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Profitable Utilization of Giant Salvinia, *Salvinia molesta*, as Local Duck Feed

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Abstract: *Salvinia molesta* is an aquatic weed that can be found in swamps and lakes. The Central Java government is very interested in overcoming the infestation of Lake Rawa Pening by this aquatic weed. The present research was conducted from May until June 2014 at the Livestock and Poultry Laboratory of the Faculty of Animal and Agricultural Sciences of Diponegoro University in Semarang, Indonesia. The feed sample analysis was obtained from the Agricultural Extension College (STPP) of Magelang, Central Java. For this trial a flock of eighty Pengging ducks 4-week-old (male ducks) with an initial average weight of 734.25±0.52 g were used as the research subjects. *Salvinia molesta* was obtained from Lake Rawa Pening, and *Aspergillus niger* was obtained from the Agricultural Extension College (STTP Magelang). This research was carried out in two phases: the first phase consisted of the preparation, and the second phase consisted of the start, maintenance and completion of the study. A feed ration that contained fermented *Salvinia molesta* was used in the second phase. The ration composition of the starter and finisher periods was arranged with iso protein and energy. The addition of 15% *Salvinia molesta* to the local duck ration resulted in an increase in the body weight and feed conversion ratio (FCR), as well as increasing the income over feed cost (IOFC) by approximately IDR 2,468.65; this was the most efficient ration compared with the controlled ration and other rations.

Key words: Salvinia, duck, performance, profitability

INTRODUCTION

Human population growth and a growing awareness of the importance of nutrition are making Indonesian people more aware of what is required for adequate nutrition. One of the sources for fulfilling nutritional needs is poultry products. The request for poultry products continues to increase along with global human population growth because poultry meat contributes valuable nutritional components (Adeola, 2006). Ducks raised to provide poultry meat are one of the means to achieve adequate nutrition. Ismoyowati and Sumarmono (2011) stated that the price of the duck was lower than beef. This presents an opportunity to develop the duck husbandry business. *Salvinia molesta* was used in the duck feed (Dwiloka *et al*., 2015) and was found to reduce total cholesterol. The ration issue often becomes an obstacle for the duck-breeding business because in intensive duck breeding, the feed cost is often 60%-70% of the total costs (Destiana, 2010). To solve this problem, an alternative feed material is required that is not used in human foodstocks and for which continuous production can be maintained; *Salvinia molesta* satisfies these requirements. *Salvinia molesta* is duckweed, which is plentiful and has not yet been embraced by society. According to Irma *et al*. (2012), *Salvinia molesta* production has reached 12,600 fresh tons per year. Mc-Farland *et al*. (2004) added that *Salvinia molesta* could grow rapidly in rivers, swamps and farmland. *Salvinia molesta* can grow quickly, and the amount can double in 14 days. Moreover, 45.6 to 109.5 tons/ha can be produced in a year. Mardika (2012) stated that *Salvinia molesta* contained the nutrients which are crude protein (14.66%), fiber content (33.72%), lignin content (1.82%), calcium (1.82%) and phosphor (0.49%).

A limitation of *Salvinia molesta* is that it contains a high rate of crude fiber. One way to reduce its crude fiber is through fermentation using *Aspergillus niger*. *Aspergillus niger* produces *amylase enzyme*, *amyloglucosidase*, and *cellulose*, which are able to degrade cellulose and will reduce the rough fiber from the water hyacinth (Darwis *et al*., 1989). According to the research of Mardika (2012), the use of *Salvinia molesta* fermentation (SMF) with Tricorderma harzianum yields the best *income over feed cost* in rations using a 15% level of fermented SM. This research aims to investigate the usage of SMF in feed rations towards the performance of ducks and the IOFC for poultry ducks.

