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Supplementation of Turmeric Flour (*Curcuma longa*) in Feed from The Grower to Laying Phase on The Productivity of Mojosari Ducks

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ABSTRACT

This research aims to determine the performance of the grower phase until the first egg laying of mojosari ducks given turmeric flour supplementation. This research used 40 mojosari ducks aged 16-28 weeks. The experimental research method used a completely randomized design with 5 treatments and 4 replications. The research was carried out for 12 weeks, maintained intensively and given basal feed with the addition of 0.2%, 0.4%, 0.6% and 0.8% turmeric flour. Basal feed is made from fine bran, ground corn and concentrate. The parameters observed were the final weight of the growth phase, body weight gain, feed conversion in the growth phase as well as body weight and age at first egg laying, as well as the weight of the first egg. The data obtained was then analyzed using analysis of variance (ANOVA) and Pearson correlation. The results showed that adding turmeric flour at 16-24 weeks of age was able to increase body weight gain and reduce feed conversion rate ($p<0.05$), and at 24-28 weeks of age could accelerate the age of first egg laying ($p<0.01$). Pearson correlation showed that there was a positive relationship (0.462) between age at first laying and first egg weight, a negative relationship (-0.569) between age at first laying and body weight, and a negative relationship (-0.398) between duck body weight and first egg weight. The addition of 0.6% turmeric flour to feed is the optimal and best level to improve the performance of mojosari ducks from the growth phase to the egg-laying phase.
Keywords: Grower, laying, Mojosari duck, turmeric flour

INTRODUCTION

Mojosari ducks are a significant part of local duck breeding in Indonesia, playing a crucial role in meeting the demand for eggs and providing an alternative source of income for small farmers [1]. They are known for their relatively large eggs, with an average weight of about 65-70 grams per granule. They can be raised using various maintenance systems, such as traditional semi-intensive and intensive (modern) maintenance systems. The average egg production of Mojosari ducks in an intensive cages system can reach 265 eggs per head per year [2].

Furthermore, research has been conducted to evaluate the egg production and quality of Mojosari ducks and their reciprocal crosses with other local duck breeds like Magelang ducks to improve their breeding and management [3]. Therefore, Mojosari ducks are an important resource for egg production and play a significant role in Indonesia's local duck breeding industry [4]. The growing global population, urbanization, and income levels have led to higher consumption of animal protein, including duck-based foods [5]. This increased demand is partly due to the growing awareness of the health benefits of consuming animal proteins and the need for alternative protein sources to meet the increasing demand for meat and eggs [6].

Local ducks, as a source of animal protein, such as Mojosari ducks, play a significant role in meeting the increased demand for animal protein in Indonesia [7]. They provide a source of high-quality protein that can be raised using various maintenance systems, such as traditional semi-intensive and intensive (modern) maintenance systems. The average egg production of Mojosari ducks in an intensive cages system can reach 265 eggs per head per year [5].

The increased demand for animal protein and the role of local ducks have economic implications for small farmers and the local economy [8]. Duck farming can provide an alternative source of income for small farmers, as they can raise ducks using various management systems and feed sources [9]. As the demand for animal protein increases, there is a need for alternative protein sources to meet this demand. Local ducks can serve as an alternative protein source, as they can be raised using various feed sources, such as plant-based proteins like rapeseed meal, soybean meals, sesame meal, leucaena leaf meal, and duckweed (Lemna minor). These plant-based proteins can be used as a substitute for fishmeal and animal by-products, which are excellent nutrients with high digestibility but are connected with price changes, pathogen contamination, and environmental consequences [8].

This research can help improve the management and breeding of local ducks, such as Mojosari ducks, to enhance their egg production and quality. Turmeric is a common spice with various health benefits, including anti-inflammatory, antimicrobial properties, and antioxidant. These properties suggest that turmeric may have potential applications in animal feed to improve health, productivity, and egg quality [10]. Turmeric flour has been used in various feed formulations for ducks, with varying levels of supplementation, such as 0.2% and 0.8%. These different levels of turmeric flour supplementation have been found to have varying effects on feed intake, egg weight, hen day production, feed-egg ratio, and mortalities in Mojosari Ducks [11]. Turmeric flour can be a potential alternative protein source for ducks, as it has been shown to increase protein levels, reduce fat content in duck meat [12], and increase egg production [5]. Turmeric exhibits antioxidative characteristics, potentially mitigating oxidative stress in laying ducks and improving their overall health and performance [13].

