

THE POTENCY OF MANURE AND REFUSED FEED OF DAIRY GOAT TO PRODUCE ORGANIC FERTILIZER

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ABSTRACT

The study was conducted to measure the quantity and chemical composition of manure and refused feed from smallholder dairy goat and the quality of final product of compost. Data were collected from thirty dairy goats (Etawah Cross-Bred), which were fed *adlibitum* forages. To measure the quantity of refused feed, manure production and taken samples were conducted every day for five consecutive days. Samples were analyzed to determine the dry matter (DM), organic matter (OM) and crude protein (CP) content. The raw material of goat manure-based compost consisted of goat manure, refused forages, lime and ash. Compost was processed by aeration method. The final product of this compost was compared with cattle manure - based compost. The results showed that forage offered was 2.26 kg DM/d, equivalent with 106.3 g/kg⁷⁵. Refused forage was 0.55 kg DM/d, mainly consisted of Calliandra and Albisia twigs (49.3% of total refused feed DM). Manure production was 269.6 g DM/d. Average DM, OM and CP content of goat manure were 33.0, 87.0 and 21.4% while for refused forages were 94.7, 91.3 and 11.8%. Texture of goat manure - based compost was fine, colored dark brown with pH of 7-9. The content phosphor (0.15%) and potassium (0.64%) were lower than those of cattle manure - based compost, however nitrogen content (1.07%) was greater. Organic matter content and C/N ratio were 25.29% and 14.72%, respectively. The value were in accordance with the minimum recommended concentration for fertilizer, therefore goat manure and refused forages have potency to provide nutrient to produce good quality compost.

Key words: Dairy Goat, Manure, Organic Fertilizer

INTRODUCTION

Goat keeping in integration with crop production is characteristic for many smallholders in the region where organic fruit production being promoted in the upland area of Yogyakarta. The utilization of goat manure to increase soil fertility has been long practiced by farmers, however often farmer only deposits manure around the goat pens. Consequently the process of producing fertilizer was commonly long, lasted around 4-5 months. According to Rynket *et al.* (1991) cited by Georgacakis *et al.* (1996) composting is an accelerated mode of the natural decomposition of organic debris achieved under controlled environmental condition by microorganisms. Composting convert biodegradable solid organic matter into a stable humus-like substance, which can be handled, stored or applied to the land, without adversely affecting the environment. Somda *et al.* (1995) cited by Tanner *et al.* (2001) reported that goat manure has been recognized as beneficial to crop or fruit growth and long term soil

fertility. It has been shown to provide nutrients, particularly N, P and K. However according to Triatmojo *et al.* (2005), as the texture of goat manure being hard and oval forms, there was possibility difficult to destruct during the manure composting process. In smallholders, majority of goats are permanently housed and fed by cut and carry system. Forage is usually hand cut daily. The amount of collected feed may be less than the goat requirement but often farmers collect large quantity of forage that produce refused feed. This practical feeding was considered to produce the source of bulky agent, which also functioning as the source of carbon for composting. Martin *et al.* (1993) reported the utilization of peat, sawdust and mixture of peat and sawdust as bulking agent in order to compost fish offal and chicken manure. There has been little data showed the productivity and the benefit of those waste products to produce fertilizer. To support the integrated farming, there is need to evaluate how dairy goat feeding under smallholder management can generate quantity of organic fertilizer by composting process and to assess the quality of the final product.

MATERIALS AND METHODS

The study was designed by using dairy goat, which kept by smallholder farmers in Girikerto village of Sleman, Yogyakarta. The village is located at 500 m above sea level. Production of *salak* fruit typically characterizes type of farming in Girikerto. Data were collected from thirty dairy goats (Etawah Cross-Bred), which were individually confined in slatted floor pens. During the observation, under the pens were fitted plastic to collect manure. Goat was fed *adlibitum* forages. The raw materials used for composting were goat manure, cattle manure, refused feed, limestone and ash.

The first study was conducted to collect data pertain to: (1) feed, including, type and amount of forage offered, consumption and refused feed; (2) goat manure production and (3) nutrient concentration of refused feed and manure. Measuring of feed was started in the afternoon, when farmers commonly offered forages to goat. Before feeding, the type of forages was identified then continued by weighting the quantity. Refused feed and manure were collected and weighed every morning. Consumption was calculated by subtracted feed offered with refused feed after 24 hours. Collecting data were conducted for five consecutive days. During the period of data collection, samples of feed, refused feed and manure were taken for dry matter (DM), organic matter (OM) and Crude Protein (CP) determination.

