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ADDITION OF *AZOLLA MICROPHYLLA* TO FEED ON THE DIGESTIVE TRACT OF MAGELANG DUCKS

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ABSTRACT

This study aims to determine the effect of additional feeding *Azolla microphylla* on the digestive tract of Magelang ducks. This research was conducted for 7 weeks in the experimental cage of Tidar University. The experiment was conducted using a completely randomized design with 4 treatments P0 (0% *Azolla microphylla*), P1 (10% *Azolla microphylla*), P2 (15% *Azolla microphylla*) P3 (20% *Azolla microphylla*) with 5 replications. The livestock used were 40 male Magelang ducks. The parameters observed were the length and weight of the digestive tract of Magelang Ducks. Data were analyzed using a completely randomized design (CRD) then continued with Duncan's test. Analysis of variance showed that supplementary feeding *Azolla microphylla* had no significant effect (on the percentage of crop length, jejunum, caecum, large intestine, cloaca, liver and esophageal weight, crop, proventiculus, gizzard, duodenum, jejunum, caecum, cloaca, and liver, but had a significant effect on the percentage of length of the esophagus, proventriculus, gizzard, duodenum, ileum, and percentage of weight of the ileum, and colon.

Key words : *Magelang ducks, Azolla microphyla, Digestive tract.*

INTRODUCTION

Magelang ducks have their own characteristics between males and females. Magelang ducks, female ducks have a color that is dominated by brown. While the male duck has a black color on the head. Some Magelang duck breeders also call it the necklace duck. Because it has a circle like a white ring on the neck. Magelang ducks have the advantage of having the highest weight compared to other ducks (Dispeterikan Kab. Magelang, 2015). This water fern plant *Azolla microphylla* has quite a lot of benefits, namely as fish feed, poultry, and can be used as fertilizer. *Azolla microphylla* is able to fix nitrogen from the air. This potential makes *Azolla microphylla* good as additional feed for livestock. Under optimal conditions, *Azolla microphylla* can grow well with a growth rate of 35% per day. *Azolla microphylla* contains a fairly high protein. The content of essential amino acids, especially lysine as much as 0.42%. The content is higher than corn concentrate and broken rice (Gunawan and Harianto, 2011). *Azolla microphylla* is a type of fern that lives on the surface of the water with a maximum height of 30 cm and can grow well at an average temperature of 15-30°C. *Azolla microphylla* also needs sunlight for photosynthesis and the use of organic

fertilizers, phosphate fertilizers and the like is highly recommended to provide additional nutrients for Azolla (Rahal, 2019). Feed is food that is given to livestock to meet the nutritional needs of the livestock body.

The ration has a very important role in he life of livestock, namely to maintain life, growth and production. The ration is one of the determining factors for the success of livestock business in addition to genetic factors and livestock management itself. Provision of rations that are not in accordance with the needs of livestock both in quantity and quality will cause the appearance of production that is not in accordance with their genetic potential. The potential value of a ration is determined, among other things, by the chemical composition contained in it, in addition to the price, availability and aspects of giving the ration to the appearance of livestock production (Ardiansyah, 2013). The feed given must meet the standard of nutritional needs because nutrients play an important role in growth, health and egg production. Feeds that meet the standard of nutritional needs are those containing protein, carbohydrates, fats, vitamins, minerals and water in sufficient and balanced quantities. Feeds (rations) can be made from cheap and easily available materials, such as yellow corn, refined rice bran, corn bran, coconut cake, peanut meal, soybeans, shellfish flour, fish meal, waste flour from slaughterhouses, blood meal. , snail flour, papaya leaf flour, cassava flour, dried bamboo shoots, crabs, mussels, dry rice, snails and so on (Cahyono, 2011). The feed requirements of ducks at various ages are presented in Table 1.

The digestive tract is a systemconsisting of complementary organs that play a role in the digestive process of feed ingredients that can be absorbed by the walls of the digestive tract. Poultry has a simple digestive tract, which consists of the oral cavity, esophagus, crop, proventriculus, gizzard, small intestine, caecum, large intestine, and cloaca (Hamzah, 2013). The digestive tract of poultry has a length ranging from 245-255 cm, depending on the age and type of poultry, consists of three types of digestion, namely the first is mechanical/physical digestion, which is digestion carried out by muscle fibers, mainly occurs in the gizzard assisted by rocks. , the second is chemical/enzymatic digestion, namely digestion carried out by digestive enzymes produced by the salivary glands in the mouth (amylase), proventiculus and gizzard (pepsin and lipase), duodenum (amylase, trypsin, collagenase, bile salts and lipase), jejunum (maltase, sucrase, lactase, peptidase), which functions to break the bonds of protein, fat, and carbohydrates, and the third is microbiological digestion, namely digestion that occurs in the cecum and colon (Porter, 2012).

