Quality of compost produced from different types of decomposer substrate and composition of straw

M I Said¹, Hastang², and V N Isra¹

¹Department of Animal Production, Faculty of Animal Science, Hasanuddin University, Indonesia 90245
²Department of Socio-economics, Faculty of Animal Science, Hasanuddin University, Indonesia 90245

E-mail: irfanunhas@gmail.com

Abstract. Compost is one of the processes of decomposing organic materials that involves the activity of microorganisms partially. The use of decomposers is very important to accelerate the rate of compost fermentation. The study was aims to evaluate the quality of compost produced from different types of decomposer substrates and straw compositions. This study uses feces from Bali cattle as main material which are maintained in a semi-intensive manner. Two types of decomposer substrate were used, namely (1) animal substrate (AS) and (2) plant substrate (PS). The level of straw applied were (1) 0%, (2) 5% and (3) 10% (from the total of compost). The study was conducted based on a completely randomized design (CRD) factorial pattern. The data were analyzed using ANOVA. The results showed that differences in the type of decomposer substrate and straw composition had no significant effect (P>0.05) on the pH value, levels of C-organic, N-organic and C/N ratio of compost. The pH value is in the range of 7.40-7.69. The value of C-organic content varies with a range of values 15.29-18.52%. N-organic content is in the range of 0.72 to 0.97% and C / N ratio of 19.00-25.66. The final results of the study showed that the use of animal substrate decomposer and using 10% straw from the from the total of compost showed better compost quality compared to other treatments.

1. Introduction
Compost is a fermented product that can be used to improve soil quality. The quality of compost is influenced by the method of manufacture and the type of material used. Various steps have been developed by researchers to improve the quality of compost. One of them is by applying local microorganisms in the production process. The level of pollution due to the use of chemical fertilizers lately is getting out of control. This factor can endanger humans and the environment. The application of chemical fertilizers had begun during the green revolution [1-3]. One of the advantages of organic farming systems is the diversity of functional microbes that are higher than conventional farming systems [4]. Ecosystem disturbance basically can occur due to excessive use of chemical fertilizers [5,6]. Microbes are organisms that have a very important role in agriculture. Microbial activities include maintaining soil stability [7,8]. Microbial activity can increase nutrient compounds in the soil [9]. The use of bacterial activity will be effective if accompanied by efforts to improve soil management [10]. Bacteria have a very important role in the processing of agricultural lands [11]. Soil stability is much influenced by the activity of microorganisms. This is related to several processes
such as de-nitrification, nitrification and nitrogen fixation [7,8]. The use of livestock waste in addition to feces by using urine as raw material for organic fertilizer has also begun to be developed [12]. Likewise, the use of *Bacillus subtilis* bacteria. This bacterium has also been maximally utilized as a biohydrolysator in livestock products [13]. Economically, the use of commercial decomposers is less profitable. In addition, it is relatively difficult to obtain. The use of organic fertilizers needs to be considered especially for land in rural areas. The use of local microorganisms needs to be developed as one solution to reduce the use of chemicals. This study aims to evaluate the properties of compost produced using the activity of local microorganisms from different substrates with a combination of straw waste.

### 2. Materials and methods

The feces of intensively raised Bali cattle were used as the main ingredient in this study. Two types of decomposer substrate were used, namely: (1) animal substrate (AS) and (2) plant substrate (PS) solution. Commercial decomposers were used as controls. Three levels of straw composition have been used namely: (1) 0%, (2) 5% and (3) 10%. Animal substrate (AS) was obtained from beef feces extract (BFE) material, while plant substrate (PS) was obtained from banana root extract (BRE).

#### 2.1. Preparations for making animal substrate (AS) solutions

Animal substrate was made by dissolving 1 kg of brown sugar + 1 kg of BFE into 500 mL of water. The solution was homogenized with a mixer for 10 minutes at a speed of 100 rpm. The solution was put in a closed container and fermented for 14 days aerobically.

#### 2.2. Preparations for making plant substrate (PS) solutions

A total of 1 kg of banana plant roots were ground and 100 g of brown sugar and rice washing waste were added. The solution was homogenized and then put in a closed container. The solution was fermented for 14 days aerobically.

