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by Sp_jasa Cek Plagiarisme Wa: 085935293540

Submission date: 26-Aug-2022 01:24AM (UTC-0700)
Submission ID: 1887354631
File name: il_on_Egg_Production_Quality_JONUNS_48_10_2021_Rohaeni_et_al.pdf (839.44K)
Word count: 7757
Character count: 32507

第 48 卷 第 10 期
2021 年 10 月

湖南大学学报（自然科学版）
Journal of Hunan University（Natural Sciences）

Vol. 48 No. 10
October 2021

Open Access Article

Effects of Feeding Alabio Ducks with Fresh Golden Snail on Egg Production and Quality

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Abstract: Alabio ducks (*Anas platyrinchos* Borneo) are a local duck breed from South Kalimantan, Indonesia. High feed cost is a major constraint in duck production. Therefore, many efforts have been conducted to find cheaper feedstuffs, especially protein sources. Golden snail (*Pomacea canaliculata*) is abundantly available in the wetland area of South Kalimantan and causes damages to paddy rice. This research aimed to determine the effects of feeding Alabio ducks with fresh golden snails (FGS) in substituting fish meal (FM) on the egg production and quality. The use of FGS to substitute FM has not been commonly applied; hence, this research will provide an applicable method of golden snail utilization as an alternative protein source in feeding Alabio ducks. Five treatment diets were used, namely 0% FGS + 30% FM; 10%FGS + 20% FM; 20%FGS + 10% FM; 30%FGS + 0% FM; and commercial feed (0% FGS + 0% FM). There were four replications for each treatment and eight ducks in each experimental unit. The experiment was carried out for 18 weeks. Results showed that FGS feeding levels significantly effect the egg production, egg weight, feed intake, feed conversion ratio, nutrients intake, Ca and P intakes, albumen index, yolk index, yolk color, feed economic value, and income over feed cost. However, treatments had no significant effects on metabolizable energy intake and Haugh Unit. This research indicated that 10% FGS feeding in ration containing 20% FM resulted in the best laying performance and economic value of Alabio duck farming. Utilizing the golden snail as a protein source in the diet could improve the production and profit of laying duck farming while environmentally managing the golden snail invasion on paddy fields.

Keywords: Alabio ducks, golden snail, laying duck, egg production, egg quality.

鲜金螺饲喂阿拉比奥鸭对产蛋量及品质的影响

摘要：阿拉比奥鸭（鸭嘴兽婆罗洲）是來自印度尼西亞南加里曼丹的當地鴨品種。高飼料成本是鴨生產的主要製約因素，因此已經進行了許多努力以尋找更便宜的飼料，尤其是蛋白質來源。金蝸牛（桃花心木）在南加里曼丹的濕地地區大量存在，對水稻造成損害。本研究旨在確定用新鮮金蝸牛（FGS）代替魚粉（调频）對阿拉比奧鴨的產量和蛋品質的影響。使用 FGS 代替调频尚未普遍應用；因此，本研究將為阿拉比奧鴨的最佳飼餵量提供替代建議。有五種處理飲食，即 0% FGS + 30%调频； 10%FGS + 20% 調頻； 20%FGS + 10% 調頻；30%FGS + 0% 調頻；和商業飼料（0% FGS + 0%调频）。每個處理有四次重複，每個實驗單元有八隻鴨子。實驗進行了 18 週。結果表明，飼餵 FGS 水平對產蛋量、蛋重、採食量、飼料轉化率、營養素攝入量、鈣和磷的攝入量、白蛋白指數、蛋黃指數、蛋黃顏色、飼料經濟價值和收入超過飼料成本有顯著影響。然而，治療對代謝能攝入和哈夫單位沒有顯著影響。該研究表明，在含有 20%调频的日糧中飼餵 10% FGS 導致阿拉比奧鴨養殖的最佳產蛋性能

Received: June 11, 2021 / Revised: August 9, 2021 / Accepted: September 5, 2021 / Published: October 30, 2021
Fund Project: Indonesian Center for Agricultural Technology Assessment and Development, Indonesian Ministry of Agriculture
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和經濟價值。在飼料中使用金蝸牛作為蛋白質來源可以提高蛋鴨養殖的產量和利潤，同時對稻田的金蝸牛入侵進行環境管理。

关键词：阿拉比奧鴨, 金蝸牛, 蛋鴨, 產蛋量, 蛋質量.