MATERIALS AND METHODS

This research was conducted at the Livestock and Poultry Laboratory of the Faculty of Agriculture and Animal Husbandry of Diponegoro University. The feed-sample analysis was conducted by the Agricultural Extension College (STPP) Magelang, Central Java. For this trial a flock of eighty Pengging ducks (male ducks)

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with initial average weights of 734.25±0.52 g were used as the research subjects. *Salvinia molesta* was obtained from Lake Rawa Pening and *Aspergillus nigger* was obtained from STTP Magelang. This research was carried out in two phases: the first phase consisted of preparation and the second phase consisted of the *starter*, maintenance and the finisher periods using a ration containing fermented *Salvinia molesta*. The ration composition of the starter and finisher periods was arranged by iso protein and energy, as seen in Table 1 and 2.

The preparation phase included supplying and collecting *Salvinia molesta* from Lake Rawa Pening, cleaning their long-roots, and later, drying the samples under sunlight until they were completely dried. The dried *Salvinia molesta* was then milled into flour. The fermentation process was performed aerobically using *Aspergillus niger* and required 10 kilos of Salvinia molesta flour, which had been mixed with 80 g of *Aspergillus niger*, 584.4 g of chicken minerals and warm water. The mixture was put inside the tray and wrapped in thin paper for a week.

In the treatment phase, the 80 4-weeks-old Pengging ducks were placed in litter cages of approximately 20 testing units; each unit consisted of four ducks. From the age of 4 until five weeks, the ducks were given the starter rations that contained EM 2,900 Kkal and PK 22%. For the finisher period, from the age of five weeks until twelve weeks old, the ducks were given a ration that contained EM 2,900 Kkal and PK 20%. The ration was given three times a day in age-appropriate amounts. Drinking water was provided *ad libitum*. The weight of each duck was measured once a week and the ration amount was recorded daily. The parameters examined were weight gain, ration conversion, the final body weight and income over feed cost.

This research used a complete random design, with five treatments and 4 repetitions; each repetition consisted of four animal experiment units. The treatments tested were T0 (basal ration), T1 (the ration that contained 15% SMNF), T2 (the ration that contained 15% SMF), T3 (the ration that contained 17.5% SMF) and T4 (the ration that contained 20% SMF). The results of the various treatments were analyzed at the 5 % level of significance using SPSS.20 and if effects were found, testing would be continued using the Duncan multiple range test (DMRT) (Steel and Torrie, 1991).

RESULTS AND DISCUSSION

The observed results of adding SMF to the local duck rations for seven weeks did not show any actual effects ($p \geq 0.05$) in terms of weight gain, ration conversion, or the final weight, although there were significant differences ($p \leq 0,05$) for the IOFC (Table 3).

Weight gain can be used as a success benchmark for poultry-raising farms; the highest weight gain of 868.88 g/duck was for rations with SMF added at the 15% level. Weight gain is related to ration consumption and the nutritional value of the ration. Hascik *et al*. (2010) stated that balanced ration nutrition could increase the weight gain and fix the feed conversion.

The nutritional content of SMF (duckweed) is better than that of SMNF because the fermentation process can reduce the crude fiber and increase the protein and amino acids. Khan *et al*. (2011) stated that the increased level of the amino acids lysine and methionine would enable a gain in body weight. According to Bilgili *et al*. (1992), the increased lysine could repair body weight, improve feed efficiency and reduce carcass fat deposition. Ma'rifah *et al*. (2013) stated that weight gain and livestock production were influenced by the availability of the energy and protein from the ration. Naghshi *et al*. (2014) added that giving duckweed in feed rations would increase feed palatability, which could lead to gains in broiler chicken weight. Based on the study of Ma'rifah *et al*. (2013), up to 18% *Salvinia molesta* could be used in rations to increase the weight gain for mixed-breed chickens raised for their meat.

Ration conversion is one of the indicators of the efficiency of ration usage toward body weight gain. The lower the conversion number is, the higher the success of the poultry business. The lowest conversion number was for the 15% ration; however, this high-conversion number did not influence either weight gain or economic sale. Sinurat *et al*. (1996) reported that the value of duck feed conversion would be associated with the length of breeding time. Tegal ducks aged 1 to 8-weeks-old had a feed conversion value of 5.2, whereas 1 to 9-weeks-old Tegal ducks had a feed conversion value of 6.3.

