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Effect of duck hatchery waste supplementation as an alternative protein source on growth performance, and income over feed cost of hybrid ducks

Abdul Ghoni[1], Muhammad F. Hanif[2], Heru Sasongko[3], Bambang Ariyadi[3*]

[1]*Undergraduate School, Faculty of Animal Science, Universitas Gadjah Mada, Special Region of Yogyakarta, 55281, Indonesia.*
[2]*Graduate School, Faculty of Animal Science, Universitas Gadjah Mada, Special Region of Yogyakarta, 55281, Indonesia.*
[3]*Department of Animal Production, Faculty of Animal Science, Universitas Gadjah Mada, Special Region of Yogyakarta 55281, Indonesia.*

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***Correspondence:**

Corresponding author: Bambang Ariyadi
E-mail address: bambang.ariyadi@ugm.ac.id

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ABSTRACT

Duck hatchery waste is an alternative feed ingredient for protein sources in poultry. This study aimed to determine the effect of duck hatchery waste supplementation on growth performance, and income over feed cost of hybrid ducks. A total of 120-day-old male hybrid ducks (body weight: 61.4±4.9g) were randomly divided into three treatments (4 replicates per treatment, 10 ducks per replicate). At 0-14 days of age, ducks were fed the same complete feed in all treatments. After 14 days of age, ducks were fed an experimental diet until 35 days of age. The treatment feed consists of a basal diet (P0), basal diet with 8% hatchery waste (P1), and basal diet with 16% hatchery waste (P2). Supplementation of 8% and 16% duck hatchery waste increased accumulated feed consumption and body weight gain of hybrid ducks on day 35 ($P<0.05$). However, feeding duck hatchery waste did not affect the feed conversion ratio of hybrid ducks on week 5. In contrast, supplementation of duck hatchery waste decreased the FCR of hybrid ducks at weeks 3 and 4. Furthermore, the inclusion of duck hatchery waste in the duck diet increased revenue generation from duck sales and increased the IOFC value. In conclusion, supplementation of duck hatchery waste can increase feed intake and body weight gain, duck sales and IOFC value of hybrid ducks.

Introduction

Duck is one of the poultry that is favored by many people. The world's duck population is largely influenced by Asia. There are a lot of ducks in Asian nations like Bangladesh, China, Vietnam, Indonesia, and Malaysia. With 40.5% of all poultry produced from ducks, Cambodia is the country with the highest duck density in the world, with 438.8 ducks per square kilometer. Bangladesh is the least duck-dense country in the world. Between 1961 and 2019, the number of ducks worldwide rose sixfold to 1177.4 million heads (Jalaludeen and Churchil, 2022). Based on data from the Badan Pusat Statistik (2022) the total duck population in Indonesia in 2020 was 56,569,977 heads, in 2021 it was 56,569,983 heads, and in 2022 it was 58,351,458 heads. This indicates that the duck population in Indonesia has increased every year. Feed ingredients contribute a large proportion of duck production costs. In Indonesia, most feed ingredients have to be imported from other countries. As a result of these conditions, the availability and price of poultry feed often fluctuate (Setiadi *et al*., 2021).

Poultry hatchery waste is a type of alternative feed ingredient often used in poultry feed nowadays (Abiola and Onunkwor, 2004; Mehdipour *et al*., 2009; Suleiman *et al*., 2014; Mahmud *et al*., 2015). The poultry industry produces large amounts of hatchery waste which includes solid waste and wastewater. The solid hatchery waste comprises empty shells, infertile eggs, dead embryos, late hatchings and dead chickens, and a viscous liquid from eggs and decaying tissue (Glatz *et al*., 2011). According to Sharara *et al*. (1992), hatchery waste contains 43–71% moisture, 33.1% protein, 29.0% ether extract, 12.1% crude fiber, 21.5% ash, and 28.8 MJ/kg of gross energy. Similarly, Ilian and Salman (1986) reported that hatchery waste contained 22.8% crude protein 21.48% true protein, 22.64% Ca, and 2706 kcal kg− metabolisable energy.