1. Introduction

Alabio ducks are one of the Indonesian duck breeds that originated in the Alabio regions, Hulu Sungai Utara District, South Kalimantan Province, Indonesia. Alabio duck is an excellent local livestock resource that needs to be maintained and developed, especially to supply animal protein sources and livelihoods of small-scale laying duck farmers. However, shifting the production system from extensive to intensive resulting many problems, especially high feed cost that constitutes the bulk expenses in duck farming [1]. Feed cost constitutes 50 to 80% of the total production cost in duck farming [2], [3]. Many efforts have been carried out to find non-conventional feedstuffs and improve feeding management to reduce feed costs. Local feed as non-conventional feedstuffs could be an alternative source of cheaper feedstuffs [4]-[6].

One of the locally available protein sources for duck's diet is the golden snail. Golden snail (*Pomaceacanaliculata*) is a pest for plants, especially paddy rice, but it contains high protein and can be used as feedstuffs for livestock [7]. As reported in [8], golden snails are still abundantly available in South Kalimantan province. Snails are often found in paddy fields or wetland areas. [9] stated that the potency of snails as feed material for ducks in tidal swamp areas is as much as 140,618.4 tons of dry matter (DM), which could provide feed for as much as 25.57 million ducks. It is estimated that a tidal swamp area could produce 34,076.3 tons of golden snail, equivalent to feeding 6.19 million ducks.

According to [10], the golden snail is a good source of animal feed due to high protein content that could substitute fish meal in the ration. The nutrient content of fresh golden snail flesh is 10.45% crude protein, 0.37% fat, and 1.74% ash [11]. Golden snails have the potential as a protein source in the diet as the crude protein content (CP) of golden snails powder ranges from 16-50%. In addition, golden snails contain omega fatty acids 3, 6, and 9. According to[12], snails have good macro and micro mineral content, which are beneficial for health.

As found in [13], ducks could play a significant role in biological control when herded in the paddy field. A recommended number of ducks, according to this research, is about 5-10 duck/ha which could decrease the number of snails drastically. The same experience showed in the Local Collaborative Program in Bali that the integration between paddy and duck could reduce the cost of purchasing pesticides and extra benefit by providing golden snail as feed for the duck. Ducks received golden snails in ration have laying period of up to 5 months, and farmers could get extra income from selling eggs ranging from IDR. 189,000/month to IDR. 315,000/month [14].

Conventional protein sources have a high price and tend to increase over the years. Thus, it is necessary to look for alternative feedstuffs which are easily obtained at low prices and have a high protein content [15]. Previous research reported that golden snails have high protein content that meets the requirement for laying duck [16]. In addition, the egg of golden snails contains a carotenoid pigment, namely xanthophyll, which is beneficial for yolk color [17]. Therefore, golden snails can be used as an alternative protein source to increase egg production of laying duck. Protein is useful to replace cells of the body that have been damaged for growth and is also a precursor for egg synthesis. Protein requirements in poultry are influenced by age, growth rate, reproduction, climate, energy requirement, disease, and breed [18].

The possibility of golden snails' utilization as feedstuffs is also based on their abundant availability, and it is a troublesome plant pest. According to [14], the golden snail is a major pest in the paddy field, and it has not been found effective ways to control it. A golden snail could decrease rice production by 16-40%. The utilization of golden snails in the diet for duck is an effective and efficient way of pest management for sustainable agriculture [19].

