Properties of rabbit feces compost using indigenous 
**Alcaligenes** sp. LS2T and **Arthrobacter** sp. LM1KK

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**Abstract.** This study aims to determine the effects of indigenous **Alcaligenes** sp. LS2T and **Arthrobacter** sp. LM1KK in the composting of rabbit feces. This study consists of 3 treatments (commercial starter as control, **Alcaligenes** sp. LS2T, and **Arthrobacter** sp. LM1KK) in triplicate replication. Starter growth profile, emitted ammonia concentration, physical qualities of compost, and the compost's chemical quality were observed in this study. The data was analyzed using a randomized design (One-way ANOVA). **Alcaligenes** sp. LS2T has a significant ability to reduce ammonia emission compare to **Arthrobacter** sp. LM1KK and commercial starter. The best result of the chemical quality of compost was done by **Arthrobacter** sp. LM1KK with water content observed 28.78%, organic matter was 13.75%, 7.97% of C-organic, P total observed 1.38%, K determined 2.52%. Furthermore, the N value was 0.65%, and C/N Ratio observed 14.97%. As a conclusion, **Alcaligenes** sp. LS2T and **Arthrobacter** sp. LM1KK had the potency as same as with commercial starter for composting of rabbit feces. During the composting processes, the **Alcaligenes** sp. LS2T and **Arthrobacter** sp. LM1KK had a lower ammonia emission occurs compare to the commercial starter.

1. Introduction

Compost is a product containing organic materials that can improve soil quality and support plant growth. This product can be made from various raw materials such as household waste, agricultural waste, and livestock waste. The quality of compost is influenced by the raw materials and methods used. Various methods have been developed by researchers to improve the method effectivity and the quality of compost produced. One of the methods is applying a biological agent from local indigenous microorganisms to maximized the decomposing process [1]. Rabbit manure has a higher potential for high-quality compost production compared to the other manures. Rabbit manure has contained the highest organic compound, including Nitrogen (N), phosphor (P), and Kalium (K) compared to the other livestock manure (horse, buffalo, cow, goat, pig, and chicken)[2]. Rabbit manure contains nitrogen compounds in the NH₃ form and may be causing nuisance odors together with H₂S during the composting process. The occurring of odorous mechanisms is highly related to microorganism activity in the manure [3]. This phenomenon may decrease the proportion of N substrate in the final product of compost. Several indigenous bacteria can be used to mitigating the NH₃ volatilization from livestock...
manure decomposition, such as *Pseudomonas* sp. [4,5], *Candida* sp. [6], *Alcaligenes* sp. [7,8], *Arthrobacter* sp. [6,9].

This research aims to deal with the N losses and NH$_3$ emissions from aerobic treatment in the composting process and to investigate indigenous bacteria’s potency as a starter to decompose organic content in rabbit manure. In this study, the Rabbit manure was composted using the indigenous *Alcaligenes* sp. LS2T and *Arthrobacter* sp. LM1KK that used as the decomposer.

2. Materials and Methods

2.1. Sample and bacterial preparation.

The sample of rabbit manure was collected from a local farm in Yogyakarta. The indigenous strains *Alcaligenes* sp. LS2T and *Arthrobacter* sp. LM1KK are collected at the Laboratory of Leather, Waste, and By-Products Technology (Faculty of Animal Science, UGM Yogyakarta). Before used as a starter at compost processing, these bacteria were characterized by the growth profile (OD600) in the 10% stock solution medium. The stock solution was made by mix 1 g meat extract, 1 g peptone, 0.5 NaCl, and *Aquadest* for 100 ml (pH was adjusted at 7.2).

2.2. Procedure and methods

2.2.1. Composting procedure

In this study, the composting procedure was performed using a different starter (Moralis Commercial starter as Control, *Alcaligenes* sp. LS2T, and *Arthrobacter* sp. LM1KK) in triplicate replication. The composting mechanism can be seen in Figure 1. As much as 500 g of rabbit manure was taken and placed in the plastic bottle (1.5 l). Furthermore, a 10 ml starter was added, and composting was done in 14 days. During 14 days, the ammonia emission was observed. In observing the ammonia emission, the bottle was aerated, and the airflow from the bottle was connected into the Boric acid solution (0.02N) for trapping the NH$_3$ gas emission. After 14 days, the physical-chemicals and microbiologist quality of compost were determined.

![Figure 1. Composting mechanism of rabbit manure](image)

2.2.2. Determination of ammonia emission

The determination of ammonia emission was performed by using Nesler methods. The Nessler reagent was made by mixing the Nessler A and B (ratio 1:1). The ammonia gas, which is trapped in Boric acid 0.02 N, was measured every day by taking a 1 mL solution sample, then mix the solution
with 0.2 mL Nessler reagent and incubated in 10 min in the light-tight room. After the incubation, the optical density of the solution was measured using spectrophotometry at 425 nm.

