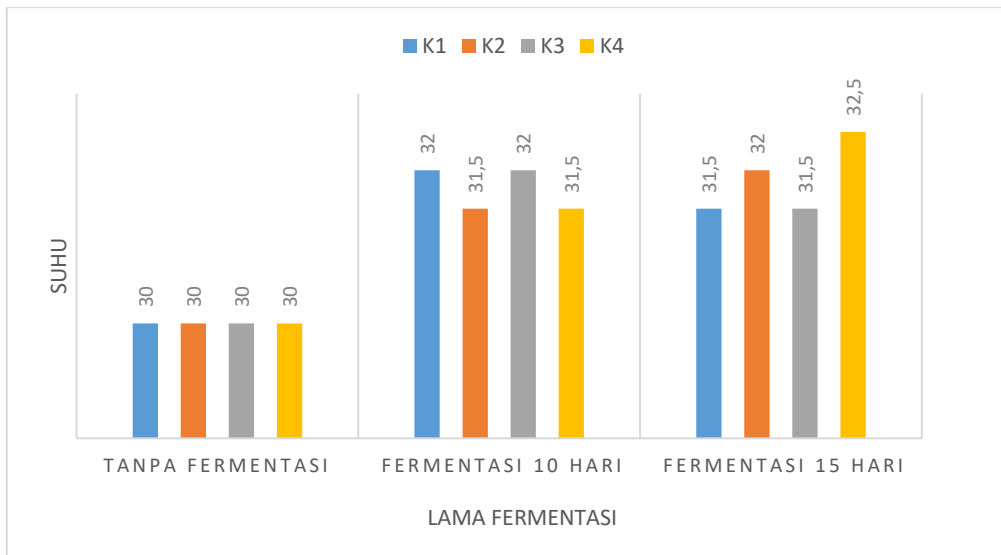


Figure 3. Fluctuation of mixture temperature during fermentation

The results of the analysis of Nitrogen content in variations of fermentation time and MOL concentration can be presented in Table 3. It can be seen that the nitrogen content of biourine increases with increasing fermentation time. With the highest value obtained in variation K2 which utilised 50 grams of straw for each litre of cow urine. When viewed from the difference with the control value, during 15 days of fermentation the Nitrogen content increased by 0.0711%.

Table 3. Total N content of cow biourine

Perlakuan	% Nitrogen		
	Kontrol (tanpa fermentasi)	10 hari fermentasi	15 hari fermentasi
K1 (0 gr jerami:1000 ml urine:5 ml EM4)	0,0269	0,0541	0,0828
K2 (50 gr jerami:1000 ml urine:5 ml EM4)	0,0399	0,0836	0,1110
K3 (75 gr jerami:1000 ml urine:5 ml EM4)	0,0334	0,0835	0,1074
K4 (100 gr jerami:1000 ml urine:5 ml EM4)	0,0271	0,0546	0,0836

The longer the fermentation, the higher the nitrogen content will be. The nitrogen content in the fertilizer comes from organic materials that are degraded by microorganisms, namely straw. Nitrogen is essential for the soil as a fertilizer for plants. To obtain good nitrogen in fertilizers, bacteria such as EM-4 are added with the help of microorganisms like rice straw for their sustenance. Thus, rice straw plays an active role in helping the growth of these bacteria. Rice straw contains organic matter and nutrients that are good for soil fertility. Lignocellolytic microbes are capable of producing various enzymes that can hydrolyze lignin, hemicellulose, and cellulose compounds found in straw (Setiarto, 2013).

If we look at the variation of MOL concentrations involved in the biourine mixture, the nitrogen content increases with the addition of 50 grams of straw per liter of urine. However, the addition of a higher amount of straw, specifically 75-100 grams, actually decreases the nitrogen content in the biourine. This could be due to the limitations of the

microorganisms present in the mixture, causing the increase in nitrogen content produced not to be linear.

Based on the exposure of the nitrogen content values that have been produced, this liquid fertilizer still yields relatively low nitrogen levels. However, in this study, fermentation was only carried out over a period of 15 days, which is a relatively short time for biourine fermentation. The N content produced in liquid fertilizer depends on the concentration or dose of MOL used as well as the duration of fermentation (Yulianingrum et al., 2019). The longer the fermentation time, the higher the Nitrogen content will generally be. However, considering the potential increase in nitrogen levels compared to the control without fermentation, the production of biourine using straw has the potential to be further developed.

CONCLUSION

Based on the research data and discussion, it can be concluded that the duration of fermentation and the concentration of MOL rice straw affect the nitrogen content produced in the cow biourine that has been made. The longer the fermentation time, the higher the nitrogen content. Whereas for the MOL concentration, the increase is not linear but rather a decrease in nitrogen content if the MOL concentration used is too high. Therefore, in this study, the effective fermentation period is 15 days using a straw MOL concentration of 5 grams per liter of urine.

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