Several previous research has been conducted to use Golden snail flesh powder in the ration for laying duck [7], [11]-[12]. However, the use of golden snail powder in the diet is not applicable for small farmers due to the high cost of processing snail flesh into powder. In the Philippines, fresh golden snail was reported to improve duck performance and profit [10]. Therefore, this experiment is objected to studying the effects of substitution of fish meal with fresh golden snail on egg production and quality and its economic value.

2. Materials and Methods

2.1. Materials

This study was conducted in Teluk Baru Village, Amuntai Selatan Sub-district, Hulu Sungai Utara District, South Kalimantan Province, Indonesia. The

study was carried out 18 weeks using 160 Alabio ducks grouped in five treatments and four replications. Thus, there were eight ducks in each experimental unit.

2.2. Feeding Experiment

The treatment included fresh Golden snail (FGS) to substitute fish meal (FM) in the diet. Treatment diets were as follows:

T1: 0% FGS and 30% FM
T2: 10% FGS and 20% FM
T3: 20% FGS and 10% FM
T4: 30% FGS and 0% FM
T5: Commercial diet (0% FGS and 0% FM)

The experiment was carried out for 18 weeks. Feed was offered 250 g/head/d in two feeding times (morning and afternoon). Feed refusal was collected and weighed the next day before morning feeding. Water was offered *ad libitum*. Feed ingredients and nutrient composition of treatment diets are described in Table 1.

Table 1 Feed ingredient and nutrient composition of experimental diet

	Treatment diet (%)				
Feed Ingredient	**T1**	**T2**	**T3**	**T4**	**T5**
Bran	30.0	30.0	30.0	30.0	0.0
Whole rice grain	8.5	8.5	8.5	8.5	0.0
Commercial feed	30.0	30.0	30.0	30.0	100
Fresh Golden snails	0.0	10.0	20.0	30.0	0.0
Fish meal	30.0	20.0	30.0	0.00	0.0
Mixed Lys + Met	0.50	0.50	0.50	0.50	0.0
Mineral	0.50	0.50	0.50	0.50	0.0
Grit	0.50	0.50	0.50	0.50	0.0
Total amount	100	100	100	100	100
Nutrient Contents (in dry matter):					
Metabolizable Energy (kcal/kg)	3015	3089	3163	3236	2800
Crude protein (%)	20.2	21.83	23.5	25.1	18.0
Fat (%)	8.04	7.60	7.16	6.71	5.00
Crude Fiber (%)	6.34	6.18	6.02	5.87	5.00
Calcium (%)	2.94	3.21	3.47	3.74	3.00
Phosphorus (%)	1.20	1.55	1.89	2.24	1.00
Price (IDR/kg)	5635	5535	5435	5335	7500

2.3. Observed Variables

The observed variables were egg production, egg weight, feed intake, feed conversion ratio (FCR), crude protein intake, calcium intake, phosphorus intake, fat intake, crude fiber intake, energy metabolism, Haugh Unit (HU), Albumen Index (EAI), Yolk Index (EYI), level of yolk color, feed economic value, and income over feed cost (IOFC).

Feed intake was calculated daily, while feed and feed refusal samples were composited and stored in the freezer before proximate analysis. Egg production was observed from weeks fifth to eighteenth. Egg quality was determined from egg samples collected in the last week of the experiment.

The variables for the internal quality of eggs were Haugh Unit (HU), Egg Albumen Index (EAI), and Egg Yolk Index (EYI). HU is calculated based on the formula: $HU = 100 \log (H + 7.57 - 1.5^{W0.37})$, where

H = height of albumen (mm); W = egg weight (g).