2.2.3. Determination of compost quality
The physical quality of compost determination included observing the color, odor, texture, and pH. The organic compound, total Nitrogen, Phosphor, Kalium, Carbon, and C/N ratio were determined as the chemical properties [10]. The microbiological quality of compost was determined in the total plate count (TPC) method.

2.3. Analysis of data
The starter growth characteristics and physical quality of compost were analyzed descriptively using figure and graphic. The data in Ammonia emission during the composting and the chemical quality were analyzed with the statistical analysis used completely randomized design (One-way ANOVA) followed by Duncan’s multiple range test (DMRT) if there were differs with significant effect (P<0.05) among the treatments [11].

3. Results and Discussions

3.1. Growth Profile of indigenous starter culture
In this study, the indigenous isolate used as a starter was *Alcaligenes* sp. LS2T dan *Arthrobacter* sp. LM1KK. Both of the strains were deposed in the laboratory of Leather, Waste, and By-Products Technology (Faculty of Animal Science, UGM Yogyakarta). These strains were grown in the stock solution medium to known the characterization of the growth curve profile. The growth curve profile of *Alcaligenes* sp. LS2T and *Arthrobacter* sp. LM1KK had done by looking at the turbidity level (optical density), and it can be seen in Figure 2.

![Growth curve](image)

**Figure 2.** Growth curve of *Alcaligenes* sp. LS2T and *Arthrobacter* sp. LM1KK in the medium contains 10% of stock solution.

During the observations, the starters' growth in the medium can be confirmed from the liquid medium, which changed became more cloudy. This phenomenon occurred due to cell activity from strains, which can measure bacterial growth in the liquid medium. The growth of several bacteria strains
in the liquid medium may have different characters, which can be determined from several methods: (1) observing the visibility in a medium (increases of the turbidity to cloudy liquid), (2) membrane formation (a collection of cells floating on the surface of the medium), and (3) sediment (a pile of cells that settles at the bottom of the liquid culture, which will dissolve when the medium is gently shaken).

The liquid medium's cell growth is presented in 4 phases/stages: lag phase, log phase, stationary phase, and death phase [12]. The lag phase is the initial phase condition, in which cell bacteria tried to adapt to survive and live in the medium conditions. The log phase is the bacteria's conditions adapted to the environment condition and capable of utilizing the nutrient in the medium to grow maximally. The stationary phase is the condition in which the medium's nutrient was limited for the cells' activity. No activity occurred in cell growth, some cells reaching death, and the secondary metabolite was produced. The death phase is the condition of bacteria that was not adaptable to the condition of the medium. There were limited in the nutrient and high content of the poison substrate from secondary metabolite. The time of each phase growth of bacteria can differ in the different species. It depends on the isolate itself, the availability of nutrients in the medium, inhibitors, pH conditions, and temperature conditions. In the observation data of the growth profile during 48 hours in Figure 2, the lag, log, and stationary phase in both isolated bacteria were observed—the growth of *Alcaligenes* sp. LS2T has reached the lag phase for the initial 3 hours, the log phase occurred at 6th to 24th hours, and then reached the stationary phase. The growth curve of *Arthrobacter* sp. LM1KK had shown faster cell growth compared to *Alcaligenes* sp. LS2T. The lag phase has reached less initial 3 hours (< 3 hours) and showed increased density value to the 39th hour before it has continued to the stationary phase.

### 3.2. The ability of indigenous decomposer in reducing ammonia emission during the rabbit feces composting

After understanding the growth profile of *Alcaligenes* sp. LS2T and *Arthrobacter* sp. LM1KK in the liquid medium, each starter was cultivated for 24 hours before used as a starter to decompose rabbit feces and compare them with the commercial starter as a control. As much as 500 gr rabbit feces was placed in a bottle (1.5 L) and then added 10 mL starter (Control, *Alcaligenes* sp. LS2T and *Arthrobacter* sp. LM1KK).

![Figure 3](image-url)

**Figure 3.** The graphical fluctuation of ammonia gas emission trapped in the boric acid solution during 14 days composting process

Rabbit feces composting was carried out aerobically and conducted in 14 days. The emission of ammonia was observed daily, and after the 14th day, the compost was collected and determined the quality. The emission of ammonia emission during 14 days of composting rabbit manure can be seen in
Figure 3. The emission of ammonia fluctuated day by day for each type of starter. The highest emission has occurred at the control, and the lowest emission has occurred at the addition of Alcaligenes sp. LS2T. The starter from Alcaligenes sp. LS2T and Arthrobacter sp. LM1KK can decrease the ammonia emission during the rabbit feces composting. It can be assumed that the Alcaligenes sp. LS2T and Arthrobacter sp. LM1KK had capable of utilized ammonia as a nutrient in cell metabolism for growth.