Previous research shows a correlation between body weight at first laying eggs and age at first laying eggs in ducks. The body weight of a duck when it first lays eggs can influence the age at which it first lays eggs. Research results show that the heavier the duck's body weight when it first lays eggs, the younger the age at which it lays its eggs [14]. This indicates that duck body weight can be an important indicator in predicting the age at which they first lay eggs, which impacts the efficient management of egg production and rearing of ducks.

This suggests that turmeric flour could be a useful ingredient in duck feed, especially considering the increased demand for animal protein and the role of local ducks in meeting this demand.

MATERIALS AND METHODS

This research was conducted for four months with 40 Mojosari ducks. Ducks are maintained intensively and given basal feed (110g/head/day at 16-24 weeks of age and 150g/head/day at 24-28 weeks) supplemented with turmeric flour 0.2%, 0.4%, 0.6%, and 0.8%. Basal feed is made from fine bran, ground corn, fish meal, and CP144 concentrate produced by PT. Charoen Pokphand (Table 1). Turmeric flour comes from the rhizomes (tubes) of the turmeric plant, which are harvested at 11–12 months (330–360 days). The experimental design used five treatments and four replications. The parameters observed were body weight, weight gain, growth phase feed conversion, body weight at first egg laying, age at first egg laying, and first egg weight. The data obtained was then analyzed using variance analysis, and the Pearson correlation was examined to see the relationship between variables.

Table 1. The Composition of the Feed of Ducks Mojosari During Rearing (12 Weeks)

Feed Ingredients	Total nutritional content provided		
	EM (Kcal/kg)	Protein (%)	Crude Fiber (%)
Rice bran	1092	4.8	6
Ground corn	990	2.4	0.489
Concentrate	185	3.7	0.6
Fish flour	443.8	10	0.596
Mineral Premix	0.5	-	-
Total	2710.8	20.9	7.685

RESULTS AND DISCUSSIONS

Mojosari Ducks Aged 16-24 Weeks (Grower Phase)

Ration Consumption

The rations used in this study were basal rations derived from fine bran, ground corn, and concentrates. Each treatment received turmeric flour at different levels. Table 2 presents the average ration consumption, body weight, final weight gain, and feed conversion of ducks aged 16-24 weeks.

The consumption of the grower phase-ration in this study amounted to the same in each treatment, namely with an average of 110 g / head/day. This is due to the amount of feed given, as much as 110 g/head/day and consumed (without residue); the significance (Sig.) of the

consumption data is not significant (ns). According to Riyanti *et al*. [15], the ratio of laying ducks at 18 weeks of age ranges from 9-110 g/head/day. The nutritional content of the feed given in this study is protein 20.9%, EM 2710.8 Kcal/kg, and crude fiber 7.69% [16].

Body Weight

Performance or body size is a hereditary attribute heavily impacted by environmental variables. The growth phase of ducks is 8-24 weeks old. Although the addition of turmeric flour did not significantly affect the body weight of ducks, there was a tendency to increase those given turmeric flour. Compared to those who were not. The results showed that the average body weight of ducks aged 16-24 weeks was 1.554.85 ± 77.15 g (Table 2). This result is similar to Damayanti *et al*. [17], whose body weight at 16 weeks of age in Mojosari ducks was 1.299±142 g.

Ducks that were given the addition of turmeric flour to their feed tended to gain better body weight than those treated without adding turmeric to their feed. Turmeric can stimulate the bile wall to remove bile and release pancreatic sap, with which lipase, protease, and amylase enzymes are produced, increasing the digestibility of feed ingredients such as fat, protein, and carbohydrates [18]. This is possible because of the curcumin content contained in turmeric, which can increase the metabolism of livestock bodies. Curcumin in turmeric has antibacterial properties, so the digestive process can increase by killing pathogenic bacteria. It can also stimulate the bile wall to secrete bile so that fat metabolism can run smoothly [19]. Curcumin has broad-spectrum antibacterial action and is active against both Gram-positive and Gram-negative bacteria, so it can increase appetite, which will ultimately increase live weight.

