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THE USE OF BANANA PEEL AS FEED TO INCREASE GROWTH OF EARTHWORMS (*Lumbricus rubellus*)

8
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9
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Abstract: Research on using banana peels as feed to increase the growth of *Lumbricus rubellus* has been carried out. This study aims to determine: (1) the effect of different doses of banana peel pulp on feed on the growth of earthworms (*Lumbricus rubellus*), (2) the best dose of banana peel pulp to increase the growth of earthworms. This research is a one-factor study. The research was carried out with five levels of treatment and five replications. The doses of banana peel pulp are 0 ml, 250 ml, 500 ml, 750 ml, and 1000 ml. The parameters of the growth of earthworms measured were the addition of the number of individuals and the addition of the weight of the earthworm population. The research data were analyzed by analysis of variance. The research results show that: (1) the difference in the dose of banana peel pulp significantly affected the increase in the number of individuals and the weight of the earthworm population; (2) the addition of 1000 ml of banana peel pulp resulted in the highest number of individuals and the heaviest population weight compared to other treatment doses.

Keywords: *Banana Peel as Feed, Growth of Lumbricus rubellus*

INTRODUCTION

Earthworms live in the soil, have a segmented body, do not have special locomotion like most animals, and do not have eyes. Earthworms must use the long, thick muscles that wrap around their bodies to move. The presence of mucus on the body's surface can facilitate the movement of earthworms in hard and rough places. Earthworms are hermaphrodites where in the earthworm body, there are two sexes, namely male and female [1]. The earthworm species *Lumbricus rubellus* has a segmented body [2]. The body is bilaterally symmetrical, cylindrical, hairy, and has no exoskeleton. It has a reddish-brown body with a length ranging from 2-5 inches. A cuticle protects the body. In addition, earthworms do not have hearing aids and do not have eyes. The digestive tract is located at the front, while the anus is at the back of the body. It has a body cavity (coelom) and breathes using the skin. Earthworms have a closed circulatory system and contain hemoglobin in their blood.

Earthworms have a fairly high nutritional content, so they can be used as raw materials for making animal feed such as chicken, duck, and fish. Earthworms are protein-rich animals. The earthworm protein content is higher than in other animals, such as goats, buffalo, cows, and chickens [3]. In addition, earthworms contain 0.55% calcium, 1% phosphorus, and 1.08% fiber. The protein content of earthworms was higher than the protein content of fish meal [4]. In addition, earthworms contain complete amino acids, are easily digested, and do not contain toxins. The use of earthworm flour up to a level of 1.5% in boiler chicken feed can improve livestock health [5].

Given the high nutritional content of earthworms, these animals can be used as raw materials for making animal feed, such as chicken, duck, and fish. Therefore, it is necessary to cultivate earthworms to be available in sufficient quantities. The growth and reproduction of earthworms are influenced by the availability of nutrients in their food. Earthworms consume dissolved organic matter and easily decompose in the soil [6]. The food substances needed by earthworms are organic materials containing protein, fat, carbohydrates, minerals, and water [7].

In the territory of Indonesia, especially in the city of Mataram, many people trade fried bananas. This activity produces waste in the form of banana peels which sellers of fried bananas usually dump in a garbage dump. Using banana peels to feed worms will reduce banana peel waste in Mataram City. In addition, worms that grow and reproduce can be used as animal feed or sold to increase income. Based on the above background, research has been carried out on adding banana peel feed to the growth of earthworms (*Lumbricus rubellus*).

Based on the above background, research has been carried out on adding banana peel to feed the growth of earthworms (*Lumbricus rubellus*). The study aims to determine: (1) the effect of different doses of banana peel pulp on feed on the growth of earthworms (*Lumbricus rubellus*), (2) the best dose of banana peel pulp to increase the growth of earthworms.

RESEARCH METHODS

The materials used were banana peel waste, cow feces, bricks, water, EM 4 livestock, nylon

sacks, woven bamboo fence, bamboo, aluminum wire, zinc roof, paranet net, soil thermometer, and granulated sugar. Furthermore, the tools used are a blender, plastic bucket, shovel, push arcco, measuring cup, soil thermometer, soil pH meter, and scales.