Digestion of feed starts from the beak, continues in the mouth, there are glands that produce saliva containing the enzymes amylase and maltase, then feed goes to the crop through the esophagus, which is a flexible channel that connects the mouth with the crop as a temporary food storage. The crop does not have a direct role in the digestive system, because it does not secrete enzymes or absorb nutrients, but can soften the feed so that it helps the grinding process and the work of enzymes in the digestive tract (Svihus, 2014). Further digestion of food goes to the gizzard through the proventriculus, which is a connecting channel from the cache to the gizzard, in which there are enzymes trypsin, amylase and lipase. Then the feed enters the gizzard, grinded and ground with the liquid (enzyme) released by the proventriculus. Small soluble particles are pushed into the small intestine, while insoluble particles such as small stones or sand stay in the gizzard for several hours (Porter, 2012).

Table 1. Feed requirements of ducks of various ages

Description	Age (weeks)	Feed Requirement(g/head/day)
DOD	DOD–1	15
Starter	1-2	41
	2-3	67
	3-4	93
	4-5	108
	5-7	115
	7-8	120
Grower	8-9	130
	9-15	145
	15-20	150
Layer	>20	160-180

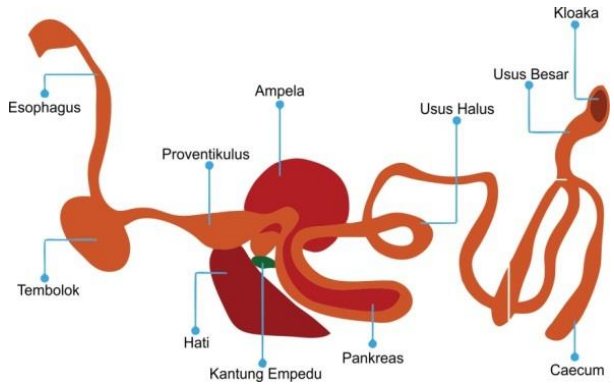

Figure 1. Digestive Tract

The small intestine is divided into 3 parts, namely the duodenum, jejunum and ileum. The small intestine is the main organ where digestion and absorption of digestive products takes place and has an important role in the transfer of nutrients. There are several enzymes in the small intestine, namely peptide, maltose, sucrose, and lactose. The small intestine is a tortuous channel that is about 6-8 meters long, 25 mm wide with many folds called villi or intestinal protrusions (Alfiansyah, 2011).

MATERIAL AND METHODS

Material

Time and Place

This research will be carried out in March - May 2021. The research location is in the experimental cage at Tidar University in Bandongan, Magelang Regency, Central Java.

Research Material

The materials used in this study were Magelang ducks purchased from Magelang duck breeders in Magelang Regency,

Central Java as many as 40 males with 3 weeks of age, cages measuring 3x5m which were given 20 bulkheads. Other materials used are feed used consisting of commercial rations, rice bran, corn, mineral mix and Azolla microphyla. The treatment rations were made for a week, except that azzola was mixed with each feeding. The tool used in this study is a walled close house cage. Other equipment used in the research was scales to weigh feed rations and duck weights, measuring tape to measure the length of the duck's digestive tract, cutting tools, plastic and tissue.