Table 2. Mean Performance of Mojosari Ducks Grower Phase During Rearing Age 16-24 Weeks

Treatment	Tm0	Tm1	Tm2	Tm3	Tm4	Mean	Sig.
Consumption (g/head/day)	110	110	110	110	110	110	Ns
BW (g)	1503.75±76.85	1542.50±58.52	1583.75±83.90	1601.75±73.68	1542.50±89.21	1554.85±77.15	Ns
BW gain (g)	615.00±54.77	708.75±66.25	747.50±42.72	785.50±69.74	727.50±84.21	716.85±82.18	*
FCR	10.80±0.94	9.37±0.83	8.85±0.49	8.45±0.70	9.17±1.08	9.32±1.10	*

ns: non-significant at the 0.05 level

*: significant at the 0.05 level

Body Weight Gain

Adding turmeric flour to feed is expected to increase livestock body weight gain, namely the difference between the final body weight and the initial body weight of rearing. In this study, the initial body weight of 14-week-old ducks was selected first to obtain the same initial body weight to see to what extent the treatment could influence weight gain.

Weight gain shows an increase over time. The highest average weight gain was in Tm3, with a value of 785.50g and a standard deviation of 69.74. This indicates that giving turmeric flour as much as 0.6% in feed can increase body weight gain. The essential oils and curcumin found in turmeric possess antibacterial and antifungal properties. Studies indicate that curcumin and turmeric oil exhibit antimicrobial effects against bacteria and fungi [20], [21], [22], [23]. Turmeric oil extracted from *Curcuma longa* has explicitly been shown to have

antifungal activity [24]. These natural components make turmeric a potential candidate as a natural antimicrobial agent.

These natural components make turmeric a potential candidate as a natural antimicrobial agent. The fastest and highest growth in ducks is in the starter phase, then decreases in the adult phase [25], added by Negara *et al*. [26] Duck growth is divided into fast and slow phases: the rapid phase at 0-8 weeks and the slow phase at 10-12 weeks. Even though the age of the ducks used in this study was in a slow phase, the treatment with turmeric flour increased body weight gain significantly, and the best feeding level was 0.6%. The increase in body weight of Mojosari ducks in the grower phase during rearing showed a decrease from the first week to the last week of rearing, this happened because the grower phase was a preparatory phase for entering the egg-laying phase.

In contrast to broiler ducks, whose body weight continues to increase, adult laying ducks reach a maximum weight of around 1700 g in the layer phase. Adult Mojosari ducks usually have an average body weight of 1.7 kg and average feed consumption of around 130-170 gr/day [27]. These breeds often have lower body sizes than meat-type ducks [28].

Feed Conversion (FCR)

One of the parameters that need to be considered in successful livestock rearing is feed conversion or feed conversion ratio (FCR). A good feed conversion value shows the efficiency of feed use. FCR is the feed released to produce each kilogram of body weight gain. Feed conversion becomes increasingly inefficient the larger the number [29]. Feeding ducks in paste has been reported to decrease water consumption and result in positive body weight and performance [30]. FCR is an important factor in the production of laying ducks. FCR is the quantity of feed an animal eats to generate one product unit, such as eggs.

The best FCR of Mojosari ducks in this study was in Tm3 treatment with the addition of turmeric flour to feed by 0.6% with a conversion rate of 8.45±0.70. This showed that turmeric flour at the level of 0.6% improved feed conversion in the grower phase. Although the conversion value obtained is relatively high, this situation is expected, where at the end of the layer phase, the body weight has reached its maximum weight, and the ducks will prepare themselves to produce eggs. Feed conversion in laying ducks was reported differently in each phase: the starter phase 5.26-6.02 [31], the grower phase 6.50-7.58 [1], and the layer phase 4.41-7.03 [11]. One study reported that NLDs (Netherlands Dwarf Layer ducks). When grown under an intensive management system, lay between 100 and 125 eggs annually and have a high hatching rate of more than 70% [32]. Another study reported that FCR in Pekin ducks ranged between 2.12 and 2.90 [33].

The high FCR in Mojosari ducks in the grower phase is caused by laying ducks, and broiler ducks are selected for different characteristics. Laying ducks are selected for their high egg-laying ability, while meat ducks are chosen for maximum growth and meat production. Laying ducks were selected for genes influencing egg production, while broiler ducks were selected for rapid growth and body mass [34]. The nutritional needs of laying ducks and broiler ducks can be different. Laying ducks need more nutrition to support egg production, while broiler ducks need nutrition for muscle growth and body mass [35]. Environmental factors such as feed, temperature, humidity, and rearing management can differ between laying ducks and broiler ducks, affecting their growth and body weight gain differently [26].

Mojosari Ducks Aged 24-28 Weeks (Laying Phase)

The ducks enter the production phase after the grower phase (24 weeks of age). In this study, the production phase observed was the first month of production (24-28 weeks of age). The feed is the same as the previous feed, with turmeric added at different levels.