In the early stages of the study, the manufacture of earthworm feed was carried out from banana peels with the following stages: (1) preparing the necessary tools and materials, (2) as many as 26 kg of banana peels were blended so that they became banana peel pulp, (3) put the banana peel pulp in a plastic bucket and close it, (4) the banana peel pulp is given 200 g of sugar and 20 ml of EM4 and fermented for 10 days, (5) store the fermented banana peel pulp in a shady place.

After preparing the banana peel pulp food ingredients, it is continued with the maintenance of earthworms with the following stages: (1) preparation of research materials and tools, (2) making research sites with length x width = 5 m x 4 m fenced with woven bamboo and given a roof of zinc material, (3) making plots for rearing earthworms from precarious materials, each plot measuring 30 cm x 50 cm. (4) placing earthworms in each study site as many as 60 earthworms, which weights 54 grams, (5) feeding cow dung as much as 1000 ml per 10 days for every 60 earthworms, (6) feeding banana peel pulp according to the dose treatment, (7) keeping earthworms for 70 days, (7) measuring research parameters, (8) carrying out data analysis.

In this study, a completely randomized design was used. The dose of banana peel feed consists of 5 levels, namely; P0 = treatment of 0 ml of banana peel pulp, P1 = treatment of 250 ml of banana peel pulp, P2 = treatment of 500 ml of banana peel pulp, P3 = treatment of 750 ml and P4 = treatment of 1000 ml of banana peel pulp. All treatment levels were carried out with 5 replications. The growth parameters measured were the increase in the number of individuals and the weight gain of earthworms. The research data were analyzed by analysis of variance [8].

RESULTS AND DISCUSSION

Increase in the Number of Individuals *Lumbricus rubellus*

Adding banana peels to earthworm feed caused variations in the number of *Lumbricus rubellus* observed after 70 days of rearing. Data on the effect of adding banana peel to feed on the number of *Lumbricus rubellus* is presented in table 1.

Table 1 shows that the lowest number of individuals of *Lumbricus rubellus* was 104 individuals observed in treatment K0 (in media without banana peel pulp treatment). Furthermore, the number of individuals increased in line with the weight of the banana peel pulp added. The highest

number of individuals was 165 individuals observed in the K4 treatment, namely adding 1000 ml of banana peel pulp to the feed. Analysis of variance showed that the addition of banana peel pulp to the feed could increase the number of individuals of *Lumbricus rubellus*.

Table 1. Average Number of Individuals *Lumbricus rubellus* after 70 Days at the study site

Treatment	Number of Individuals
K0	104
K1	122
K2	135
K3	148
K4	165

The increase in the number of individuals of *Lumbricus rubellus* due to adding banana peel pulp to the feed is possible because banana peels contain high carbohydrates. The research results show that the peel of a ripe and air-dried tangerine banana contains 14.19% carbohydrates, a fresh ripe banana peel contains 13.46% and a ripe and boiled banana peel contains 11.27% carbohydrates [9]. Carbohydrates contained in banana peels play an important role in the growth and reproduction of *Lumbricus rubellus*.

Several research results show similar results to this study. Using waste mixed with cow feces can increase the cocoon production and biomass of the earthworm *Eisenia feftida*. This media can produce as many as 207.7 cocoons/box [10]. Furthermore, the combination of coconut tree trunk sawdust media and manila grass had a significant effect on the growth of *Lumbricus rubellus* [11]. The best combination of media in increasing the growth of *Lumbricus rubellus* was 75% sawdust from coconut tree trunks combined with 25% manila grass. Furthermore, it was reported that the combination of media had a significant effect on the growth of earthworms. The best combination of media is a combination of 75% palm frond waste and 25% chicken feces and a combination of 50% vegetable waste and 50% chicken manure [12].

Total weight of *Lumbricus rubellus*

The addition of banana peel pulp feed caused variations in the total weight of *Lumbricus rubellus* in each experimental unit. After 70 days of rearing, the total weight of *Lumbricus rubellus* was measured in each experimental unit. The results of these measurements are as follows (table 2).