According to Mehdipour's (2009) findings, there was no discernible variation in the body weight of broiler groups given (0%, 1.5%, 3%, and 4.5%) hatchery waste meal throughout the entire experimental period. This pertains to the usage of hatchery waste in broilers. In contrast, over the course of the entire trial, the authors noted notable variations in feed intake and feed conversion ratio. Significant variations in the body weight increase of broilers fed 0% and 10% were observed by Abiola and Onunkwor (2004). However, there has been no research on the utilization of duck hatchery waste as duck feed ingredients. this study aims to determine the effect of duck hatchery waste supplementation on growth performance and economic analysis of hybrid ducks.

Materials and methods

Ethical clearance and study location

The Experiment received prior authorization from the Ethical Commission from the Faculty of Veterinary Medicine, Universitas Gadjah Mada, Indonesia with No: 98/EC-FKH/Eks/2023. Duck rearing was conducted from January to February 2024 at the duck barn of CV. Istana Meri Farm, Lumajang Subdistrict, East Java District, Indonesia.

Preparation of duck hatchery waste

Duck egg-hatching waste consists of eggshells, infertile eggs, dead embryos, late-hatched ducks, and viscous liquid from eggs obtained from CV. Istana Meri Farm duck hatchery, Lumajang Subdistrict, East Java District, Indonesia. The waste was boiled at 100°C for 45 minutes and then drained for 60 minutes. The drained hatchery waste was then crushed, spread on trays, and dried in an oven at 60°C for 24 hours. After drying, the material was ground using a grinder to reduce the particle size to small and facilitate the mixing process. The preparation of duck hatchery waste was presented in Figure 1.

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A B C D

Fig. 1. A.) Collection of unhatched eggs, B.) Boiling process of duck hatchery waste, C.) Mixing process of feed ingredients and duck hatchery waste, D.) Feeding treatment for hybrid ducks.

Ducks, diet, and housing

A total of 120-day-old male hybrid ducks (body weight: 61.4 g ± 4.9) were randomly divided into three treatments, each treatment consisted of four replicates of 10 ducks. Ducks aged 0-14 days were fed with commercial complete feed from PT Sreeya Sewu Indonesia (crude protein, crude fat, crude fiber, calcium, phosphorus, and energy metabolism of 22%, 3%, 5%, 0.80-1.20%, 0.60%, and 3000 kcal/kg, respectively). After 14 days of age, ducks were fed an experimental diet until 35 days of age. The treatment feed consists of a basal diet (P0), basal diet with 8% hatchery waste (P1), and basal diet with 16% hatchery waste (P2). Duck feed was formulated based on the standard nutrient requirements of ducks following SNI 8508-2018 (SNI, 2018). The formulation and chemical composition of the feed are presented in Table 1. This study was conducted by feeding ad libitum in stages twice at 06:00 and 16:00 WIB. Drinking is given ad libitum which is replaced every day. Duck maintenance was carried out in a research cage consisting of 12 plots with an open-house system. The size of each plot was 1.5x1.5 m. Each plot was equipped with 1 feeder and 1 drinker.

Table 1. Nutrient composition of grower-finisher duck diets.

Ingredient (%)	Treatment		
	P0	P1	P2
Rice bran	70	67	64
High protein concentrate[1]	30	25	20
Duck hatchery waste	0	8	16
Total	100	100	100
Nutrient Composition			
Gross energy (kcal/g)	3817	3787	3669
Crude protein (%)	18.34	18.59	19.2
Crude fat (%)	9.02	10.39	11.98
Crude fiber (%)	8.57	8.03	7.49
Calcium (%)	3.73	3.85	3.54
Phosphor (%)	1.09	1.18	1.21

[1]Commercial high protein concentrate provided moisture 12%, crude protein 36%, ether extract 2%, crude fiber 8%, calcium 11%, total phosphor 1.2%, lysine 2 %, methionine 1.2%, methionine+cysteine 1.6% and tryptophan 0.35%. concentrate is composed of fish meal, soybean meal, meat bone meal, wheat crumbs, and leaves meal.