Body Weight of First Laying

The body weight of laying ducks significantly influences their reproductive performance. Research has shown that in breeding ducks, the body weights of females increase before clutch initiation and then decline rapidly during laying and incubation. Changes in the weights of digestive organs and atrophy or mobilization of muscle tissue have also been implicated in these weight changes [36]. The average weight of the first eggs produced by Mojosari ducks was 1703.00±73.58 g. This result is different from the opinion of Damayanti et al. [17], Lu et al. [37] , which equals 1544±120 g. In the context of laying performance, high positive correlations were found between egg weight and body weight traits in laying ducks [38]. In this study, feeding for the egg-laying phase was 150g/head/day, and the feed requirement for laying ducks was 125-180 g/head/day [39]. Additionally, the daily feed intake and performance of laying hens are influenced by their body weight, with heavier hens showing higher feed intake and egg production [40]. Therefore, the body weight of laying ducks is a crucial factor that affects their reproductive performance, egg production, and overall productivity.

Table 3. Average Performance of Mojosari Ducks During Rearing Age 24-28 Weeks

Treatment	Tm0	Tm1	Tm2	Tm3	Tm4	Average	Sig.
Consumption (g/head/day)	150	150	150	150	150	150	Ns
BW (g)	1581.25±78.04	1617.50±57.38	1671.25±85.18	1703.00±73.58	1638.75±87.31	1642.35±80.96	Ns
Age at first laying (weeks)	27.75±0.50	26.50±0.58	26.25±0.58	25.25±0.50	25.25±0.82	27.00±0.80	**
Weight of first egg (g)	51.26±0.46	52.06±1.19	51.67±1.93	50.67±0.88	52.75±2.08	51.68±1.48	Ns

ns: non-significant

**: significant at the 0.01 level

Age of First Egg Laying

The average age at first egg laying in Mojosari ducks was 27.00±0.80 weeks. This is quite similar to the results reported by other studies, which found the average age at first egg-laying in Alabio and Mojosari ducks to be 24.27 weeks (169 days) [17].

Table 3. shows that adding 0.6% turmeric flour to the feed can accelerate the age of first egg laying in Mojosari ducks. The age of the first egg laying in ducks is an important factor that can significantly impact their reproductive performance. Ducks usually begin laying at around 6-7 months of age, with some breeds, such as Pekins, starting to lay eggs at approximately 26-28 weeks [41]. The average laying performance of ducks up to 50 weeks was reported to be 147 eggs per female [42]. Regarding genetic correlations, body weight at ten weeks of age has been found to exhibit a positive genetic correlation with age at first egg laying in Muscovy ducks [43]. The age at first egg laying is a critical indicator of ducks' onset of reproductive maturity. It is

essential for the optimal management of breeding stock and the overall productivity of duck farming. Understanding the effects of age on the reproductive performance of laying ducks is crucial for efficient production and the breeding program's coefficient of variation to figure out its variation.

Weight of First Egg

The weight of the first egg laid by ducks can significantly impact various aspects of production. Research has shown that the weight of the first egg is positively correlated with the age at first egg laying and body weight at first egg. The average weight of the first eggs produced by Mojosari ducks was 1703.00±73.58 g. This result is different from the opinion of Damayanti *et al*. [17] and Lu *et al*. [37], which equals 1544±120 g.

Additionally, the weight of the first egg can influence hatchability, eggshell quality, and the growth performance of the resulting ducklings [44]. Furthermore, genetic parameters have indicated that the number of eggs laid is not genetically correlated with the age of the first egg or egg weight but is correlated with body weight [38]. Therefore, the weight of the first egg in laying ducks is an essential factor that can affect reproductive performance, egg quality, and overall production efficiency.