EAI is calculated according to [20] as follows:

$$EAI = \frac{Albumen\ Height}{1/2\,(the\ Widht\ + the\ Lenghtof\ Albumen)}$$

EYI is calculated according to [20] as follows:

$$EYI = \frac{Yolk\ height}{Yolk\ diameter}$$

Egg yolk color was measured using a yolk color fan with a scale of 3-14. The economic value of feed (EV) and the income over feed cost (IOFC) were calculated as follows:

$$EV = Feed\ conversion \times Feed\ price\ (\frac{IDR}{kg})$$

$$IOFC = Egg\ selling\ income - feed\ cost$$

2.4. Data Analysis

The data were statistically analyzed using analysis of variance with a completely randomized research design (one-way ANOVA). Differences between mean were tested by Duncan's multiple range test. All statistical analyses were performed using SPSS 22.0 (IBM, USA).

3. Results and Discussion

3.1. Egg Weight and Production

This research showed that feeding with fresh Golden snails had a significant effect ($P < 0.05$) on egg production, egg weight, feed intake, FCR, crude protein intake, calcium intake, phosphorus intake, fat intake, crude fiber intake, and egg yolk color. On the other hand, the treatment did not affect metabolism energy, EAI, EYI, and HU.

Table 2 shows the highest egg production resulting from the T2 that was not significantly different from T1 and T3. This difference indicated that FGS feeding up to 20% of the diet increases egg production. According to [7], the protein content of diet significantly influenced daily egg production. However, this study found the inclusion of fresh golden snail exceeding 20% decreased egg production, which was assumed that there was a restricted factor (anti-nutrient) contained in golden snail flesh such as thiaminase [21].

Thiaminase is a destructive factor for thiamin or vitamin B1 that affects growth and productivity in poultry. Thiamin deficiency in livestock causes decreases in egg production and animal growth [4].

Table 2 Effects of feeding fresh golden snail on egg weight and production

	Treatment diet						
Variables	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	***P***
Egg production (%)	69.8^{ab}	72.3^{a}	65.5^{ab}	61.4^{b}	45.71^{c}	2.47	0.00
Egg weight (g)	66.9^{a}	67.2^{a}	67.3^{a}	63.9^{b}	62.6^{b}	64.48	0.00

Notes: SEM - standard error of the mean
$^{a, b, c}$ Means with different superscripts in the same row are statistically different

Diet T1 produced eggs that were not significantly different from T2 and T3). T1 is a diet containing 0% FGS and 30% FM. This research indicated there is no significant difference in egg production by replacing FM with FGS. As stated in [7], egg production efficiency can be achieved if the intake ratio meets the nutritional requirements standards. The protein content in the treatment diet was higher than the recommendation (18%).

Furthermore, [7] reported that feeding with snails as much as 20% resulted in the highest egg production and egg weight compared to other treatments. However, the substitution of FM with FGS reduced the feed cost. Thus the T2 and T3 diets were more affordable by small farmers. It is necessary to look for alternative feedstuffs that are easily obtained at low prices and have high protein content [15]. It was shown that the utilization of golden snails as feed is a non-chemically way of controlling snail pests and an opportunity for selling Golden snails as non-conventional poultry feed.

This study shows T3 diet produced the heaviest egg, but it was not different with T1 and T2. Heavier egg in the T1, T2, and T3 diet is probably caused by protein and amino acid supplies from golden snails. Protein is the most important factor in the feed that affects egg weight, especially the content of amino acids because more than 50% of the dry weight of eggs is protein [11]. Research by [22] showed that laying duck performance and egg quality are not affected by the interaction of cassava leaves powder and golden snail powder. Their study indicated that the combination of 10% cassava leaves powder and 5% golden snails powder in the diet result in the best laying duck performance and egg quality. Likewise, [23] explains that the factor affecting egg weight related to egg production is the protein content in golden snails. The effects of treatment on egg weight were similar to egg production. According to [24], egg weight is influenced by egg size, while egg size is influenced by body size, physiological state, climate, the availability of feed and nutrients, and other factors. There is also an enormous range in egg size among different species and within the species between individuals.