The data in table 2 shows that the lowest total weight of *Lumbricus rubellus* was 92 grams observed in the K0 treatment, namely the control treatment. Furthermore, the total weight of *Lumbricus rubellus* increased with the increase in the dose of banana peel pulp given. The highest average weight of *Lumbricus rubellus* was 142

grams which were found in the treatment of 1000 mg of banana peel pulp per 10 days. Based on the analysis of variance, it is known that adding banana peel pulp to the feed can increase the total weight of *Lumbricus rubellus*. The increase in the weight of *Lumbricus rubellus* due to the addition of banana peel feed was due to the banana peel containing various important compounds needed to stimulate the growth of earthworms. In 100 g of banana peel, there are 18.5 g carbohydrates, 2.1 g fat, 0.32 g protein, 715 mg calcium, 117 mg phosphorus, 1.60 mg iron, 0.12 mg vitamin B, 17.5 mg. mg of vitamin C and 68 g of water [13]. Proteins in banana peels are important in stimulating the growth of earthworms. Protein is a nutrient in food that is very important for cell division of the earthworm body because this substance is not only a source of energy but also a provider of various amino acids, so it acts as a building material. As a building block, protein is the material for forming new cells and tissues that always occurs in the body of earthworms in the growth phase [14].

Table 2. The average weight of *Lumbricus rubellus* After 70 Days at the Study Site

Treatment	Weight of <i>Lumbricus rubellus</i> (g)
K0	92
K1	105
K2	126
K3	137
K4	142

Several studies give similar results to the results of this study. Additional feeding of tofu dregs can increase the body weight gain of the parent and the body weight of the offspring of *Pheretima* Sp. for 60 days of care [15]. Furthermore, [16] found that feeding the baglog mushroom waste *Pleurotus ostreatus* significantly affected the growth and cocoon production of the *Lumbricus rubellus*. Feeding chicken manure significantly affects the growth and cocoon production of the *Lumbricus rubellus*. The interaction of treatment with mushroom and chicken manure waste significantly affected the growth and cocoon production of the *Lumbricus rubellus*.

Lumbricus rubellus Environmental Conditions

Abiotic environmental conditions such as pH and media temperature also greatly affect the survival of earthworms. Therefore, in cultivating earthworms, it is necessary to create an atmosphere or media condition in their natural habitat so that the worms can adapt and develop properly. In this study, measurements of environmental factors that can determine the growth and reproduction of

Lumbricus rubellus were carried out. The environmental factors measured were the pH and temperature of the *Lumbricus rubellus* rearing medium. Data on the pH and temperature of the maintenance media are presented in Table 3.

Table 3. Average pH and Temperature of Media *Lumbricus rubellus*

Treatment	pH	Temperature
K0	6.2	25 ^o C
K1	6.2	25 ^o C
K2	6.5	25 ^o C
K3	6.5	26 ^o C
K4	6.5	26 ^o C

Table 3 shows that the pH conditions of the growth media ranged from 6.2 to 6.5. Furthermore, the media temperature ranged from 25^o C to 26^o C. The earthworm-rearing media required a pH of 6.8 – 7.2 and a temperature ranging from 18^oC-27^oC [17]. Furthermore, it is explained that a good temperature condition for earthworm rearing media is 18^oC-27^oC [18]. Earthworm growth media requires a pH of 6 - 7.2 and a temperature of 23^oC-27^o C [19]. Furthermore, earthworm maintenance media requires a temperature of 15^oC-25^oC and a pH ranging from 6.0 to 7.2 [20]. It was concluded that the earthworm media in this study's pH and temperature conditions were in accordance with the media required for the growth and reproduction of earthworms.

CONCLUSION

The following conclusions can be drawn from the research and discussion presented in this study: (1) the addition of different amounts of banana peel pulp had a significant impact on the increase in the number of earthworm individuals and the weight of the population; and (2) the addition of 1000 ml of banana peel pulp produced the highest number of individuals and population weight. The heaviest dose compared to another treatment dose.

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PAGE 2

PAGE 3

PAGE 4