Methods

Research Design

The study was conducted experimentally using a Completely Randomized Design (CRD) with 4 treatments with 5 replications (each replication consisted of 2 ducks). The treatment that will be applied is 4 levels of giving Azolla microphyla to the feed:

P(0) : Feed Ration + 0% *Azolla microphyla*
P(1) : Feed Ration + 10% *Azolla microphyla*
P(2) : Feed Ration + 15% *Azolla microphyla*
P(3) : Feed Ration + 20% *Azolla microphyla*

Research procedure

a. Seedling of *Azolla microphyla*

First, make a pond for *Azolla microphylla* to grow using a tarp, after that the tarp is filled with water and after everything is ready, the *Azolla microphylla* seeds are planted. Then at the age of a week *Azolla microphylla* can be harvested, then dried by heating in the sun until the water content decreases, after that Azolla mircrophylla is mixed into the feed ration as additional feed for Magelang ducks.

b. Preparation of Feed Ration

The feed ingredients used consisted of corn, rice bran, commercial feed and mineral mix. Treatment rations were made for a week. The treatment ration can be seen in the following table

Table 2. Composition of treatment feed composition for male Magelang ducks

	Treatment			
	P0	P1	P2	P3
Grower phase Commercial Ration	75	64	58	53
Corn	10	13	15	17
Bran	14	12	11	9
Azolla microphylla	0	10	15	20
Mineral Mix	1	1	1	1
Total	100	100	100	100
Crude Protein Level (%)	18,017	18,055	18,032	18,076
Metabolic Energy (kkal/kg)	2820	2805,1	2800	2801,9

c. Maintenance

40 ducks with 3 weeks of age who had arrived were put into a cage that had been coded at random, each 2 tails, with the body weight being weighed beforehand. Feeding for treatment adaptation was carried out in stages for 5 days, after which full feeding was carried out with a size of 120gr / head / day. Weighing of the remaining feed is carried out every day.

d. Sampling

Data was taken when the ducks were 12 weeks old in the following way:

1. Ducks are slaughtered and plucked
2. Then remove the digestive tract organs from the body of the duck.

3. The digestive tract is measured from the top to the bottom of the digestive tract using a measuring tape in cm.
4. The digestive tract is weighed using an analytical balance

Observed Changes

1. Measurement of the length of the part or organ of the digestive tract
   a. Esophageal length (cm) was measured from the tip of the floor of the mouth of the pharynx at the floor of the mouth to the base of the proventiculus through the widening part of the esophagus (the cache). The length of the esophagus is measured using a measuring tape.
   b. Proventiculus length (cm) was measured from the tip of the esophagus to the base of the gizzard. The length of the proventiculus was measured using a measuring tape.
   c. The length of the small intestine (cm) was measured from the base of the gizzard to the junction of the bile duct (duodenum) then the junction of the bile duct to the Meckels diverticulum (jejenum) and from the Meckels diverticulum to the caeca branching (illeum). The length of the small intestine was measured using a measuring tape.
   d. The length of the cecum (cm) is a branching at the end of the small intestine (ileum) consisting of two organs measured using a measuring tape.
   e. The length of the large intestine (cm) was measured from the base of the caeca/appendix branching to the end of the cloaca, measured using a measuring tape.
2. Weighing of parts or organs of the digestive tract
   a. Esophageal weight (g) is the weight of the esophagus weighed using an analytical balance.
   b. The weight of the cache (g) the weight of the cache was weighed using an analytical balance
   c. The weight of the proventiculus (g) the weight of the proventiculus was weighed using an analytical balance.
   d. The weight of the gizzard/gizzard (g) the weight of the gizzard/gizzard is weighed using an analytical balance
   e. The weight of the small intestine (g) the weight of the small intestine was weighed using an analytical balance.
   f. The weight of the caecum (g) is the weight of the caeca weighed using an analytical balance.
   g. The weight of the large intestine (g) is the weight of the large intestine weighed using an analytical balance.
   h. Cloaca weight (g) is cloaca weight weighed using an analytical balance
   i. Liver weight (g) is liver weight weighed using an analytical balance

According to Amirullah (2017), the percentage of digestive tract weight based on live weight can be calculated using the following formula:

$$\text{Digestive ct persentage (\%)} = \frac{\text{Gastrointestinal Organ Weight (g)}}{\text{live weight of ducks (g)}} \text{ x } 100\%$$

Data analysis

The data obtained will be analyzed by analysis of variance. If the treatment has a significant effect, it will be continued with Duncan's test to see the difference in each treatment sample. The results of this study will be analyzed using a completely randomized design (CRD).

According to Elvinus (2016), the mathematical model of Completely Randomized Design (CRD) is as follows:

$Yij = \mu + \alpha i + \epsilon ij$

Note:

Yij = The observed value of the i-th treatment of the j-th replicate probiotics.