The second study consisted of examination of composting process and assessment of compost quality. The two type of compost, which has been processed in the study, were goat manure - based compost and cattle manure - based compost (Table 1).

In this study, compost was processed followed aeration method, accomplished by turning. The process was started by chopping straw or refused forage into small pieces of around 5 cm. The next step was aging. In the process each raw material (straw, refused feed, goat and cattle manure) was mixed with water, as much as 30% of material weight subsequently kept in separated plastic bags for 24 hours. The following step was making heap of about one meter height. The heap consisted of 3 to 4 layers of materials. The first layer was formed by placing goat manure or cattle manure on the ground, followed by deposited refused feed or straw, lime and ash, respectively.

Table 1. Composition of raw materials for compost

Type of materials	Weight of material (kg/100 kg mixture)	
	Goat manure based compost	Cattle manure based compost
Cattle manure	0	70
Goat manure	70	0
Straw	0	23
Refused forages	23	0
Lime	3.5	3.5
Ash	3.5	3.5

After formation of heap, turning was accomplished by means of a shovel, once every 2 days for the first two weeks and every 15 days during the rest of the time until the end of the process, which occur when temperature of heap decrease to around the air temperature. Water could be added while turning, if the mixture was dry. The heap was covered with plastic and kept under the shade to avoid sunshine and rain. The composting process was examined by measuring the temperature, pH and physical characteristic (e.g. texture, color and smell). The last step of processing was screening the final product and taking samples for chemical analysis, including DM, OM, carbon (C), nitrogen (N), phosphor (P) and C/N ratio. Data on refused feed and manure production and compost quality were statistically analyzed by calculating the average value.

RESULT AND DISCUSSION

The body weight of goat in this study was 40.9 ± 1.1 kg on average, which was equivalent to $16.2 \text{ kg}^{0.75} \pm 0.3$. By *ad libitum* feeding, the average of forage offered was known to be 11.3 kg/d, equivalent to 2264.8 g DM/d (Table 2). The average of DMI as being $106.3/\text{kg}^{0.75}$ was positively correlated with feed offered. Feeding management of goat in this study produced 554.8 g DM/d of refused feed and 269.6 g DM/d of manure, therefore available total DM for composting was 826.4 g/d.

Table 2. The amount of feed, refused feed and goat manure

Parameters	Average	S.E.D
Forage offered (kg/d)	11.3	0.4
Forage offered (g DM /d)	2264.8	65.6
Forage intake (g DM/d)	1710.0	81.1
Forage intake ($\text{g DM}/\text{kg}^{0.75}$)	106.3	4.9
Forage refused (g/d)	2301.0	167.0
Forage refused (g DM/d)	554.8	48.4
Forage refused (g DM/kg DM forage offered)	252.1	22.9
Manure production (g/d)	1284.0	65.8
Manure production (g DM/d)	269.6	13.8

Table 3. The type of feed and refused feed

Type of feed	Feed	Refused feed
	percentage	% of total DM feed or refused feed
Leguminous tree leaves	50.6 ± 1.9 ¹⁾	55.2 ± 4.7 ²⁾
Non- leguminous tree leaves	30.2 ± 0.6	23.7 ± 0.1
Grasses	19.2 ± 5.6	21.2 ± 7.6

1) Calliandra 39.4 %; Albasia 6.4 % of total DM feed

2) Calliandra 43.7 %; Albasia 5.6 % of total refused feed DM

Table 4. Nutrient production

Nutrient production	Goat manure	Refused feed	Total
OM (g/d)	234.6 ± 12.0	527.1 ± 45.9	761.7 ± 45.9
OM (g/DM forage offered/d)	106.1 ± 3.1	229.4 ± 20.9	335.6 ± 22.5
PK (g/d)	56.6 ± 2.9	66.6 ± 5.6	123.2 ± 5.8
PK (g/DM forage offered/d)	25.6 ± 0.7	30.3 ± 2.8	55.9 ± 3.2
N (g/d)	9.1 ± 0.0	10.7 ± 0.9	19.7 ± 0.9
N (g/DM forage offered/d)	4.1 ± 0.1	4.8 ± 0.4	8.9 ± 0.5

Table 5. Quality of compost

Characters	Type of compost	
	Goat manure based ¹⁾	Cattle manure based ²⁾
Chemical content (%)		
Dry matter	94.90	92.50
Carbon	14.72	19.04
Organic matter	25.29	32.70
N total	1.07	0.97
P total	0.15	0.95
K total	0.64	2.06
C/N	14.72	19.04
Physical characteristic		
Texture	Fine	Fine
Color	Dark brown	Dark brown
PH	7 to 8	8 to 9
Smell	Odorless	Odorless

Maximum temperature during termophylic phase of¹⁾ 64 °C ²⁾ 62 °C

Table 3 showed the main type of refused feed. In this result, above 70% of DM was leguminous (mainly Calliandra and Albasia) and non-leguminous trees remain. Consequently, the refused feed majority consisted of twigs and woody part of leguminous and non-leguminous trees. However, there was also refused grasses, which normally softer than the twigs of trees and therefore easier to decompose.