#### Table 1. Compost raw material composition of different substrate and straw composition combinations

| Compost composition | AS-0% | AS-5% | AS-10% | PS-0% | PS-5% | PS-10% |
|---------------------|-------|-------|--------|-------|-------|--------|
| Bali Cattle Feces (kg) | 8     | 8     | 8      | 8     | 8     | 8      |
| Husk Ash (%)        | 1     | 1     | 1      | 1     | 1     | 1      |
| Dolomite (kg)       | 0.2   | 0.2   | 0.2    | 0.2   | 0.2   | 0.2    |
| Straw (kg)          | 0     | 0.5   | 1      | 0     | 0.5   | 1      |
| Decomposer (L)      | 0.05  | 0.05  | 0.05   | -     | -     | -      |
| Decomposer (L)      | -     | -     | -      | 0.05  | 0.05  | 0.05   |

AS (Animal Substrate); PS (Plant Substrate); Composition of Straw (0%, 5% and 10%)

#### 2.3. Data analysis and parameters

The parameters observed were: (1) pH value, (2) C-organic content and (3) N-organic. Data were analyzed using ANOVA and further tests using Duncan's Multiple Range Test (DMRT) at 5% [14].

### 3. Results and discussions

#### 3.1. pH Value

The results of pH of compost made from the feces of Bali cattle produced using a combination of decomposer substrate types with different straw compositions were presented in figure 1.
Based on figure 1, it can be seen that on average the pH value of compost made from feces of Bali cattle is in the range of 7.40-7.69. This data shows that the compost produced is in neutral pH. The ANOVA results showed that there was no significant difference (P>0.05) between treatments on the pH value of compost. Based on the pH value standard that has been regulated in the regulation of the Minister of Agriculture of the Republic of Indonesia, it has been explained that the criteria for the quality of organic fertilizers, biological fertilizers and soil ameliorants are pH 4-9 [15]. This shows that the compost produced is still in accordance with the specified standards. According to [16], fertilizer pH values are in the range of 8.5-10. This data is different from the compost that has been produced previously. This can be caused because the fertilizer does not undergo a fermentation process so that the resulting pH value is higher. Different results can be seen from the pH value of organic fertilizer produced by [17] which produces organic fertilizer with a pH of 5.45-5.64. Lower pH conditions can be caused by the fermentation process that occurs that uses 3 types of bioactivators (EM₄, boisca and shrimp paste). The pH value is almost the same as the liquid organic fertilizer produced by [18] which is 7.8.

3.2. C-organic
Fertilizer produced from livestock can experience an increase in C-organic levels up to 18%, especially on the ground surface [19]. According to [20], that C-organic content is one of the parameters that can determine the quality of a fertilizer. The results of compost testing made from Bali cattle feces using decomposer substrate with different straw compositions were presented in figure 2. The results of ANOVA in the data (figure 2) show that the application of decomposer substrate types with different straw compositions did not show a significant difference (P>0.05) on the C-organic compost content. C-organic content varies from each treatment with a range of values 15.29-18.52%. Based on the requirements of organic fertilizer is to have C-organic of at least 15% [15]. Therefore, the compost produced is apparently still in accordance with the standards required by the Ministry of Agriculture. The C-organic value obtained is still higher than the fertilizer produced by [17] which is 0.67-0.86%. According to [21], C-organic content can cause an increase in root production and air...
biomass. One important factor in the composition of organic fertilizers is the availability of nutrients. [22] and [23] state that the role of decomposers is very important in producing certain enzymes. The enzymes produced by the decomposer can break down organic matter in the compost. In a biochemical reaction, the microbes will take energy and break down the organic material. Biomass that can be obtained by plants and is rich in carbon compounds in the form of liquid smoke can also be utilized in extending the shelf life of processed meat products [24,25].