3.2. Feed Intake and Feed Conversion Ratio

The lowest feed intake resulted from ducks fed T2, then T4, and T1, while the T5 diet had the highest feed intake, indicating that the T5 diet was significantly different from the other four treatment diets (Table 3). However, the T5 diet resulted in the highest or less efficient conversion value. The lowest feed intake was observed from the T2 diet, but this diet had the most efficient feed conversion. This study indicated the commercial feed (T5) had fewer nutrients to meet the requirement for production; thus, instinctively, the ducks consumed more feed to meet those needs.

The T5 diet contained the lowest nutrients (energy and protein) based on feed formulation compared to T1, T2, T3, and T4. According to [25], feed intake is largely determined by the protein content in feed because it is closely related to the proportion of essential amino acid availability needed by livestock. Feed intake increases when the ambient temperature is low, and vice versa will decrease when the ambient temperature is high. Feed intake is influenced by the palatability of the feed, but the palatability is also influenced by the presence of anti-nutrients in the feed.

3.3. Energy and Protein Intakes

The levels of FGS in the diet had no significant effect on energy intake, whereas the highest energy intake was observed in T3 (20% FGS) (Table 3). It is presumably because there was no significant difference in the energy content among treatment diets. Nutrient intake is largely influenced by feed consumption. Higher feed intake leads to higher nutrient consumption. The nutrients will be absorbed and metabolized in the body for duck production and balance energy and protein content.

Table 3 Effects of feeding with fresh golden snail on feed and nutrients intakes

	Treatment diet						
Variables	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	***P***
Feed intake (g)	217.8^{b}	207.5^{b}	221.6^{ab}	213.7^{b}	236.1^{a}	3.16	0.03
FCR	3.25^{b}	3.09^{b}	3.29^{b}	3.34^{b}	3.77^{a}	0.06	0.00
ME intake (Kcal/g)	656.7	641.0	700.9	691.5	661.2	8.63	0.13
CP intake (g)	44.0^{b}	45.3^{b}	52.1^{a}	53.6^{a}	42.5^{b}	1.14	0.00
EE intake (g)	17.5^{a}	15.8^{c}	15.9^{b}	14.3^{c}	11.8^{d}	0.47	0.00
CF intake (g)	13.8^{a}	12.8^{abc}	13.3^{ab}	12.5^{bc}	11.8^{c}	0.21	0.00
Ca intake (g)	6.40^{c}	6.66^{bc}	7.69^{a}	7.99^{a}	7.08^{b}	0.16	0.00
P intake (g)	2.61^{d}	3.21^{c}	4.19^{b}	4.78^{a}	2.36^{d}	0.22	0.00

Notes: FCR - feed conversion ratio; ME - metabolizable energy; CP

- crude protein; EE - extract ether; CF - crude fiber; SEM - standard error of the mean
[a, b, c, d] Means with different superscripts in the same row are statistically different

The use of FGS in the diet significantly affected protein intake. The highest protein intake was found in T4 (30% FGS). This study showed protein intake increased along with the increasing use of Golden snails in the diet. However, there was no difference among T1, T2, and T5 and between T3 and T4 diets. This was caused by higher protein content in T3 and T4 diets, so the protein intake was also high. Factors influencing protein intake are ration intake, live weight, temperature, and humidity. High ration intake will be followed by an increase in protein intake to meet the amino acid requirements of the chicken. In addition, protein intake is influenced by several factors, including live weight, age, physiological phase, temperature, ration protein content, and ration intake. Furthermore, [26] suggested that higher feed intake will result in higher protein intake that affects Alabio duck performance.