Refused feed contains DM, OM and CP, as 94.7, 91.3 and 11.8% while those for goat manure were 33.0, 87.0 and 21.4%, respectively. Total nutrient production (Table 4) indicated that refused feed produced more OM than that from goat manure (527.1 compared to 234.6 g/d). Crude protein production of this study, which reflected as the source of nitrogen for compost was produced as 66.6 g/d, similar amount to that in goat manure of 56.6 g/d.

The composting process of cattle manure - based lasted for 42 days, while that for goat manure - based compost was 41 days. In term of quality, goat manure - based compost contained C and OM lower than those of cattle manure - based compost but

higher in N, consequently, C/N ratio was smaller (Table 4). The physical characteristic of goat manure - based compost was as expected, such as showing fine texture, dark brown color, odorless and pH alkaline of 8 to 9.

DISCUSSION

The amount and quality of refused feed

Under smallholder feeding management conducted by offering *ad libitum* forage, the goat consumed 106 g DM/kg^{0.75} and refused forage about 554 g DM/d. This average DMI was above the value recommended by AFRC (1992), which ranged from 65 to 73 g/kg^{0.75}. This achievement indicated that DMI was adequate. As the excess of feed, the refused feed consisted by not only twigs and woody part of plant but also leaves. According to Devendra and Burn (1983) goat tends to select diets with higher nitrogen content and because of higher tolerance of bitter taste, goat can consume a wide range of plant species. In this study, the refused feed contained 11.8% of CP and 91.3% OM, because of great remaining of leguminous and non-leguminous trees, such as Calliandra and Albisia. Referred to Baba *et al.* (2002), the leaves of legume trees contain CP as ranging from 11 to 21%. Could be pointed out in this study, that under cut and carry system, there was not only manure could be recycled to cropland but refused feed was also valuable as the source of nutrient for compost. The quantity OM and N produced from goat (Table 4) showed the available nutrient to be recycled to the land. However, as the main component of refused feed was mainly twigs and woody part of plant, there was need to chop it into small pieces, in order to improve decomposition process.

Compost quality

The objective of this study was producing fine compost from goat manure and refused feed. The process was expected to be able to destruct the oval form and hard texture of goat manure and woody part of refused feed. Preliminary treatment by chopping materials into small pieces and aging process were useful to improve decomposition process. The texture of final product was fine, colored dark-brown, alkaline and odorless. The alkaline condition of the final product was resulted from adding lime and ash to the mixture of compost material. Similarly, to this study was reported by Solano *et al.* (2001) on sheep manure-straw compost, the final product was alkaline, earthy smell and dark brown.

Maximum temperature during thermophilic phase of 64 °C, indicated a proper decomposition. Lau *et al.* (1992) stated that the temperature of windrow composting must over 55 °C for at least three consecutive days for pathogen destruction. According to Rynket *et al.* (1991) cited by Georgacakis *et al.* (1996), proper composting results in thermophilic temperature due to the generation of microbial metabolic heat and this can effectively destroy pathogen and weed seeds. Solano *et al.* (2001) reported during the thermophilic phase, maximum temperature inside the heap of sheep manure-straw compost aerated by turning was 80 °C reached 5 days after the beginning. A rapid temperature rise was produced after turning in the initial stages of composting. The respond to turning decreased as composting proceeded.

In compared with cattle manure-based compost, the goat manure-based compost has similar DM, the content of C and OM was lower but higher in N content. According to Zucconi and De Bertoldi (1987) the recommended concentration of OM, C, N and

C/N ratio of compost were 25 %, 17 to 42%, 0.6% and lower than 22, respectively. The final product of goat manure - based compost of this study passed the minimum recommended OM and N but lower in C content. However, C/N ratio of this product was in the range of recommended value as lower than 22. The study concluded that refused feed of dairy goat in smallholder usefully to provide C and N for making good quality compost.

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