![Graph showing C-organic value of compost made from Bali cattle feces produced using a combination of different types of decomposer substrates and different straw compositions; Note: AS (= animal substrate); PS (= plant substrate)](image)

**Figure 2.** C-organic value of compost made from Bali cattle feces produced using a combination of different types of decomposer substrates and different straw compositions; Note: AS (= animal substrate); PS (= plant substrate)

### 3.3. N-organic

Element N is one of the elements that are highly needed by animal feed plants in a livestock grazing area. Therefore, appropriate supervision efforts are needed to maintain its sustainability. Application of fertilizer is an attempt to maintain levels of element N in an area [26,27]. The N-organic content of compost made from Bali cattle feces using different types of substrates and different straw compositions were presented in figure 3. Based on the data in figure 3 shows that the value of compost organic N value is in the range of 0.72-0.97%. The results of ANOVA showed that there was no significant difference (P>0.05) on the compost organic N value. This is because the fermentation process is influenced by the activity of the decomposer. The decomposers cannot work optimally in the fermentation process. Organic matter will easily undergo decay process quickly. This is caused by the activity of microorganisms. The availability of C/N/P elements greatly influences the activity of the fermentation process [28]. Bioavailability of N-organic can be increased through composting process activities. The decomposition process of organic matter occurs quickly when the nitrogen content is high. This is because microorganisms utilize the N source for their development process [29].
Figure 3. N-organic value of compost made from Bali cattle feces produced using a combination of different types of decomposer substrates and different straw compositions; Note: AS (= animal substrate); PS (= plant substrate)

4. Conclusion
The application of a combination of decomposer substrate types with different straw compositions in the production process of compost made from Balinese cattle feces did not affect compost characteristics such as pH value, C-organic and N-organic content. The pH value and C-organic compost produced are still in accordance with the standards set by the Ministry of Agriculture of the Republic of Indonesia, especially in the category of organic fertilizer. Application of 10% straw composition to the compost fertilizer mixture showed the best quality compared to other treatments.

Acknowledgements
The research team would like to thank the Ministry of Technology and Higher Education Research and the Rector of Hasanuddin University for supporting research funding through the Community Service Program scheme of “Program Kemitraan Wilayah (PKW)”. The researcher also thanked the Dean of the Faculty of Animal Science, Hasanuddin University and Head of Institute for Research and Community Service, Hasanuddin University and then Bone Regency Government for facilitating the implementation of this research.

References
[1] Tilman D 1998 The greening of the green revolution Nature 396 211–212
[2] Leita L, De Nobili M, Mondini C, Muhlbachova G and Marchiol L 1999 Influence of inorganic and organic fertilization on soil microbial biomass, metabolic quotient and heavy metal bioavailability Biol. Fert. Soils 28 371–76
[3] Morari F, Vellidis G and Gay P 2011 Fertilizers, In Encyclopedia of Environmental Health, edited by J.O. Nriagu, (Burlington: Elsevier) pp 727-37
[4] Mä der P, Fliessbach A, Dubois D, Gunstl L and Fried P 2002 Soil fertility and biodiversity in organic farming Science 296 1694–97
[5] Kaur T, Brar B and Dhillon N 2008 Soil organic matter dynamics as affected by long-term use of organic and inorganic fertilizers under maize–wheat cropping system *Nutr. Cycl. Agroecosyst.* **81** 59–69

[6] Chaudhry A N, Jilani G, Khan M A and Iqbal T 2009 Improved processing of poultry litter to reduce nitrate leaching and enhance its fertilizer quality *Asian J. Chem.* **21** 4997–5003

[7] Hsu S F and Buckley D H 2008 Evidence for the functional significance of diazotroph community structure in soil *ISME J.* **3** 124–36

[8] Philippot L, Andert J, Jones C M, Bru D, Hallin S 2011 Importance of denitrifiers lacking the genes encoding the nitrous oxide reductase for N_{2}O emissions from soil. *Global Change Biol* **17** 1497–04

[9] Zhang Q C, Shamsi I H, Xu D T, Wang G H, Lin X Y 2012 Chemical fertilizer and organic manure inputs in soil exhibit a vice versa pattern of microbial community structure *Appl. Soil Ecol.* **57** 1–8

[10] Ge Y, Zhang J-b, Zhang L-m, Yang M and He J-z 2008 Long-term fertilization regimes affect bacterial community structure and diversity of an agricultural soil in northern China. *J. Soil Sediment* **8** 43–50

[11] Bending G D, Turner M K, Jones J E 2002 Interactions between crop residue and soil organic matter quality and the functional diversity of soil microbial communities *Soil Biol. Biochem.* **34** 1073–82