Feed intake, body weight gain and feed conversion ratio

Feed consumption was obtained by calculating the difference between the feed given and the remaining feed for one week in each replicate. The total amount of feed obtained for one week was divided by the number of ducks in each replicate to obtain the weekly average feed consumption per duck in each week. The result of feed consumption is the summation of feed consumption every week per duckling in one rearing period (g/duck). Body weight was obtained by weighing ducks every week. Body weight gain was obtained by calculating the difference between the final week's body weight minus the previous week's body weight in each replication. Feed conversion ratio was obtained by calculating the ratio between feed consumption and body weight gain every week per replicate in one period.

Income over feed cost (IOFC)

IOFC is the result of calculations by comparing the average revenue from duck sales and the total expenditure costs for feed and day-old-duck.

Statistical analysis

The data obtained were analysed by analysis of variance (ANOVA) based on a Randomized Complete Block Design. If there is a significant difference, the mean difference test is continued with the Duncan Multiple Range Test (DMRT) using the Statistical Product and Service Solution (SPSS) version 26.0 program.

Results

Feed intake

Feed consumption of hybrid ducks at day 35 was presented in Table 2. Supplementation of 8% and 16% duck hatchery waste increased accumulated feed consumption on day 35 ($P<0.05$). However, feed consumption per week showed an increasing trend in feed consumption in the hatchery waste supplementation group in weeks 3 and 4 ($P<0.10$, Figure 2).

Table 2. Effect of duck hatchery waste supplementation on productivity of hybrid duck at day 35.

Variables	Treatment group			SEM	*p-value*
	P0	P1	P2		
Feed intake (g/duck)	3129[b]	3361[a]	3422[a]	50.6	0.04
Body weight gain (g)	1139[c]	1226[b]	1320[a]	22.4	0
Feed conversion ratio	2.74	2.74	2.59	0.03	0.12

P0, control or basal diet; P1, Basal diet with 8% duck hatchery waste supplementation; P2, Basal diet with 16% duck hatchery waste supplementation

[abc] Means in the same row without common letters are different at $P<0.05$

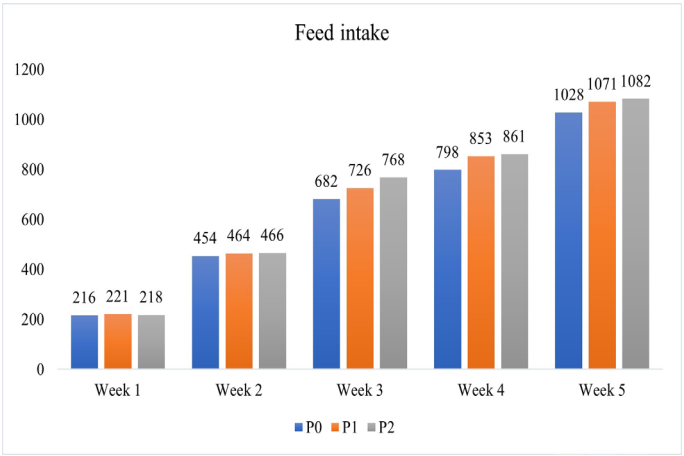

Figure 2. Effect of duck hatchery waste supplementation on feed intake of hybrid duck (g/duck/week).

Body weight gain

Body weight gain of hybrid ducks on day 35 was presented in Table 3. Feeding 8% and 16% duck hatchery waste improved body weight gain of hybrid duck at day 35 (P<0.001). Furthermore, the supplementation of 8% and 16% duck hatchery waste increased body weight gain at weeks 3, and 4 (P<0.01, Figure 3). The increasing inclusion of duck hatchery waste in the duck diet significantly increased the weight gain of ducks at week 5 (P<0.001).

Table 3. Effect of duck hatchery waste supplementation on income over feed duck cost at day 35.