μ = Actual average score
αi = Effect of treatment at level i
ϵij = Galat
i = P1, P2, P3
j = 1,2,3,4,5

RESULT AND DISCUSSION

Weight Percentage of the Digestive Tract of Magelang Ducks

The results of a 7-week study which included additional feed in the form of *Azolla microphylla* on the weight and length of the digestive tract of Magelang ducks.

The percentage of internal organs measured in this study was the percentage of weight of the esophagus, crop (crop), proventriculus, gizzard, small intestine, cecum, large intestine, cloaca, and liver. The average results of this study are presented in Table 3. The results of the analysis of variance showed that the administration of *Azolla microphylla* had no significant effect on the percentage of esophageal weight. The percentage of esophageal weight from the highest to the lowest were P2 (0.49%), P3 (0.49%), P0 (0.42%), and P1 (0.41%). Based on the table the lowest percentage of esophageal weight is P1 (0.41%) while the highest percentage of esophageal weight is P2 (0.49%) and P3 (0.49%) with the addition of 15% and 20% *Azolla microphylla*. According to Asmawati (2013) the difference in the size of the esophagus is influenced by the increased consumption of poultry feed. In addition, factors that affect the size of the esophagus of poultry are the amount of feed consumed, the type of feed, sex and age. The results of the analysis of variance showed that the administration of *Azolla microphylla* had no significant effect on the percentage of crop weight (crop). Based on the table the lowest percentage of crop weight was P0 (0.50%) and the highest was P2 (0.68%) with the addition of 15% *Azolla microphylla* as additional feed. The percentages of cache weight from the lowest to the highest were P0 (0.50%), P1 (0.60%), P3 (0.64%), and P2 (0.68%). This is in accordance with the opinion of Amirullah (2017), which states that the normal crop percentage is 0.3% - 0.7%. The results of analysis of variance showed that the feeding of *Azolla microphylla* was not significantly different in the percentage of proventiculus weight. The average weight percentage of proventiculus was 0.50% – 0.62%. This is in accordance with the opinion of Yuwanta (2014) which states that the percentage of proventiculus weight is 0.5% to 0.7%. The percentage of weight of proventiculus from the lowest to the highest were P1 (7.00%), P0 (7.33%), P2 (7.66%) and P3 (7.66%). Amirullah (2017) stated that the size of the proventriculus is influenced by animal feed, the higher the crude fiber and phytate in the feed given to poultry, the more it will affect the enlargement and depletion of the proventriculus organs, because the proventriculus works to produce hydrochloric acid (HCl) and pepsin, and enzymes that can break down protein and crude fiber of the feed provided. The results of the variance study showed that the administration of *Azolla microphylla* was not significantly different (P>0.05) in the

percentage of gizzard weight. The percentage of gizzard weight from the highest to the lowest were P0 (5.70%), P1 (5.92%), P3 (6.18%) and P2 (6.37%). One of the factors that affect the increase in gizzard weight is crude fiber feed, the higher the crude fiber, it takes more work intensity for the gizzard to digest. The presence of high crude fiber can affect the digestibility of foodstuffs and can affect the digestive organs and internal organs. According to Suparjo (2013) the percentage of gizzard is influenced by age, weight and eating. Giving more food will result in a greater burden on the gizzard to digest food, as a result, the gizzard will be thicker, thus increasing the size of the gizzard.

Table 3. Average relative weight of digestive tract organs

Parameters Observed	Treatment			
	P0	P1	P2	P3
Eesophagus (%)	0.42^{a}	0.41^{a}	0.49^{a}	0.49^{a}
Crop (%)	0.50^{a}	0.60^{a}	0.68^{a}	0.64^{a}
Proventiculus (%)	0.53^{a}	0.50^{a}	0.62^{a}	0.59^{a}
Gizzard (%)	5.70^{a}	5.92^{a}	6.37^{a}	6.18^{a}
Duodenum (%)	0.45^{a}	0.55^{a}	0.51^{a}	0.58^{a}
Jejunum (%)	0.68^{a}	0.84^{a}	1.03^{a}	0.89^{a}
Ileum (%)	0.90^{a}	1.16^{ab}	1.36^{b}	1.20^{ab}
Caecum (%)	0.44^{a}	0.36^{a}	0.41^{a}	0.33^{a}
Usus Besar (%)	0.40^{ab}	0.31^{a}	0.41^{ab}	0.45^{b}
Cloaca (%)	0.66^{a}	0.67^{a}	0.74^{a}	0.71^{a}
Hati (%)	2.51^{a}	2.58^{a}	2.73^{a}	2.64^{a}