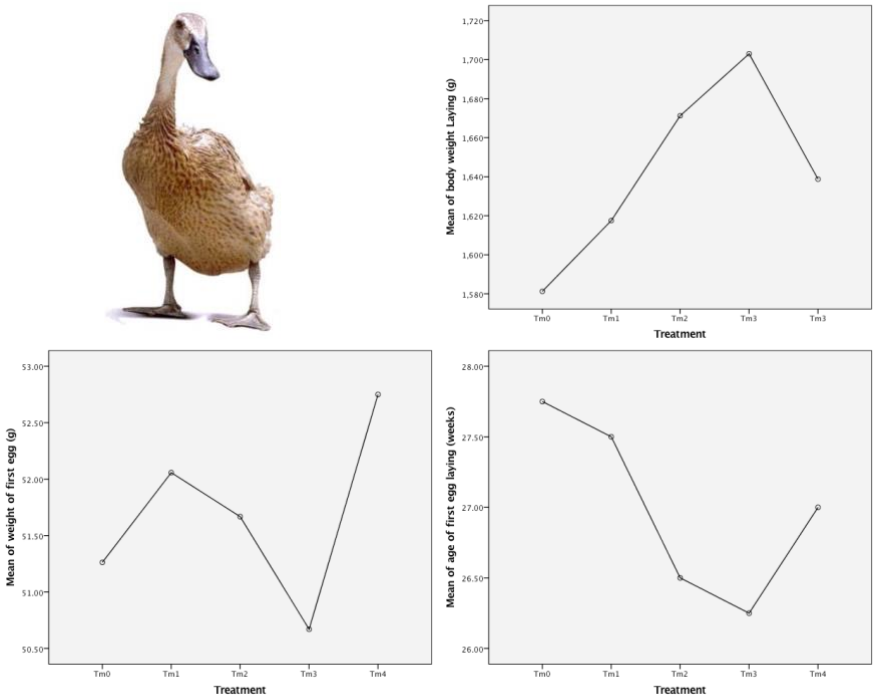

Figure 1. Mean of Body Weight Laying, Weight of First Egg, and Age of First Egg Laying of Mojosari Ducks

Correlation Between Body Weight, Age at First Egg Laying, and First Egg Weight

The results above show that adding 0.6% turmeric flour to feed can increase body weight gain in the growth phase. The weight of the duck when it first lays eggs can influence the age at which it lays eggs. Previous research shows that the heavier the duck's body weight when it first lays eggs, the younger the age at which it lays its eggs [14]. This indicates that duck body weight can be an essential indicator in predicting the age at which they first lay eggs, which impacts the efficiency of managing egg production and rearing ducks. The same results were also stated by Lin *et al*. [38] states that eggs produced correlate with body weight, indicating a relationship between a duck's body weight and egg production ability.

Additionally, positive correlations have been observed between age at first egg, body weight at first egg, and first egg weight, highlighting the interconnectedness of these traits in laying ducks [37]. Furthermore, body weight at specific ages, such as ten weeks, exhibits positive genetic correlations with age at first egg and negative correlations with egg production traits [43]. These correlations emphasize the influence of body weight on laying ducks' reproductive performance.

Table 4. Pearson's Correlation Coefficient Between Body Weight, Age at First Egg Laying, and First Egg Weight

	Body Weight	**Age of first laying eggs**	**weight of first egg**
Body Weight	1	-0.569**	-0.398
Age of first laying eggs	-0.569**	1	0.462*
weight of first egg	-0.398	0.462*	1

** Correlation is significant at the 0.01 level

* Correlation is significant at the 0.05 level

Table 4. Shows the correlation coefficient between body weight, age at first egg laying, and first egg weight. The correlation coefficient measures the strength and direction of the linear relationship between two variables. The study found a negative correlation between body weight and age at first laying eggs, indicating that as body weight increases, the age at which participants first lay eggs lowers. As body weight increases, the digestive organs and muscle tissue experience changes; apart from that, it also affects reproductive maturity, according to an explanation by Drobney [36]. Changes in the weights of digestive organs and atrophy or mobilization of muscle tissue have also been implicated in these weight changes. There was also a positive relationship between age at first laying and first egg weight, indicating that the more ducks laid their first egg at an older age, the higher the egg weight tended to be. The duck's weight when it first lays eggs greatly influences the weight of the first egg. In contrast, ducks that are lightweight when they first lay eggs tend to produce a small weight of the first egg, and vice versa [45], whereas ducks that weigh those that are heavy when they first lay eggs will produce a sizeable first egg. Added statements from Nort and Bell [46], Medion [47], and Campbell [48] stated that body weight positively correlates with egg size. Finally, there is a negative relationship between body weight and the weight of the first egg, which shows that as body weight increases, the weight of the first egg tends to decrease.

CONCLUSIONS

Supplementation of 0.6% turmeric flour in feed can increase body weight gain and reduce FCR numbers in the growth phase. Additionally, it can accelerate the onset of egg-laying, thereby improving the performance of Mojosari ducks from the growth phase to the egg-laying phase. Body weight has been shown to correlate with the age at first laying and the weight of the first egg.

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