USE OF RABBIT FECES AND RURAL BY-PRODUCTS WITH ADDITION OF *AZOTOBACTER* MICROBIAL CULTURE AND ITS EFFECT ON MEDIA QUALITY AND *LUMBRICUS RUBELLUS* PRODUCTIVITY

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ABSTRACT

The purpose of the research was to analyzed the use of rabbit feces and rice straw; and the addition of Azotobacter microbes culture to be fermented as media and the effect to the media quality and the productivity of *Lumbricus rubellus*. The treatments were T_0: no addition, T_1: 150 ml, T_2: 250 ml and T_3: 350 ml / 100 kg addition of Azotobacter microbes culture. The experimental method was designed as Completely Randomized Design with 4 treatments repeated 4 times. The result showed that the treatment increased the quality of the media and the productivity of Lulbricus ribellus. The crude protein content was increased (P <0.01) and the crude fiber was decreased (p <0.01) compared to control. The average number (production) and hatchability of cocoon, the highest increase in number and growth of earthworms was in the treatment of T_3 (350 ml / 100 kg addition of Azotobacter microbes culture) (P<0.01).

Key words: stool, earth worm, fermentation, decomposer

INTRODUCTION

Based on data from the Central Statistics Agency (2016) rabbit population growth in Indonesia from 2015-2016 increased by 2.26% with a population of 1,128,426. This increase was accompanied by an increase in faecal and urine waste production. An adult rabbit every day produces 200 grams of feces and 100-150 ml of urine (Bahar, 2015). Rabbit feces contain higher N, P, K elements (2.7; 1.1 and 0.5%) than those of other livestock such as horses, buffaloes, cattle, sheep, pigs and chickens (Setyanto, Riawati and Lukodono, 2014). Rabbit farming that ignores waste management will have a negative impact on the environment.

Earthworms are animals that breed quickly and are easy to handle. The method of treating waste by raising earthworms is a perfect recycling method because it is inexpensive, natural and provides many benefits to the environment. With high protein content (70%), the worms produced can be used as animal feed. The former worm maintenance media mixed with worm feces (vermicompost) is useful as fertilizer. Utilization of rabbit feces and rice straw fermentation results as an earthworm growth medium needs to pay attention to the characteristics of its nutritional needs because the growing media is at the same time a source of food for earthworms. In principle, earthworms need a cool and humid place, protected from direct sunlight.

Azotobacter microbial culture taken from Alfalfa plants is a new starter / decomposer that has been used to ferment feed ingredients. The time required is 12 hours but to maximize the fermentation process a 2x24 hour time is used. The fermentation process can increase energy and protein content, reduce crude fiber content and increase the digestibility of low-quality feed ingredients (Hatmiko, Cholis and Soejosopuro, 2013). The aim of this study was to analyze the use of fermented rabbit and rice straw feces with the addition dose of different Azotobacter microbial cultures to determine their effect on media quality and productivity of the Lulbricus ribellus worm.

MATERIALS AND RESEARCH METHODS

Research Location and Time

This research was conducted at the home of Mr. Dwi Wahono who was in Jalan Istana No. 64 RT 04 RW 01 Gondon Wangi Village Wagir District, Malang Regency on February 23-March 27, 2017.

While the proximate test of nutrient content in earthworm media was carried out at the Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, Brawijaya University, Malang, East Java.

Research Material

1. Material:

Materials used during the study were: rabbit feces, rice straw, Azotobacter microbial culture, water, molasses, sugar water and earthworms. The earthworms used in this study were earthworms of the Lulbricus ribellus productive age ± 3 months with a total total of 800gr where each replication used 50gr earthworms. Determination of age in earthworms can be seen through the presence or absence of "klitelum". Productive earthworms have a clit yet of 2.5-3 months of age.

2. Tools:

Equipment that will be used in this study include: analytical scales, thermometers, polybags, label paper, HTC (Hand Tally Counter), gloves, pH meters

Research methods

The study was conducted using the RAL method (Completely Randomized Design) with 4 treatments with each treatment having 4 replications so as to get 16 units of research trials. The research design used in the study as follows:

- T_0: Azotobacter bacteria 0cc / 100kg rabbit feces + rice straw (75%-25%)
- T_1: Culture of Azotobacter 150cc / 100kg rabbit feces + rice straw (75%-25%)
- T_2: Azotobacter culture of 250cc / 100kg rabbit feces + rice straw (75%-25%)
- T_3: Azotobacter culture of 350cc / 100kg rabbit feces + rice straw (75%-25%)

Rabbit feces and rice straw used in the study have a ratio of 3: 1 where for every 100 kg of media is composed of 75 kg of rabbit feces and 25 kg of rice straw. Data analysis was performed using CRD (Complete Randomized Design). As for the terms of use of CRD (Completely Randomized Design) in addition to the treatment, everything must be homogeneous. Data obtained from the study were analyzed using the RAL method (Complete Randomized Design) with a fixed model (Fixed Model) with the formula:

$Yij = \mu + \pi i + \beta ij$ where:

Yij = introductory value at i-th treatment and j-th replication
μ = mid value
πi = Effect of i-i treatment
βij = Error (error) of the experiment in the i-th and j-th replication
i = 1, 2, 3, and 4
j = 1, 2, 3, and 4

Making Procedure

1. Making Media

The media used in this study are media that has been fermented for 2 days. Making media has the following steps:

1) Prepare media material to be fermented including rabbit feces that have been cleaned from foreign objects and rice straw in a ratio of 3: 1 where for 100kg the media consists of 75 kg of rabbit feces and 25 kg of rice straw. Then the rabbit feces is mashed by pounding to reduce particle size.

2) Add the Azotobacter bacterial culture in accordance with the predetermined dose taken with a dropper dropper, add 1 teaspoon sugar water, 2 tablespoons drops and then homogenize with 5 liters of water evenly.

3) The media is put into a large plastic bag of 60cm x 60cm size and then fermented anaerobically. Tightly closed for 3 days.

4) Finished media is first aerated for one day to reduce heat and gas, then biologically tested by inserting several earthworms into the media. Media can already be used if the earthworm does not come out or die.

The weight of the earthworm used was 50gr for each treatment and each replication.

2. Mixing the Decomposer Solution

The procedure for making decomposer solutions is as follows:

1) Prepare materials to be used such as water, molasses, and Azotobacter bacteria.

2) Mix all ingredients in a bucket container.
3) Homogenize all ingredients.

Observation Variables
The variables observed in this study were:
1. pH, Temperature and Humidity of Earthworm Media
2. Worm Media Quality.
With proximate analysis we will find out the contents of crude protein, crude fiber, crude fat, dry matter and ash of earthworm media.
3. Earthworm Growth Speed
The weight of the earthworm (Lulbricus ribellus) at the beginning of maintenance is measured first and then every week maintenance is observed to increase body weight to the end of maintenance so that the speed of growth of earthworm weights in each unit of experiment is known by calculating the average weight gain every week.
4. Percentage of Hatchability
Calculation of hatchability percentage is obtained by reducing the number of incubated cocoons divided by the number of incubated cocoons multiplied by one hundred percent (Prencia, 2016).
% hatchability = (Σ incubated cocoon-Σ non-hatched cocoon) / (Σ incubated cocoon) * 100%
5. The number of earthworms
The number of earthworms at the beginning of maintenance is calculated first and on the end of maintenance for four weeks is calculated again so that it is known earthworm accretion in each unit of experiment.

RESULTS AND DISCUSSION

Media as a place to live and breed the earthworm Lumbricus luberrus declared quality if it has a match with the original natural environment in nature. The media is a nesting place for earthworms so that the material needs to be selected and arranged in such a way as to help the production and reproduction processes (Haryono, 2003). Whether or not the quality of the media can determine the success of an earthworm farm. Organic materials that can be used as live media for earthworms are livestock manure, wood sawdust, rice straw, leaves, soil mud, garbage compost, cassava pulp and various other types of organic waste. The combined fermentation efforts of rabbit feces and rice straw were carried out to improve the nutritional value or quality of the media.

1. Temperature, pH and Moisture of Earthworm Media

The temperature of earthworm media is very influential on biological activity, metabolism, growth, reproduction, respiration, productivity and survival of earthworms. At the time of research the temperature of each treatment was measured once every 6 hours at 06:00, 12:00, 18:00, 24:00 WIB and each measurement was repeated 3 times on each treatment media using a thermometer with different positions. This is done to get the average temperature of each medium. It is known by Sriharti and Salim (2010) that the parameters of compost maturity are done by observing changes in the physical properties of compost, namely color, temperature, and aroma (done visually). In each compost reversal, temperature measurements are taken. The temperature is measured using a thermometer that is inserted into the compost heap. The initial temperature of the media before fermentation for all treatments was 25-26oC. The temperature of the media increased after fermentation for 72 hours ie 30-31 ^{o}C except at P0: 26.5 ^{o}C. The temperature of the fermentation media decreased to the lowest temperature at 72 hours for all treatments, namely 25-26 ^{o}C. The increase in media temperature during the fermentation process is due to the presence of Azotobacter bacteria microorganisms. The temperature reduction in earthworm media fermentation at 72 hours before being used as a medium is sufficient in accordance with the conditions of the earthworm media conditions. According to SNI (Indonesia National Standar) Number19-7030-2004, the requirement for fermentation maturity is the temperature in accordance with ground water no more than 30 ^{o}C, blackish color, texture like soil and odorless. Media criteria for the survival of earthworms are:

Contains fiber, a neutral pH of 6.8-7.2, a temperature between 22-28 ^{o}C and a water content of 40-60 % (Matondang, et al., 2001).
In the research that has been done, the initial pH observation of the fermentation media for all of the pH changes is 7. The change in pH occurs at the 24th hour ie for the control remains 7 but for the media receiving the treatment of addition of microbes has decreased to 6. This is due to the occurrence fermentation activity by Azotobacter bacteria so that the media becomes acidic. Changes in pH occur again at the 48th hour fermentation of the pH of the media all treatments become alkaline with a pH of 8. At the 72nd hour all pH of the media becomes neutral ie7. This pH already supports the living conditions for earthworm media. It is known that SNI-19-7030-2004 mentions a minimum pH of 6.8 and a maximum of 7.49 is the composting pH standard. Earthworms prefer to live in moist soils, good air conditioning, warm temperatures around 21 ^{o}C, soil pH 5.0-8.4, contain lots of organic matter, and low salt content (Firmansyah et el., 2014).
In addition to temperature and pH, humidity is also a factor to be considered in making earthworm live media. When researching the initial moisture fermentation media, namely: T_0: 32%, T_1: 30%, T_2: 31%, and T_3: 36%. After fermentation for 48 hours the media moisture increases to T_0: 38%, T_1: 40%, T_2: 41%, and T_3: 41%. After fermentation for 72 hours the media moisture becomes T_0: 38%, T_1: 40%, T_2: 42%, and T_3: 41%. Moisture media that has been fermented meets the moisture requirements for earthworm media. It is known that SNI 19-7030-2004 states that the maximum composting water content is not more than 50%. The humidity needed by earthworms ranges between 15-30% and the cocoon will be produced optimally at 28-42% humidity. Earthworms in principle require a shady and humid place, so the chosen location must be protected from direct sunlight (Haryono, 2003).
2. Quality of Media Content of Earthworms
The earthworm media after fermentation changes from the temperature, pH and humidity. Changes also occur in the nutrient content of earthworm media. The fermentation process will simplify the particles of feed ingredients, so that it will increase its nutritional value and quality. The fermentation process can increase the protein content of the organic material used (Chilmawati et al., 2014).
The average nutrient content of the media can be seen in Table 1.

Table 1. Average content of Crude Protein, Crude Fiber, Crude Fat, Dry Matter, and Ash

Treatment	CP (%)	CF (%)	CF (%)	DM (%)	Ash (%)
T_0	10,45±0,14^{a}	38,84±0,52^{c}	1,32±0,00c	8,17±0,05^{a}	11,98±0,01^{a}
T_1	11,39±0,01^{b}	27,55±0,10^{b}	1,29±0,00^{b}	8,30±0,00^{b}	12,14±0,01^{b}
T_2	11,41±0,00^{b}	26,78±0,40^{b}	1,22±0,01^{b}	8,65±0,00^{b}	12,21±0,02$^{\mathbf{b}}$
T_3	11,53±0,14^{b}	14,71±8,49^{a}	1,08±0,00^{a}	9,82±0,05^{c}	13,16±0,02^{c}

Note: Different superscripts in the same column show very significan differences (P <0.01)

From the table above it can be seen that rabbit feces and rice straw fermented with Azotobacter microbial culture improve the quality of earthworm media by increasing Crude Protein, Dry Ingredients, and Ash and decreasing Crude Fiber and Crude Fat. Prayitno (2015) states that the most optimal protein content for worm growth is 9-15 %. The coarse fiber content of the media in this study has decreased dramatically as a result of the work of the decomposed microbes Nur et al, 2015 stated that high fibrous media can cause earthworms to consume media. The decrease in the content of the Coarse Fat content of the fermented media may be caused by the breakdown of the triglyceride complex bonds into simpler bonds, among others in the form of fatty acids and alcohol. A portion of the fatty acids will evaporate so that the Coarse Fat Kadaara goes down (Pratiwi et el., 2015).

3. Earthworm Growth Speed

The speed of growth of earthworms during observation can be seen in Table 2.