Note: different superscripts on the same line show significantly different treatments (P<0.05)

Table 4. Average relative length of digestive tract organs

Parameters Observed	Treatment			
	P0	P1	P2	P3
Eesophagus (cm)	21,33^{a}	22,66^{ab}	23,66^{b}	26,66^{c}
Crop (cm)	6,66^{a}	7,33^{a}	7,66^{a}	7,66^{a}
Proventiculus (cm)	6,00^{a}	6,33^{a}	7,66^{b}	7,66^{b}
Gizzard (cm)	6,66^{ab}	6,00^{a}	6,66^{ab}	7,00^{b}
Duodenum (cm)	26,66^{ab}	27,00^{b}	26,00^{ab}	26,66^{a}
Jejunum (cm)	58,33^{a}	60,33^{a}	61,00^{a}	61,33^{a}
Ileum (cm)	57,00^{a}	58,33^{a}	62,00^{b}	62,33^{b}
Caecum (cm)	35,33^{a}	34,00^{a}	36,00^{a}	33,66^{a}
Usus Besar (cm)	14,00^{a}	14,00^{a}	14,33^{a}	14,66^{a}
Cloaca (cm)	3,66^{a}	4,00^{a}	3,66^{a}	3,66^{a}
Hati (cm)	7,33^{a}	7,00^{a}	7,00^{a}	7,33^{a}

Note: different superscripts on the same line show significantly different treatments (P<0.05)

The small intestine is divided into 3 parts, namely the duodenum, jejunum and ileum. The small intestine is the main organ where digestion and absorption of digestive products takes place and has an important role in the transfer of nutrients. The results of the analysis of variance in table 1, showed that the administration of *Azolla microphylla* had no significant effect on the percentage of the weight of the duodenum

and jejunum, but had a significant effect on the percentage of the ileum. Based on Duncan's test P0 (0.90%), P1 (1.16%) , and P3 (1.20%) had no significant effect, but P2 (1.36%) was significantly different with P1 (1.16%). This shows that giving *Azolla microphylla* to the feed can increase the weight of the ileum in Magelang ducks, because the higher the level of crude fiber in the ration, the higher the weight of the small intestine. Hamdan et al (2014) reported that the use of high-fiber feed in the ration significantly reduced performance, increasing the weight of the gizzard, cecum and small intestine. Analysis of variance showed that the administration of *Azolla microphylla* had no significant effect on the percentage of weight of the cecum. Successively the percentage of cecum weight from the lowest to the highest was P3 (0.33%), P1 (0.36%), P2 (0.41%), P0 (0.44%). Based on Table 3, the highest percentage of cecum weight was P0 (0.44%) with the addition of 0% *Azolla microphylla*. Cecum is a digestive tract that functions as a place for microbial digestion with the aim of digesting nutrients that are not absorbed in the small intestine, especially fiber and nitrogen. The increase in cecum weight is due to an increase in the digestive activity of nutrients that are not absorbed in the small intestine as a result of reduced digestibility of feed in the intestine (Syarifi *et al*., 2012).

The results of the analysis of variance showed that feeding *Azolla microphylla* had a significant effect (P<0.05) on the percentage of large intestine weight. based on Duncan test P0 (0.40%), P1 (0.31%), and P2 (0.41%) had no significant effect, but P1 (0.31%) had a significant effect (P<0.05) with P3 (0.45%). The percentages of colon weight from the highest to the lowest were P3 (0.45%), P2 (0.41%), and P0 (0.40%). The results of the analysis of variance showed that the application of *Azolla microphylla* to the feed ration of Magelang ducks had no significant effect (P>0.05) on the percentage of cloaca weight. The percentages of cloacal weight from the highest to the lowest were P2 (0.74%), P3 (0.71%), P1 (0.67%), and P0 (0.66%). The results of analysis of variance showed that the administration of *Azolla microphylla* had no significant effect on the percentage of liver weight. Based on Table 3, the lowest percentage of liver weight was P0 (2.51%) while the highest percentage of liver weight was P2 (2.73%) with the addition of 15% *Azolla microphylla* to the feed ration. This is in accordance with the research of Widianingsih (2011) which states that the percentage of liver weight ranges from 2.35% – 3.01%.

