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An Economic Analysis of Kampung Chicken Production Using the Small Water Plant *Azolla microphylla* in Their Feed

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Abstract: We investigated the physical appearance and feed cost of kampung chickens whose feed was supplemented with 20% *Azolla* in commercial feed. The experiment was carried out with 15-day-old kampung chicks assigned to two treatments. One hundred birds were used in the study, with 50 birds assigned to treatment 1 (T1) and 50 birds assigned to treatment 2 (T2). Birds in T1 received a control diet consisting solely of commercial feed, with the diet containing 210 g/kg of crude protein. Birds in T2 received a diet that included 20% *Azolla microphylla* (AM) mixed in the 'commercial diet'; this diet contained 200.4 g/kg of crude protein. The experiments were conducted over a period of 8 weeks. No differences were found in feed consumption and the final weight of the birds, but birds who were fed the T2 diet had a better feed conversion ratio (FCR) ($p<0.05$) than that of birds who were fed the T1 diet. No mortality of birds occurred during the experiment. Utilization of AM could reduce the costs of feed from IDR 7,000/kg to IDR 5,800/kg, while increasing income per bird from IDR 8,760 to IDR 11,834. In conclusion, utilization of 20% AM in the diet of kampung chickens reduces the feed cost, improves the FCR and increases the income per birds sold.

Key words: Kampung chicken, *Azolla microphylla*, production, feed, economics

INTRODUCTION

Water plants are abundant in ponds, lakes and rivers. Previous studies have focused on the potential of water plants as a source of feed supplement for commercial fish and poultry (Ali and Leeson, 1995; Nobuyuki and Shunji, 2001; Maejima *et al*., 2002; Peng *et al*., 2007; Leterme *et al*., 2009; Abraham, 2010). *Azolla microphylla* is one such water plant that occurs worldwide in tropical freshwater ecosystems. *A. microphylla* grows in rice fields, ponds and rivers. According to Arora and Singh (2003), *A. microphylla* fixes atmospheric nitrogen and is high in protein. In Indonesia, *Azolla* is a source of affordable feedstuff for formulating fish and poultry diets, but little research has been conducted on its effectiveness as a feed supplement. Kampung is a common type of chicken in Indonesia that is easy to raise and usually provides additional income for households in rural areas of the country.

Previous studies have shown that the use of *Azolla* in chicken feed may increase egg production in layer chickens (Khatun *et al*., 1999). *Azolla* could replace sesame meal in chicken diets; inclusion of proportions of *Azolla* up to 20% increased egg size and yolk color, as well as increased weight gains due to its high protein content. Kampung chickens have no specific characteristics and can be found throughout Indonesian islands (Nataamijaya, 2009). These chickens are typically left to scavenge outside for feed, including grasses and vegetables, suggesting that a lack of protein may be the most limiting nutrient in their diets. Natamijaya (2009) reported that kampung chickens are very efficient in converting low-protein inputs into high-quality meat and egg products.

Water plants have long been recognized as among the most affordable and abundant potential sources of protein (Ali and Leeson, 1995). Due to their ability to fix free atmospheric nitrogen, species of *Azolla* constitute a cheap potential source of nitrogen and have a total protein content of 22-37% (Khan, 1988). Thus, *Azolla* represents a potential diet-supplement substitute for soybean protein, thereby reducing the cost of production and perhaps alleviating the possible contamination of antibiotic residues that derive from soybean. The primary issue facing kampung chicken development in Indonesia is the cost of feed, due to the presence of relatively expensive ingredients like imported soybean and corn.

The economic efficiency of substituting AM for costlier soybean or corn as a protein supplement in the feed of kampung chickens has not been investigated in Indonesia. In this study, we used a 20% incorporation of AM in commercial feed, following the procedure described in Khatun *et al*. (1999), who found that a similar incorporation of *Azolla* produced the best results in layer chickens, for the purpose of investigating the effects of supplementation with AM on the physical appearance and feed cost of kampung chickens.