[12] Said M I, Abustam E, Yuliati F N and Mide M Z 2018 Characteristics of feather protein concentrates hydrolyzed using *Bacillus subtilis* FNCC 0059 *OnLine J on Biol. Sci* **18**(2) 138-6

[13] Said M I, Asriany A, Sirajuddin S N, Abustam E and Rasyid R 2018 Evaluation of the quality of liquid organic fertilizer from rabbit’s urine waste fermented using local microorganisms as decomposers *Iraqi J. Agric. Sci.* **49**(6) 990-1003

[14] Steel R G D and Torrie J H 1991 *Principle and Procedure of Statistics*. 2nd ed. (Tokyo: International Book Company)

[15] Permentan 2011 *Persyaratan Teknis Minimal Pupuk Organik Padat* (Jakarta: Kementerian Pertanian RI)

[16] Zamora P, Georgieva T, Hejine A T, Sleutels T H J A, Jeremiasse A W, Saakes M, Buisman C J N, Kuntke P 2017 Ammonia recovery from urine in a scaled-up Microbial Electrolysis *Cell J. Power Sources* **356** 491-99

[17] Raden I, Fathillah S S, Fadli M and Suyadi 2017 Nutrient content of liquid organik fertilizer (LOF) by various bio-activator and soaking time *Nusantara Biosci.* **9**(2) 209-13

[18] Singh J, Kunhikrishnan A, Bolan N S and Sagar S 2013 Impact of urease inhibitor on ammonia and nitrous oxide emissions from temperate pasture soil cores receiving urea fertilizer and cattle urine *Sci. Total Env.* **465** 56-63

[19] Dordas C A, Lithourgidis A S, Matsi T and Barbayiannis N 2008 Application of liquid cattle manure and inorganic fertilizers affect dry matter nitrogen accumulation, and partitioning in maize *Nutr. Cycl. Agroecosyst.* **80** 283–96

[20] Reeves D W 1997 The role of soil organic matter in maintaining soil quality in continuous cropping systems *Soil Till. Res.* **43** 131–67

[21] Izaurrelde R C, McGill W B and Rosenberg N J 2000 Carbon cost of applying nitrogen fertilizer *Science* **288** 811–12

[22] Wang Q, Awasthi M K, Zhao J, Ren X, Li R, Wang Z, Wang M J and Zhang Z 2017 Improvement of pig manure compost lignocellulose degradation, organic matter humification and compost quality with medical stone *Bioresour. Technol.* **243** 771–77

[23] Wu S H, Shen Z Q, Yang C P, Zhou Y X, Li X, Zeng G M, Ai S J and He H J 2017 Effects of C/N ratio and bulking agent on speciation of Zn and Cu and enzymatic activity during pig manure composting *Int. Biodeter. Bioderg.* **119** 429–36
[24] Abustam E, Said M I, Yusuf M and Ali H M 2019 Effect of aging time on changes in smoke flour meatballs and fresh meat of bali beef. *IOP Conf. Ser. Earth and Env. Sci.* 247 012026

[25] Abustam E, Said M I and Yusuf M 2019 The effect of antioxidant activity of liquid smoke in feed supplement block on meat functional of muscle *Longissimus dorsi*. *IOP Conf. Ser. Earth Environ. Sci.* 119 012046

[26] Draganova I, Yule I, Stevenson M and Betteridge K 2016 The effects of temporal and environmental factors on the urination behaviour of dairy cows using tracking and sensor technologies. *Precision Agric.* 17(4) 407-20

[27] Moir J L, Cameron K C, Di H J 2007 Effects of the nitrification inhibitor dicyandiamide on soil mineral N, pasture yield, nutrient uptake and pasture quality in a grazed pasture system. *Soil Use Manag* 23(2) 111-20

[28] Sileshi G W, Nhamo N, Mafongoya P L and Tanimu J 2017 Stoichiometry of animal manure and implications for nutrient cycling and agriculture in sub-Saharan Africa. *Nutr. Cycl. Agroecosys* 107(1) 91–105

[29] Zhu L, Zhao Y, Zhang W, Zhou H, Chen X, Li Y, Wei D and Wei Z 2019 Roles of bacterial community in the transformation of organic nitrogen toward enhanced bioavailability during composting with different wastes. *Bioresour. Technol.* 285 121326