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The Effect of Young Coconut Husk on the Quality of Goat Manure-Chicken Excreta Bioculture

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ABSTRACT

The negative impact of chemical fertilizers use is soil fertility declining. The situation occurs because of biological, physical, and chemical properties of the soil is decreased. Agricultural waste is a large commodity which utilization can still be optimized, for example by using as raw material for organic liquid fertilizer. Agricultural wastes that have good quality as fertilizer include goat manure, chicken excreta, and coconut husk. The utilization of agricultural waste as organic fertilizer is one way of creating sustainable agriculture. This study aims to test the quality of liquid fertilizer (bioculture) of goat manure and chicken excreta by adding various levels of coconut husk. Bioculture is made by anaerobic fermentation for 21 days. The parameters observed included levels of C-organic, N, P, and K bioculture, as well as germination tests to determine the presence of phytotoxins. The data were analyzed using one way ANOVA. The treatment of P5 (5% coconut husk) showed the highest levels of N and P, while the K content was not significantly different from the treatment of P4 (2.5% coconut husk). The germination test showed no phytotoxin activity in bioculture.

Keywords: Bioculture, Chicken excreta, Coconut husk, Goat manure, Liquid fertilizer

Introduction

In 2018, the employment of 29.6% of the Indonesian people was in the agrarian sector, this number was the highest compared to other occupations. That causes the need for fertilizer to continue increased annually. In 2017, Indonesia imported 7 million tons of fertilizer and national production in the range of 11 million tons. The excessive use of chemical fertilizers on agricultural land have serious problems such as damage to the physical, biological, and chemical properties of the soil, which leads to a decrease in soil quality (Sharma and Singhvi, 2017; Rahman and Zhang, 2018). Other problems such as water pollution by fertilizer leaching are also commonly found (Zhang *et al.*, 2018), and that may couse massive algae bloom (Alobwede *et al.*, 2019) and the process may result in destruction of aquatic habitats (Rahman and Zhang, 2018).

In a sustainable farming system, all aspects must be considered for long-term effects, and must not have a negative effect on one side (Pretty, 2008) including the problems mentioned above. Processing agricultural waste into useful material (recycle) is also one of the principles of sustainable agriculture (Sorathiya *et al.*, 2014). In terms of overcoming agricultural problems caused by the use of chemical fertilizers, agricultural waste utilization in organic fertilizer production can be a solution. Agricultural waste such as goat manure, chicken excreta, coconut husk, and molasses are widely available in Indonesia, however, its use as a liquid fertilizer is still low. Organic fertilizer does not have a macro-elemental content (NPK) as high as synthetic fertilizer (Shaheen *et al.*, 2018) but its has very diverse elements (macro and micro minerals, organic matter, increasing soil microbes) that can fertilize the soil by improving physical, biological, and chemical of properties the soil (Hossain *et al.*, 2017).

Liquid organic fertilizer has advantages over the solid, including facilitating transportation and facilitating application to the plants (Nurdiawati *et al.*, 2019). Unlike bulky solid fertilizers, liquid fertilizers are more compact and effective to be applied to plants, and their nutrient content is more easily absorbed (Lestari *et al.*, 2019). Various forms of liquid fertilizers can be in the form of plant extracts, compost tea, liquid manure, and manure tea (Govere *et al.*, 2018; Shaheen *et al.*, 2018). The use of agricultural-waste liquid fertilizers has been proven to increase the production of agricultural crops, such as spinach (Pyakurel *et al.*, 2019), corn (Kizito *et* *al.*, 2019), chillies, tomatoes, andrice (Samsuddin *et al.*, 2014; Mowa *et al.*, 2017; Sunaryo *et al.*, 2018). Liquid manure (bioculture) of goat manure (Sunaryo *et al.*, 2018; Fitriyanto *et al.*, 2019) and chicken excreta (Shaheen *et al.*, 2018) have been studied previously, although the bioculture proven to have a positive effect on plants, the P and K content are still low. On the other hand, coconut husk has high K and P content, but low N. Coconut husk as raw material for solid fertilizer has also been studied (Bonneau *et al.*, 2010). Bioculture resulting from a combination of goat manure, chicken excreta, and coconut husk has never been reported before. It is hoped that with coconut husk supplementation on bioculture production, it will increase the K and P content. This research sought to identify the quality (C-organic, N, P, K) of liquid fertilizer (bioculture) of goat manure and chicken excreta by adding various levels of coconut husk.