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MATERIALS AND METHODS

Kampung chicken trials: The study was conducted in the Faculty of Animal Science and Agriculture of Diponegoro University, in Semarang, Indonesia. Commercial feed BR 1 Charoen Phokphand commercial broiler kampung chickens were used in this study, with 100 birds divided into two treatment groups. The price of commercial feed at the time of the experiment was IDR 7,000/kg. In treatment 1 (control), 50 kampung chickens (15 days old, 85 g initial weight) were fed a diet consisting strictly of commercial feed. In treatment 2, 50 kampung chickens (15 days old, 85 g initial weight) were fed a diet consisting of commercial feed and 20% *Azolla* meal. Both diets were provided in meal forms and formulated on a crude-protein basis, at a rate of approximately 17-18%, which is required by chickens. The experiments were conducted over an 8-week period. During the experiments, feed consumption and body weight were recorded daily and weekly, respectively, for each bird. Daily consumption was calculated by subtracting the amount of feed leftover from the total provided each day.

Feed sources: *Azolla microphylla* (AM) were cultured in the Animal Agriculture Faculty of Diponegoro University, in Semarang, Indonesia. AM was harvested every 7 days and both fresh and dry matter weights were measured. *Azolla* meal was composed of fresh AM that had been sun-dried for 3 days and ground, then mixed into commercial feed. The relative growth rate and doubling time were calculated using the standard procedure described by Arora and Singh (2003). The price of *Azolla* meal during the study was IDR 1,000/kg. The price of feed for T1 was IDR 7,000 and the price of the diet for T2 was IDR 5200/kg.

Chemical analysis: *Azolla* meal was analyzed for proximate composition using standard procedures (AOAC, 1996). All of the chemical analyses were conducted in the Animal Nutrition Laboratory, Faculty of Animal Science and Agriculture, Diponegoro University. Diets were well-balanced nutritionally for chicken growth, as shown in Table 1. Chickens typically require 17-22% crude protein during early development; chemical analysis of the two treatment diets showed that the T1 diet had a higher protein content than did the T2 diet.

Economic efficiency: Economic efficiency was calculated on the basis of feed cost, assumed revenue and total income per bird. Total income was calculated by subtracting the price of the bird when sold minus its feeding cost. The feed conversation ratio was calculated by dividing the amount of feed consumed by the final weight.

Statistical analysis: An independent t-test was used to analyze the differences between birds consuming T1 and T2 diets (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Chemical composition of *Azolla*: AM were cultivated at pH 6.1-7.2 and temperatures of 28.5-29.5°C, conditions in accordance with Datta (2011) for ideal AM production. As shown in Table 2, the chemical composition of the cultivated AM was 21.3% crude protein, 16.3% crude fiber, 3.2 crude fat and 14.7% crude ash; dry matter content was 3.5% and moisture content was 96.5%. Biomass production of AM was 30.3 g/kg. Fasakin (1999) noted a crude protein content for AM at approximately 28%, but the cultivated AM could be utilized despite its lower protein content because the protein requirement of kampung chickens is 17-21%. The high protein content of *Azolla*, which is comparable with that of more common sources such as soybeans, demonstrates its potential for use as a protein source in poultry feed.

Chicken performance: The initial weight of the birds were similar between individuals in T1 and T2, but the final weight of birds fed the T2 diet was, on average, greater than that of birds fed the T1 diet, although this difference was not statistically significant. This finding is perhaps explained by the similarities in protein content in diets T1 and T2 and hence, *Azolla* provide essential amino acids for the birds' growth.