The compost quality of rabbit feces by utilization of different starter can be seen in Table 1. There was no significant effect (P>0.05) in the rabbit feces compost quality in all treatments. The compost's physical quality from Rabbit manure has the brownish-black in color, the aroma compost like soil, and the texture was loose like soil in all treatment. The pH and temperature of rabbit manure after composted 14 days had approximately 6.7 – 7.2 and 27.6 – 28.2°C. These result has indicated that the compost was mature. Compost material had got into mature condition when it changed in the color of black and brown (ripe), the smell of composting smells like the soil, the texture is loose and has a pH level of 6.5 – 8.0 [13,14].

**Table 1.** Physical and chemicals composition of Rabbit manure after 14 days of composted use different starter decomposer

| Komposisi      | Commercial control | Alcaligenes sp. LS2T | Arthrobacter sp. LM1KK | SNI : 19-7030-2004 |
|-----------------|---------------------|-----------------------|-------------------------|---------------------|
| Color           | Brownish black      | Brownish black        | Brownish black          | Brownish black      |
| Aroma           | Like soil           | Like soil             | Like soil               | Like soil           |
| Texture         | Loose like soil     | Loose like soil       | Loose like soil         | Loose like soil     |
| pH<sup>ns</sup> | 6.9 ± 0.6           | 7.2 ± 0.5             | 6.7 ± 0.3               | 6.8 – 7.49          |
| Temperature (°C)<sup>ns</sup> | 27.6 ± 0.3 | 28.2± 0.3             | 28.0± 0.1               | 28.9 – 30.3         |
| Moisture (%)<sup>ns</sup> | 25.55 ± 3.77 | 25.15 ± 1.27          | 28.79 ± 2.53            | Max 50              |
| Organic matter (%)<sup>ns</sup> | 11.45 ± 0.81 | 11.11 ± 0.87          | 13.75 ± 1.83            | 27 – 58             |
| Total C organic<sup>ns</sup> | 6.64 ± 0.47 | 6.45 ± 0.5            | 7.97 ± 1.06             | 9.8 – 32            |
| Total N (%)<sup>ns</sup> | 0.58 ± 0.02 | 0.44 ± 0.06           | 0.65 ± 0.15             | Min 0.4             |
| Total P (%)<sup>ns</sup> | 1.16 ± 0.47 | 0.83 ± 0.66           | 1.38 ± 0.52             | Min 0.1             |
| Total K (%)<sup>ns</sup> | 2.21 ± 0.35 | 1.59 ± 0.56           | 2.52 ± 0.21             | Min 0.2             |
| C/N Ratio<sup>ns</sup> | 11.42 ± 0.72 | 14.97 ± 1.93          | 12.45 ± 1.79            | 10 – 20             |
| Microbial colony (CFU/g) | 149 x10<sup>5</sup> | 21 x10<sup>5</sup> | 24 x10<sup>5</sup> | -                   |

Notes:  
<sup>ns</sup> = There were no different significant effect (P>0.05)

The chemicals composition of Rabbit feces compost by using a Commercial starter (control), Alcaligenes sp. LS2T and Arthrobacter sp. LM1KK, as a starter decomposer, has met the requirements of the Indonesian Standard for compost product (SNI: 19-7030-2004) except in the variable of total carbon and organic matter. This result has proven the rabbit feces have high potency as the organic fertilizer due to the characterization similar to compost composition standard, even it just single raw material. Besides that, this result also proved that the single isolate in both of Alcaligenes sp. LS2T or Arthrobacter sp. LM1KK was the same potency as a commercial starter decomposer product. Based on the observation and the microbiological colony calculation in the rabbit manure composted in 14 days in Table 1 and Figure 3. The highest colony population has occurred in the compost with a starter commercial as the control treatment. It can be assumed because the starter commercial was contained in various microorganisms.
Figure 4. The visualization of the bacterial colony of Rabbit manure composted in 14 days (Control (a); *Alcaligenes* sp. LS2T (b) and *Arthrobacter* sp. LM1KK (c))

4. Conclusion

Based on the result of this study, it can be concluded that the indigenous *Alcaligenes* sp. LS2T and *Arthrobacter* sp. LM1KK has the same potency and ability as the commercial starter decomposer product but has lower ammonia emission during Rabbit manure's composting process. The Rabbit manure compost quality in physical and chemicals (Color, Aroma, Texture, pH, Temperature, Moisture content, Total organic matter, Total C organic, Total N, Total P, Total K, and C/N ratio) have been met with the requirement of standard compost criteria except in Total C-organic and organic matter content.

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