The FCR value for 12 weeks was high and in this case, it decreased feed efficiency. This occurred because the ducks had reached the deceleration stage and the feed, that was consumed was not as effective as it was in the starter stage. In the deceleration stage, bone, meat and body organs were already maximized and half of the energy consumption was accumulated or stored in the form of body fat (Prescott, 1976). The complete content of amino acids also influenced the FCR. The usage of SMF in rations could provide the complete amino acid needs for ducks. Leterme *et al*. (2009) reported that the amino acid and mineral contents of *Salvinia molesta* were suitable for monogastric poultry feed. Bregendahl *et al*. (2002) stated that when the ration consumption increased, the addition of crude protein and acid amino in the ration would affect the ration conversion value. Mukhtar *et al*. (2010) stated that the rations that contained higher lysine content would result in a good conversion ratio, if the lysine could be balanced by a methionine supplement.

The final weight was the result of the combined effects of the consumed ration together with the feed conversion. The consumption of more ration and a low FCR value could consequently increase the final weight. The highest body weight in this study resulted from

Table 1: Ration composition on starter period

	T0	T1	T2	T3	T4
Feed materials	%				
Corn	53.60	48.10	47.50	45.60	44.90
Non fermented *Salvinia molesta*	0.00	15.00	0.00	0.00	0.00
Fermented Salvinia molesta	0.00	0.00	15.00	17.50	20.00
Soybean meal	22.80	20.40	19.60	19.10	18.60
Vegetable oil	0.60	1.00	0.70	1.00	1.00
Bran	13.90	7.00	9.10	8.60	7.50
Fish flour	7.00	7.00	6.80	6.80	6.80
Calcium	0.60	0.40	0.30	0.30	0.20
Premix	0.60	0.30	0.30	0.30	0.30
Methionine	0.40	0.30	0.30	0.30	0.30
Lysin	0.50	0.50	0.40	0.50	0.40
Total	100.00	100.00	100.00	100.00	100.00
Nutrition Ingredient					
Metabolism energy (kkal/kg)	2922.96	2904.27	2900.42	2900.139	2900.6
Crude protein (%)	22.09	22.02	22.03	22.01	22.03
Crude fat (%)	4.40	4.15	4.18	4.41	4.35
Crude fiber (%)	5.67	8.70	8.55	9.11	9.11
Methionine (%)	0.76	0.66	0.65	0.65	0.64
Lysin (%)	1.43	1.39	1.28	1.36	1.26
Arginine (%)	0.54	1.28	1.27	1.25	1.23
Ca (%)	1.20	1.15	1.27	1.34	1.34
P (%)	0.76	0.72	0.70	0.70	0.68
Price	6,478.90	5,844.80	5,777.90	5,776.30	5,642.60

Table 2: Ration composition on finisher period

Feed materials	T0	T1	T2	T3	T4
Corn	54.70	51.10	52.20	50.00	49.00
Non fermented *Salvinia molesta*	0.00	15.00	0.00	0.00	0.00
Fermented *Salvinia molesta*	0.00	0.00	15.00	17.50	20.00
Soybean meal	20.00	18.50	17.50	16.80	16.40
Vegetable oil	1.00	0.70	0.50	0.50	0.60
Barn	15.00	8.50	8.50	9.30	8.10
Fish flour	5.50	4.50	4.50	4.50	4.50
Calcium	1.00	0.50	0.50	0.30	0.30
Premix	1.50	0.30	0.40	0.30	0.30
Methionine	0.40	0.30	0.30	0.30	0.30
Lysin	0.90	0.60	0.60	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Nutrition ingredients					
Metabolism energy	2903.25	2900.00	2914.10	2900.17	2900.16
Crude protein	20.03	20.04	20.02	20.00	20.04
Crude fat	4.80	3.92	3.96	3.98	4.00
Crude fiber	5.73	8.84	8.13	9.04	9.41
Methionine	0.72	0.61	0.60	0.60	0.60
Lysin	1.69	1.39	1.36	1.27	1.26
Arginine	1.28	1.18	1.16	1.14	1.13
Ca	1.48	1.06	1.29	1.16	1.22
P	0.70	0.65	0.61	0.62	0.61
Price	6,637.90	5,490.20	5,423.90	5,226.20	5,111.60