Variable	Treatment group			SEM	*p-value*
	P0	P1	P2		
Total feed cost (IDR)	21741	20552	19322	330	0.05
Total cost (IDR)	29894	29608	28078	330	0.05
Duck sales (IDR)	35927[c]	38628[b]	41540[a]	693	0
IOFC value	6032[c]	9018[b]	1346[a]	910	0

P0, control or basal diet; P1, Basal diet with 8% duck hatchery waste supplementation; P2, Basal diet with 16% duck hatchery waste supplementation
[abc] Means in the same row without common letters are different at P<0.05

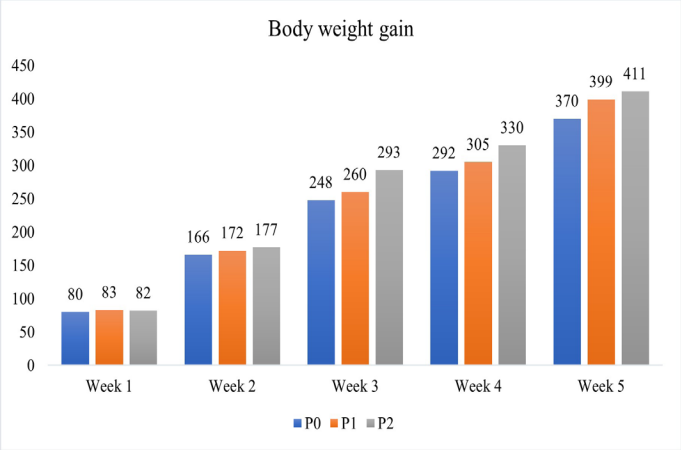

Figure 3. Effect of duck hatchery waste supplementation on body weight gain of hybrid duck (g/duck/week).

Feed conversion ratio

The results of feed conversion ratio of hybrid ducks on day 35 was presented in Table 4. The inclusion of duck hatchery waste did not affect the feed conversion ratio of hybrid ducks on day 35 (P>0.05). At week 3, supplementation of 8% duck hatchery waste decreased the FCR of hybrid ducks (P<0.01, Figure 4). Moreover, the inclusion of 8% and 16% duck hatchery waste reduced the FCR of hybrid ducks (P<0.01).

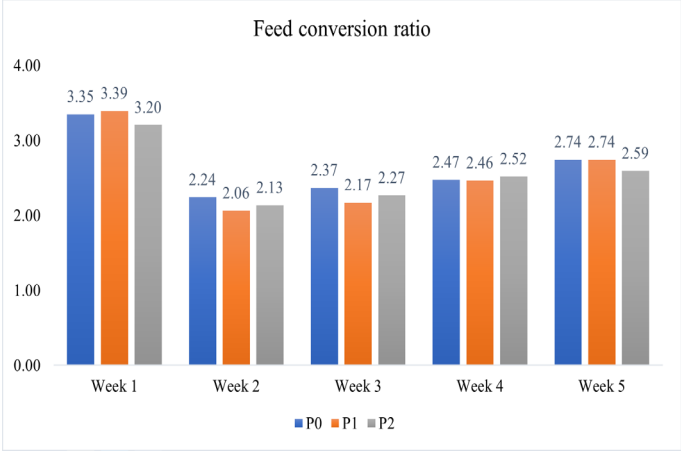

Figure 4. Effect of duck hatchery waste supplementation on feed conversion ratio of hybrid duck..

Income over feed duck cost (IOFC)

Supplementation of duck hatchery waste tends to reduce feed costs as well as total costs (P=0.01, Table 3). However, the inclusion of duck hatchery waste in the duck diet increased revenue generation from duck sales and increased the IOFC value (P<0.001).