As shown in Fig. 1, although there was no significant difference in the growth rate of kumpang chickens fed T1 and T2 diets, it is evident that feed supplemented with AM could meet the nutrient requirements of these birds. Birds fed the T2 diet had a higher average final weight than those fed the T1 diet; this result is in agreement with Kalita *et al.* (2007), who found that aquatic plants have great potential as protein sources for fish and poultry; anti-nutritional factors in low concentrations in AM would not have deleterious effects. The results also suggest that kampung chickens efficiently utilize the protein provided by AM supplementation. These findings accord with those of Ali and Leeson (1995), who found that incorporation of *Azolla* in the diet improves the weight gain of broiler chickens. As depicted in Fig. 1, all birds added approximately 60-80 g per week.

Economic efficiency: As shown in Table 3, birds fed the T2 diet performed better than those fed the T1 diet and FCR of T2 birds was more efficient than those of T1. Incorporation of 20% AM efficiently reduces the cost of feed; in fact, given the ease with which AM is cultivated, costs were lower than those of similar ingredients even though the protein content of AM was high. None of the chickens fed either diet died during the course of the experiment, indicating that inclusion of AM in feed does not have a negative effect on livability, a result that accords with Kalita *et al.* (2007), who found anti-nutritional components contained in AM were within tolerable limits and would not result in any deleterious effects on the birds. Kampung chickens usually sold on a per-bird basis and during our study, the price per bird

Table 1: Nutrient composition of Kampung chicken diets

	Diets	
Nutrient composition	T1	T2
Crude protein (g/kg)	210.7	200.4
Digestible protein (g/kg)	157	153.2
Crude fiber (g/kg)	46	47.6
ME (MJ g/kg)	11.35	11.60

Table 2: Proximate composition of *Azolla microphylla* in field condition

Component	Value
Biomass (g/kg)	30.3
Doubling time (days)	3.7
Relative growth rate (g/day)	0.15
Crude Protein (%)	21.3
Crude fiber (%)	16.3
Crude fat (%)	3.2
Crude ash (%)	14.7

[a]Average of three analyses

Table 3: Kampung chicken weight before and after diet trials

	Diets	
Items	T1	T2
Initial weight (g)	85±2.5	85±1.7
Final weight (g)	827.2±3.7	840±7.2

Table 4: Parameter of study before and after diet trials

	Diets	
Items	T1	T2
Feed consumption (g/day)	116 ± 4.21	118±3.17
Feed Conversion ratio (g/day)	2.32	2.27
Livability (100%)	100	100
Revenue (IDR/bird)	25.000	25.000
Feeding cost (IDR/bird)	16.240	13.166
Income (IDR/bird)	8.760	11.834

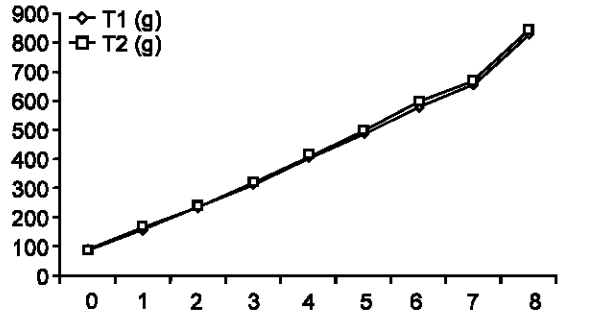

Fig. 1: Growth of Birds during experiment (week)

was IDR 25,000. Due to their larger size, kampung chickens fed the T2 diet generally sold for a higher price than those chickens fed the T1 diet.

In Semarang, the price of an 800g kampung chicken averaged IDR 25,000. Revenues from the average price per bird sold were collected during the period of the study. The average income for the birds fed the T2 diet was greater than the average income for birds fed the T1 diet. In addition, utilization of AM in the diets of kampung chickens also improved the FCR, which may also increase income from the selling of the birds. We conclude that *Azolla* is a cost-effective source of protein for kampung chickens. Inclusion of 20% AM in chicken diets reduced the cost of the feed from IDR 7,000/kg to IDR 5,800/kg and increased income, without altering the physical appearance of the birds (Table 4). Further research is needed to investigate the PUFA content of *Azolla* and to examine the impacts of supplementary *Azolla* on the quality of the meat and eggs of kampung chickens.

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