Table 2. Growth rate of earthworms for each treatment

Treatment	**Week 0 (gr)**	**Week 1 (gr)**	**Week 2 (gr)**	**Week 3 (gr)**	**% Weight Gain 1**	**% Weight Gain 2**	**% Weight Gain 3**	**% Average Weight Gain**
T_0	50	57,5	63	67,5	15,5	9,1	7,1	10,6±4.39$^{a)}$
T_1	50	63,25	68,75	75,25	26,5	8,7	9,4	14,9±10.08$^{a)}$
T_2	50	70,5	79	88	41	12	11,4	21,4±16.92$^{b)}$
T_3	50	74,5	88,75	103,5	49	19,1	16,6	28,2±18.03$^{c)}$

Note: Different superscripts in the same column show very significan differences (P <0.01)

The speed of growth in week 1 at T_3 treatment was higher than in other weeks due to the fact that this week was the optimal period of earthworm growth and as a result of the media having increased crude protein content, so as to be able to supply the nutrients needed for earthworms. Komang, Kartini, and Soniari (2015) explained that soil organic matter had a great influence on the development of earthworm populations because organic material contained in the media was needed for food sources and to continue their livelihoods. Seen in Table 2, the growth rate of earthworms with the highest average was shown in the T_3 treatment and the lowest average in the T_0 treatment.

4. Number and Hatchability of Earthworm Cocoon

The number and hatchability of earthworm cocoon can be seen in Table 3.

Table 3. Mean and Hatchability of Earthworm Cocoon

Treatment	Average number of cocoons (items)	Average hatchability of cocoon (%)
T_0	$60{,}75 \pm 5{,}12^a$	$40{,}49 \pm 5{,}61^a$
T_1	$75{,}75 \pm 4{,}85^b$	$43{,}74 \pm 4{,}46^a$
T_2	$81{,}00 \pm 6{,}73^b$	$47{,}20 \pm 1{,}17^a$
T_3	$102{,}00 \pm 8{,}90^c$	$55{,}45 \pm 0{,}925^b$

Note: Different superscripts in the same column show very significan differences (P <0.01)

The high cocoon production in T_3 is due to the high content of Crude Protein media compared to the others while the Crude Fiber is low so that earthworms are used to meet their nutritional needs and support their production activities. Gaddie and Dougless (2000) state that the activity of earthworm production can be inhibited if the content of Protein and cellulose in the media is too high. The digestive system of the earthworm is imperfect so it requires the help of bacteria to change food substances such as protein and carbohydrates. Nofyan (2010) states that the low production of earthworm cocoon is related to the activity of eating earthworms.

Overall the earthworm cocoon hatchability of all treatments was 46.7% within 30 days. This percentage can be said to be good. Anderson, Kille, Lawlor and Spurgeon (2013) explained that the percentage of hatchability of earthworm *Lulbricus ribellus* was 80% with the assumption that the cocoon was hatched for 56 days. Low earthworm cocoon hatchability can be caused by the condition of the media environment during maintenance, among others, if the media is exposed to direct sunlight will cause the cocoon unable to hatch on the same day. If the temperature of the media is warm, the worm eggs will hatch within 3 weeks, if the temperature is cold, it will take 3 months. In this study the highest hatchability was 55.4% within 30 days. The hatchability will increase when the time span is extended to maximize the hatching cocoon as a whole.

5. Number and Weight of Earthworms

The average number and weight of earthworms can be seen in table 4.

Table 4. Average Number and Weight of Earthworms

Perlakuan	Average initial amount (tail)	Average final number (tail)	Average initial weight (grams)	Average final weight (grams)
P_0	86	$186{,}75 \pm 12{,}82^a$	50	$67{,}50 \pm 2{,}38^a$
P_1	104,50	$271{,}00 \pm 16{,}51^b$	50	$75{,}25 \pm 2{,}99^a$
P_2	102,25	$313{,}50 \pm 12{,}23^b$	50	$88{,}00 \pm 4{,}40^b$
P_3	100,50	$383{,}00 \pm 15{,}81^c$	50	$103{,}50 \pm 6{,}24^c$

Note: Different superscripts in the same column show very significan differences (P <0.01)

The overall weight of the earthworm has increased. This is due to the availability of nutrient supply in the media thereby increasing the weight of earthworms. Aslamyah (2010) states that the earthworm Lulbricus ribellus has better productivity than other species such as Megascolocidae. Among its advantages are easy maintenance and maintenance, no smell and high productivity. In this study the administration of Azotobacter microbial doses at a dose of 350 ml / 100 kg of rabbit feces and rice straw fermentation media produced the highest average final weight as shown in Table 4.

CONCLUSION

The conclusions that can be drawn from this study are:
1. Rabbit feces and rice straw fermented by the addition of Azotobacter microbial culture increase its quality which is characterized by increased content of dry matter, crude protein and decreased coarse fiber and coarse fat.
2. Rabbit feces and rice straw fermented with the addition of Azotobacter microbial culture increase the speed of growth and the number (production) of earthworm cocoons of *Lulbricus ribellus*.
3. Rabbit feces and rice straw fermented by the addition of Azotobacter microbial culture increase the number and weight of *earthworms Lumbricus rubellus*.
4. Overall, the best dose of microbial culture addition is 350 ml / 100 kg of a mixture of rabbit feces and rice straw as a medium for earthworm *Lumbricus rubellus*.

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