Materials and Methods

Fabrication and analysis of bioculture were carried out at the Livestock Product Processing Technology Laboratory on Politeknik Negeri Banyuwangi. The ingredients of bioculture are fresh goat manure (Bligon goat), chicken (commercial layer) excreta, and young coconut husk (waste). The ratio of goat manure, chicken excreta, and water is 1: 0.3: 3, with the total weight of the mixture without coconut husk is 15 kg. Materials were obtained from farmers in the vicinity of the study site. Five treatments were carried out based on coconut husk addition (0; 0.65; 1.25; 2.5; 5% by mass of young coconut husk compare to the solid waste). Fermentation is done for 3 weeks in anaerobic conditions (Sastro *et al.*, 2013), the anaerobic method was chosen because of its simplicity than aerobic, and based on previous research the type of fermentation (aerobic or anaerobic) does not significantly affect the quality of the bioculture (Fitriyanto *et al.*, 2019). Fermentation is carried out in a tightly closed (20 liter) plastic container, to ensure anaerobic conditions, the stirrer/sampling hole (Ø 2 inch PVC pipe) is made half immersed in the bioculture solution and there is a check valve to remove the fermentation gas. The research design used was completely randomized design (CRD) with three replications.

The parameters observed were the levels of C-organic, N, P, and K biocultures which were observed immediately after harvesting. Phytotoxic tests were carried out by germination tests on Mung beans (*Vigna radiata* L.). Tests were carried out in Petri disks on washed sand media covered with cotton on the bottom. Bioculture was dissolved with destiled water in 10 mL of solution with concentrations of 0, 5 and 10% (Imatomi *et al.*, 2015), applied daily and observed after watering for 3 days. Data on liquid fertilizer contents and germination tests were analyzed using one way ANOVA. Duncan's Multiple Range Test was performed when the ANOVA results showed significant results (P<0.05).

Results and Discussion

Nutrient content in bioculture raw materials shows that chicken excreta has the highest content in the N-total, P, and K parameters, although the P content is not significantly different from coconut husk (Table 1). Coconut husk and goat manure have higher C-organic content (P<0.05) compared to chicken excreta. The nutrient content of goat and chicken excreta varies, according to the feed and the maintenance (Paul *et al.*, 2009). The previous reports of C-organic, K, P, and N contents of chicken excreta amounted to 34.9, 2.14, 2.32 and 5.13% (Dede and Ozer, 2018), respectively. Another study reported chicken K, P, and N excreta levels of 1.5, 1.92 and 3.96% (Shahid *et al.*, 2015), respectively. Goat manure are more varied in their nutrients content, due to diverse maintenance procedures, it is very different from commercial chickens which tend to have fixed procedures (Paul *et al.*, 2009). Goat rearing is generally in traditional procedures, producing C-organic, N, P, and K contents of 18.51, 1.37, 0.26, and 0.66% (Wuta and Nyamugafata, 2012), respectively. The P content of coconut husk in this study has a higher value (1.79%) than previously reported (0.9%) (Bethke, 2008). This is possible because in this study using husk from young coconuts, which have lower lignin, cellulose, and hemicellulose contents than the older coconut husk.

Layer chicken feed has average crude protein (CP) and energy metabolism (EM) ranging from 18% and 2,700 kcal/kg, as well as additional mineral premixes that cause high mineral content including P and K in its excretions (Almeida *et al.*, 2012). Feed with high EM requires the use of low-fiber feed ingredients, while C-organic content on manure is obtained mainly from fiber fraction (cellulose, hemicellulose, and lignin) (Tripolskaja *et al.*, 2014). Goat feces have high C-organic content but have a low N content (Table 1). To obtain good bioculture results, the three (goat manure, chicken excreta, coconut husk) ingredients are composed and fermented using

Table1. The average nutrient content of the bioculture raw material (%)

Material	C-organic	Potassium	Phosphor	N-total
Goat manure	50.13 ± 0.204^b	1.204 ± 0.019^a	0.116 ± 0.006^a	1.61 ± 0.330^b
Chicken excreta	45.19 ± 0.343^a	3.568 ± 1.311^b	1.812 ± 0.010^b	2.61 ± 0.100^c
Young coconut husk	55.56 ± 0.280^b	1.597 ± 0.034^a	1.760 ± 0.049^b	0.58 ± 0.110^a
Average value	50.29±4.429	2.123±1.279	1.229±0.823	1.59±0.870

Different superscripts in the same column are significantly different (P<0.05).

Table 2. Nitrogen content of bioculture (%)

Husk addition	N-total	Ammonium	Nitrate	Nitrite
P1 (0%)	0.096±0.005^{a}	0.117±0.006^{a}	0.425±0.019^{a}	0.315±0.015^{a}
P2 (0.65%)	0.107±0.004^{a}	0.129±0.004^{a}	0.462±0.006^{a}	0.354±0.017^{a}
P3 (1.25%)	0.104±0.015^{a}	0.126±0.018^{a}	0.452±0.056^{a}	0.339±0.045^{a}
P4 (2.5%)	0.112±0.004^{a}	0.133±0.006^{a}	0.495±0.019^{a}	0.363±0.015^{a}
P5 (5%)	0.141±0.021^{b}	0.177±0.029^{b}	0.623±0.093^{b}	0.472±0.073^{b}
Average value	0.113±0.019	0.138±0.026	0.496±0.085	0.373±0.067

Different superscripts in the same column are significantly different (P<0.05).