Percentage of Digestive Tract Length of Magelang Ducks

The percentage data on the length of the digestive tract are presented in Table 4. The use of *Azolla microphylla* in the diet of Magelang ducks was significantly different (P<0.05) in increasing the percentage of length of the esophagus, proventiculus, gizzard, and small intestine. But not significantly different in the percentage of the length of the crop, cecum, large intestine, and liver. This is thought to be due to the stretching ability of the digestive tract to accommodate and digest rations containing high crude fiber with a larger volume.

The results of analysis of variance showed that *Azolla microphylla* was significantly different (P<0.05) with respect to the percentage of esophageal length. Based on the results of Duncan's test, P0 (21.33) and P1 (22.66) had no significant effect while P0 (21.33), P2 (23.66), and P3 (23.66) had a significant effect (P<0.05) on the percentage of esophageal length. . It is suspected that the addition of more *Azolla microphylla*, the higher the percentage of esophageal length, because of the high crude fiber. The results showed that the addition of

Azolla microphylla to the feed ration was not significantly different to the percentage of crop length, but increased in each percentage of the addition of *Azolla microphylla* to the feed ration. The percentages of cache length from the highest to the lowest were P3 (7.66), P2 (7.66), P1 (7.33), and P0 (6.66). The results of the analysis of variance showed that the addition of *Azolla microphylla* was significantly different (P<0.05) on the percentage of Proventiculus length. Based on the results of the Duncan test, P0 (6.00) and P1 (6.33) were significantly different (P<0.05) with P2 (7.66) and P3 (7.66). The results of analysis of variance showed that the addition of *Azolla microphylla* had a significant effect (P<0.05) on the percentage of gizzard length. Based on the results of Duncan's test, P0 (6.66), P1 (6.00), and P2 (6.66) had no significant effect, while P3 (7.00) with P1 (6.00) had a significant effect (P<0.05) on the percentage of gizzard length. The results of analysis of variance showed that the addition of *Azolla microphylla* had a significant effect (P<0.05) on the percentage of small intestine length. This difference occurs in the Duodenum, based on the table the average percentage length of the duodenum is 26.00cm – 27.00cm. The results of the Duncan test P0 (26.66), P2 (26.00), and P3 (26.66) had no significant effect, while P3 (26.66) and P1 (27.00) had a significant effect (P<0.05) on the percentage of duodenum length. Then in the Ileum P0 (57.00) and P1 (58.33) there was a significant difference (P<0.05) with P2 (62.00) and P3 (62.33). In the opinion of Wang et al. (2016) that a longer small intestine is an indication of a larger area of digestion and absorption of nutrients. The results showed that the addition of *Azolla microphylla* to the feed ration was not significantly different to the percentage of cecum length, respectively, the percentage of cecum length from the highest to the lowest was P2 (36.00), P0 (35.33), P1 (34.00), and P0 (33.66).

The results showed that the addition of *Azolla microphylla* to the feed ration was not significantly different to the percentage of colon length. The percentages of colon length from the highest to the lowest were P0 (14.00), P1 (14.00), P2 (14.33), and P0 (14.66). The results of the analysis showed that the addition of *Azolla microphylla* increased the percentage of the length of the large intestine. Analysis of variance showed that the administration of *Azolla microphylla* had no significant effect on the percentage of cloacal length. The percentages of cloacal length from the lowest to the highest were P0 (3.66), P2 (3.66), P3 (3.66), and P1 (4.00). Based on Table 4, the highest percentage of cloacal length was P1 (4.00) with the addition of 10% *Azolla microphylla*. Analysis of variance showed that the administration of *Azolla microphylla* had no significant effect on the percentage of liver length. The percentages of liver length from the highest to the lowest were P0 (7.33), P3 (7.33), P1 (7.00), and P2 (7.00). Based on the table the highest percentage of cloacal length was P1 (7.00) and P2 (7.00) with the addition of 10% and 15% *Azolla microphylla*.

CONCLUSION

Based on this study, it was found that the addition of *Azolla microphylla* to the feed ration of Magelang ducks as much as 15% could increase the percentage of weight and length of the digestive tract of Magelang ducks.

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