3.4. Calcium and Phosphor Intakes

Calcium intake increased corresponded with the increase of FGS levels in the diet (Table 3). The increase in calcium intake is due to the increase of potassium content in the diet. This study showed no difference between T1 and T2 diets, but a significant difference was found between T3 and T4 diets. The highest intake of calcium in the T4 diet was due to the high content of calcium in the diet as golden snail was given freshly after being ground so that containing snail shell. According to [10], golden snails contain quite high calcium, around 3-4%. As recommended in [27], calcium needs for laying ducks ranged from 2.90 to 3.25%. The calcium content of the feed is directly related to the quality of eggs, mainly egg weight, and shell thickness. The intake of phosphorus also increased along with the increased levels of FGS in the diet. The highest intake was in the T4 treatment (30% FGS) ($P < 0.01$). It was presumably due to the high phosphorus content in the T4 diet as the diet contains the highest levels mix of fresh golden snails and their shells.

3.5. Egg Internal Quality

Variables for determining internal egg quality, including EYI, EAI, and HU, were not affected by treatment (Table 4). Research by [28] reported a similar result that feed treatment did not affect EYI, EAI, and HU values. Likewise, [11] found that adding 9% golden snail powder did not affect the EYI, EAI, and HU values.

EAI value in this study ranged from 0.11-0.12; this value was considered normal because it was in the range of 0.05-0.17 [29]. This study also corresponded with the research reported by [30] that normal AI values of duck's egg are between 0.10-0.13.

Table 4 Effects of feeding with fresh golden snail on internal egg quality

	Treatment diet						
Variables	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	***P***
EAI	0.11	0.12	0.12	0.12	0.12	0.001	0.57
EYI	0.41	0.41	0.42	0.42	0.42	0.002	0.55
HU	76.45	77.18	76.56	78.35	79.33	0.588	0.51
Yolk colour	5.56[c]	6.72[b]	7.64[a]	8.00[a]	6.60[b]	0.212	0.00

Notes: EAI - egg albumin index; EYI - egg yolk index; HU - Haugh unit; SEM - standard error of mean
[a, b, c] Means with different superscripts in the same row are statistically different

EYI value in this study (0.41-0.42) was in the normal range, according to [29], who set the range for the normal duck egg yolk index from 0.36 to 0.50 with an average of 0.42 that in agreement with [25] that found EYI of egg stored in 2-44°C is ranging from 0.38 to 0.45. Another study on Magelang ducks obtained EYI values between 0.38-0.46 [26]. According to [11] and [26], the EYI and HU are influenced by the protein content in the diet. Higher protein content in the diet will increase YI, EAI, and HU values.

According to [31], in a longer stored egg period, albumin will decrease in its height. Likewise, the longer the stored period will decrease egg weight. During storage, there is an increase in pH, and a complex ovomucin-lysozyme bonding will occur, which results in the release of water from the ovomucin nets so that the albumen becomes watery. As stated in [32], the protein content in the feed affects the viscosity of the albumen, which wraps egg yolk. Amino acid (methionine) is a nutrient needed to form the albumen structure and ovomucin nets. The more and stronger the ovomucin nets, the thicker the albumen will be so that the viscosity of the albumen will also be higher.

The HU values observed in this study ranged from 76.45-79.33, which was included in a good quality egg. These HU values are similar to the result of [6] that obtain the HU value for Alabio duck is 78.06.

According to [32], the criterion for good egg quality was an HU value of 75, while the poor quality of egg had an HU value below 50. Eggs that were not well preserved would experience a fast change in HU. The HU value was influenced by egg age, storage temperature, age of poultry, and strain of poultry. The albumen height and the HU value decreased along with the longer storage period, and the high storage temperature could decrease the HU value [31]. Results of this study agree with [16] that feeding with golden snail flour has no significant effects on EAI, EYI, and HU, but it affects yolk color.