Metabolism Energy (EM) was accounted with Balton formula quoted by Anggorodi (1994)
Non-Nitrogen Extract Material (BETN) = 100-(%Water + Dust + PK + LK + Sk)
Metabolism Energy (EM) = 40.81 {0.87 (PK + 2.25LK + BETN) + 4.9}

Table 3: Weight gain. FCR, finisher weight, IOFC of ducks fed by *Salvinia molesta*

	Treatment				
Parameters	T0	T1	T2	T3	T4
Weight gain	779.19^{a}	864.50^{a}	868.88^{a}	811.88^{a}	862.27^{a}
FCR	7.03^{a}	6.33^{a}	6.30^{a}	6.74^{a}	6.35^{a}
Finisher weight	1588.56^{a}	1626.94^{a}	1612.13^{a}	1549.63^{a}	1598.02^{a}
IOFC	-8483.48^{a}	2230.06^{b}	2468.45^{c}	2162.38^{b}	2387.87^{c}

Description: Different superscripts on the same rows show the actual differences ($p<0.05$)

providing 1,626.94 g of T1. Men *et al.* (2001) stated that the final body weight could be observed from the amount of feed consumption and feed conversion during breeding.

Using *Salvinia* as a non-conventional feed material for *buras* chicken gave good results for weight gain. Usman *et al.* (2005) reported that the profit from using local material in feed rations showed positive responses for *buras* chicken weight gain. The high body weight was supported by the consumption of high amounts of the treatment feed. Rezaei *et al.* (2004) stated that the relation of crude protein and lysine was considered an important factor that influenced the performance and quality of the carcass during the growing period; thus, the need for crude protein was obligatory because of the lysine it contains. Meanwhile, Si *et al.* (2004) reported that giving normal crude protein with a high lysine content could increase the average growth of poultry.

The decreasing price of the ration was because *Salvinia molesta* is an aquatic weed that has few productive uses; thus, its relative economic value was low. The income over feed cost calculation result for the local ducks during the research showed that the addition of *Salvinia molesta* at the 20% level could generate a high income, whereas the control feed could not generate a profit because the total feed cost was very high. Decreasing of the ration price could reduce the outcome cost; thus, the use of SMF could reduce the ration cost. This is compatible with the statement of Bishop and Thousant (1986) that the efficient use of duckweed would reduce the cost of the feed that generates the highest outcome from the production cost. Men *et al.* (2001) stated that the efficiency of the ration price could increase the income by using the *duckweed* ration composition for fattening ducks.

The high IOFC for the treatment feed was because of the high level of *Salvinia* in the feed, which could increase the consumption and feed conversion while reducing the high cost of the feed. This was compatible with the statement of Rasyaf (1995) that gaining an income difference with the high cost was achieved by reducing the ration cost through improvement in administering the ration or choosing the seeds that contained good ration conversion. Sujatha *et al.* (2012) stated that the addition of duckweed of the type *Azolla pinnata* could reduce the total feed cost by 30%. Naghshi *et al.* (2014) reported that the addition of *Azolla pinnata* at the standard 5% level could economically reduce the feed cost, although it did not present other benefits at that level.

Conclusion: Adding 15% SMF to the local duck ration could increase the weight gain and FCR and also the Income Over Feed Cost for IDR Rp. 2,468.65 when compared to the control and other rations.

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