Discussion

Supplementation of duck hatchery waste increases feed intake of hybrid ducks. Research by Mehdipour *et al.* (2009) showed that inclusion of 4.5% hatchery waste increased feed intake of broilers. In contrast, hatchery waste supplementation did not affect broiler feed intake (Rasool *et al.*, 1999; Agunbiade *et al.*, 2011; Suleiman *et al.*, 2024). Dietary energy can contribute to duck consumption. Hatchery waste supplementation lowers the gross energy content of the diet. Wu *et al.* (2019) explained that the metabolic energy content of feed influences the level of feed consumption, feed containing low metabolic energy will cause an increase in feed consumption by livestock. The higher the metabolic energy contained in the feed, the less feed consumed by livestock, on the other hand, the level of feed consumption will increase when the metabolic energy contained is lower (Saelan and Nurdin, 2018).

In this study, inclusion of duck hatchery waste increases duck body weight gain. Razak *et al.* (2016) suggest that a high level of feed consumption will result in high consumption of feed nutrients resulting in optimal growth, the implication is an increase in body weight and vice versa. Body weight gain indicates that nutrients consumed by ducks are efficient enough and can be absorbed for use in growth. Protein in hatchery waste has a high biological value and digestibility as well as a good amino acid balance that increases the growth rate (Lilburn *et al.*, 1997; Khan and Bhatti 2002). Rasool *et al.* (1999) found that broiler chickens fed 12% hatchery waste meal had significantly higher body weight gain compared to chickens fed the same amount of fish meal. The protein and fat content in infertile egg meal plays a role in the development of the poultry digestive tract so that the absorption of nutrients takes place optimally (Ratriyanto *et al.*, 2020). Allama *et al.* (2012) stated that the main factor affecting body weight gain is the content of food substances and nutrients in feed, especially the content of energy and protein.

Furthermore, feeding of duck hatchery waste did not affect the feed conversion ratio of hybrid ducks on week 5. However, supplementation of duck hatchery waste decreased the FCR of hybrid ducks at week 3 and 4. Daud *et al.* (2020) reported that ration conversion is a benchmark for assessing how much ration is consumed to produce body weight. The smaller the ration conversion rate indicates the more efficiency in the use of rations. Surya *et al.* (2021) stated that broiler hybrid ducks fed commercial feed until 5 weeks old produced an average ration conversion of 2.13. Anggitasari *et al.* (2016) feed conversion is influenced by metabolic energy, food substances contained in feed, genetics, maintenance management and the environment.

Income over feed cost is an important parameter that can economically illustrate the profitability and efficiency of each feed treatment. The IOFC value is calculated based on the income or revenue obtained from the sale of ducks (per live weight (kg)) minus the costs incurred for feed and DOD as an indicator that can determine the economic value of hybrid ducks raised. Muchlis *et al.* (2021) state that IOFC can be said to be an assessment parameter to see the amount of income that farmers can generate from the feed costs that have been incurred. The feed cost per kg at the time of the study was P0, P1, and P2 at IDR. 6,838, IDR. 6,279, and IDR. 5,720, respectively. Feed costs were obtained by multiplying feed consumption (kg) by the price of feed per kg. The cost of day-old duck (DOD) hybrid ducks from CV Istana Meri Farm at the time of the study was IDR. 8,500.

In this study, duck hatchery waste supplementation did not affect feed cost and total cost. Duck sales were income received from the har-

vest of ducks, duck sales were obtained by multiplying the treatment body weight by the price of ducks per kg at harvest time. The price of ducks (per kg live) at the time of the study was IDR. 30,000. Feeding dietary duck hatchery waste supplementation improved income from duck sales. The highest duck sales were in the P2 treatment, while the lowest duck sales were in the P0 treatment. inclusion of duck hatchery waste also increases the IOFC value of hybrid ducks. Noferdiman *et al*. (2018) explain that factors that can affect the IOFC value are body weight, the amount of feed consumed, and the amount of feed costs.

Conclusion

Supplementation of duck hatchery waste can increase feed intake and increase the body weight of hybrid ducks. This has led to an increase in duck sales and IOFC value. Duck hatchery waste can be used as an alternative source of protein in duck diets. Future research should examine the effect of duck hatching waste supplementation on feed digestibility and also the profile of the duck's digestive tract.

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Conflict of interest

The authors have no conflict of interest to declare.

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