This study showed that egg yolk color was influenced by treatment (Table 4). The best or preferred egg yolk color is the reddish/orange-yellow, produced from ducks fed T3 (20% golden snail) and T4 (30% golden snail) diets. Results of this study indicated that the higher levels of golden snails would improve egg yolk colour. As stated in [33], people generally preferred duck eggs with orange yolk, which indicates a high content of xanthophyll and carotenoids. The feed contains high carotene, namely xanthophyll, which will result in a more reddish-orange yolk color [34]. According to [35], yolk color is influenced by carotenoids in the form of carotene and xanthophyll. Research of [36] showed that golden snails contain astaxanthin pigment. Astaxanthin is a carotenoid compound in the xanthophyll group. This carotenoid pigment is beneficial for health since it has antioxidant activity. Golden snail contains xanthophyll [16] that influences yolk color [17].

3.6. The Economic Value of Feed

The economic analysis showed that the treatment significantly affects the FEV and IOFC (Table 5). The higher the value of economic feed means the feed is less efficient. There was no significant difference in FED values among treatment diets. IOFC calculations and analysis showed that T1, T2, T3, and T4 had positive IOFC values, but these were not significantly different. On the other hand, T5 (commercial diet) had a negative IOFC value or did not provide a profit. However, it appeared that T2 provided the most economical value and the highest IOFC value. This study urged that feeding with 100% commercial feed without being mixed with local feedstuffs is not economically feasible for duck farming. These results also indicated that the economic value of feed and IOFC corresponded to other laying performances of ducks. This study agrees with the results of [16] that 10% golden snail powder in ducks' diet had the best effects on egg weight, eggshell quality, EAI, EYI, and yolk colour.

Table 5 Economic analysis of feeding with fresh golden snail to laying duck

	Treatment diet						
Variables	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	***P***
FEV (IDR)	18,342^{b}	17,103^{b}	17,921^{b}	17,846^{b}	28,294^{a}	3.7 $X10^{8}$	0.00
IOFC (IDR)	239,638^{b}	373,707^{b}	172,915^{b}	150,800^{b}	-817,355^{a}	4.1 $X10^{12}$	0.00

Notes: FEV - feed economic value; IOFC - income over feed cost; IDR - Indonesian rupiah; SEM - standard error of mean
$^{a, b}$ with different superscripts in the same row are statistically different

3.7. Opportunity and Limitation

Kalimantan has a large wetland area, for example, in Hulu Sungai Utara district, where Alabio ducks were initially developed, there is 84,556 Ha of wetland area that suitable for paddy rice and duck farming. However, according to [9], golden snails' invasion paddies rice every year. [37] estimated there are 12 golden snails per m^2 that equivalent to 0.52 kg per m^2. Thus, the estimated result was 8,996,758.4 tons of golden snail dry matter from cultivated land for paddy fields in the district. Therefore, utilizing the golden snail as a non-conventional protein source in the diet for duck will be a sustainable way of pest management while increasing duck production and farm profitability.

However, golden snails are not continuously available throughout the year. The golden snail population declines or is hardly found in the dried swamp area in the dry season. Because the golden snail is hiding under the dry land surface and being dormant, the golden snail will wake up and reproduce in the rainy season. The inconsistent supply of golden snail will be a disadvantage for duck farmers because changing the diet formulation will negatively affect duck performance.

4. Conclusion

The use of fresh golden snails has not been widely applied as a substitution for fish meal in the duck diet. Previous research mostly used dry or powder of golden snail flesh. However, those have not been adopted by farmers because less applicable. This research shows that feeding with fresh golden snails has improved the laying performance and egg quality of Alabio duck. Furthermore, fresh golden snail could substitute fish meal up to 10% in the diet. However, the fresh golden snail is not available throughout the year. Thus, the inclusion of fresh golden snail is only possible in the rainy season. As golden snail is abundantly available and a pest for rice farming, fresh golden snails as a feed ingredient for Alabio duck can be the best solution for sustainable farming of egg and rice production in Indonesia.

Acknowledgments

The authors would like to thank the Indonesian Center for Agricultural Technology Assessment and Development, the Indonesian Ministry of Agriculture for funding this research.

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