Table 3. The average nutrient content of the bioculture (%)

Husk addition	C-organic	Potassium	Phosphor
P1 (0%)	0.404±0.070	0.410±0.012^{a}	0.039±0.001^{a}
P2 (0.65%)	0.435±0.03	0.415±0.007^{a}	0.088±0.009^{b}
P3 (1.25%)	0.428±0.018	0.400±0.019^{a}	0.104±0.005^{b}
P4 (2.5%)	0.452±0.022	0.449±0.005^{b}	0.107±0.002^{b}
P5 (5%)	0.457±0.004	0.474±0.069^{b}	0.160±0.037^{c}
Average value	0.433±0.040	0.429±0.032	0.099±0.043

Different superscripts in the same column are significantly different (P<0.05)

Table 4. The observation data of germination test in Mung bean seed (mm)

Husk addition	Bioculture concentration (%)			
	Control (water)	5	10	Average value
Control (water)	50.85±3.93			50.85±3.93^{a}
P1 (0%)		62.30±14.00	53.31±0.55	57.80±9.61^{ab}
P2 (0.65%)		63.03±13.76	63.03±10.22	63.03±10.84^{ab}
P3 (1.25%)		72.77±9.81	63.70±5.63	68.23±8.71^{ab}
P4 (2.5%)		78.90±2.31	66.47±14.31	72.68±11.42^{b}
P5 (5%)		76.83±10.65	62.30±16.17	69.57±14.60^{ab}
Average value*	50.85±3.93^{x}	71.37±11.24^{z}	62.36±10.47^{y}	

$^{(ab;xyz)}$Different superscripts in the same column or the same row are significantly different (P<0.05)

bacteria that can break down fiber, fix nitrogen and solve P and K (Olle and Williams, 2015; Etesami *et al.*, 2017).

P5 treatment (addition of 5% young coconut husk) showed the highest N levels compared to other treatments (P<0.05) (Table 2). There is an interaction between the addition of young coconut husk with the N content on bioculture. The high content of C-organic and minerals in coconut husk can optimize the fermentation process by bacteria, because during the exponential growth phase these elements become important to support bacterial cell metabolism (Abbasiliasi *et al.*, 2017).

The C content in each treatment did not show any difference, with the average value is 0.433% (Table 3). But there is a positive trend of increasing the C-organic levels with the coconut husk addition. At the fermentation process, the high carbon content in coconut husk dissolved in the solution.

The K levels showed significantly different values, the highest concentration (P<0.05) was shown by P4 and P5 treatment compared to the other. The highest P level was shown by P5 treatment and was significantly different (P<0.05) from other treatments. The addition of coconut husk has a significant effect on P concentration, this can be seen from the P1 treatment (0% coconut husk addition) that has the lowest value. This proves that there is a significant amount of P and K dissolved in coconut husk into bioculture. The dissolution of these elements in bioculture is assisted by the potassium and phosphate solubilizing bacteria (Olle and Williams, 2015; Etesami *et al.*, 2017) that found in EM4 (Pujiastuti *et al.*, 2018).

The data showed trends that the addition of up to 10% bioculture does not have a negative effect on the germination of Mung beans (Table 4).

This is indicated by sprout height in all treatment that exceeds the control sprout height. Treatment P4 showed the highest value (P<0.05) and significantly different from other treatments. The application of fertilizer with a 10% concentration showed a smaller growth and significantly different (P<0.05) compared to the treatment of 5% bioculture solution, even though the mean was above the control. This shows that the content of phytotoxic substances in bioculture solutions is in small concentrations, so it does not inhibit the process of germination of Mung bean seeds until 10% of the concentration.

Phytotoxic contained in the bioculture is the substrate produced by secondary plant metabolism that contained in its materials (manure and coconut husk), for example, ethyl acetate fraction (Imatomi *et al.*, 2015). The inhibition of germination is caused by inhibition process of protein metabolism, nucleic acids, ionic balance, water balance, photosynthesis, and respiration (El-Gawad *et al.*, 2015), obstruction of enzymes and growth hormone, suppressing the hydrolysis of nutritional materials in embryos at the early stage of growth (Imatomi *et al.*, 2015).

Conclusions

The addition of young coconut husk has a significant effect on increasing C-organic, N, P, and K levels on bioculture. There is a positive interaction between the addition of coconut husk with the chemical composition of the bioculture and no phytotoxic activity appears to inhibit the germination process.

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