The Effect of Giving Turmeric Flour (*Curcuma domestica*) on Performance and Relative Weight of Lymphoid Organs of Super Native Chicken

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Abstract. The purpose of this study is to investigate the impact of turmeric powder (*Curcuma domestica*), a dietary supplement, on the function and relative weight of lymphoid organs, a marker of immunological status in super native chickens. 100 super native chickens in total were employed in the trial, which lasted 35 days and included 5 treatments and 4 replications with identical environmental conditions. The application of the treatments followed a totally random design. Water alone served as the negative control (P0), 0.1 gr/l of feed supplement served as the positive control (P1), 1 gr/l of turmeric flour served as treatment (P2), 3 gr/l of turmeric flour served as treatment (P3), and 5 gr/l of turmeric flour served as treatment (P4). Body weight gain, feed consumption, feed conversion ratio, and relative weight of lymphoid organs were the variables that were measured in the experiment. All of the data gathered for this study were evaluated using Analysis of Variance, and Duncan's test using SPSS version 25 was required if there were any significant differences. According to statistical research, adding turmeric flour to drinking water had no significant impact on feed consumption ($P > 0.05$) but had a substantial impact on the weight gain and feed conversion of super native chickens. On the relative weights of the spleen and bursa Fabricius, the therapy also had a statistically significant ($P < 0.05$) impact. The Fabricius bursa and spleen had the highest average relative weights of the lymphoid organs (Fabricius bursa and spleen) in the treatment given turmeric flour at a concentration of 3 gr/l of drinking water. In conclusion, as a natural feed additive, adding Turmeric Flour (Curcuma domestica) to drinking water helps super native fowl perform better and have lymphoid organs that are proportionately heavier.

Keywords: Turmeric Flour · Super Native Chicken · Lymphoid Organs

1 Introduction

Due to the physiological and nutritional differences between them and ruminants, poultry have higher metabolic rates and nutrient needs. Currently, two of the most affordable

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forms of animal protein are meat and eggs derived from chicken. Numerous stressors, including immunization, feather plucking, moulting, an increase in the ambient temperature, and dense stocking, might affect birds. Even if the stress seems to be at a low level, persistent stress situations might harm the animals' health and productivity [1]. Production of poultry was concentrated on maximizing growth performance through increased growth rate and feed conversion efficiency. The best performance of birds is mostly influenced by their genetic potential, the quality of their nutrition, the environment, and disease outbreaks [2].

To increase the wellbeing and output of chickens, feed additives must be provided. Antibiotics are frequently added to feed as growth enhancers. However, since the government forbade the use of antibiotics with the regulations found in the Regulation of the Minister of Agriculture of the Republic of Indonesia Number 14/Permentan/Pk.350/5/2017 [3] concerning the Classification of Veterinary Drugs, the use of antibiotics to stimulate poultry growth has been increasingly abandoned. In theory, using antibiotics as a feed additive lowers the amount of pathogenic bacteria in the gastrointestinal system, however their use causes issues when antibiotic residues are found in human-eating carcasses and boosts the resistance of harmful bacteria.

The active component of turmeric root, which makes up 1.5–2% of its weight, is curcumin. Three distinct curcumin analogues, including 5% bisdemethoxycurcumin, 18% demethoxycurcumin, and 77% diferuloylmethane, are present in turmeric. Turmeric powder, a yellow or gold-colored spice made from the dried rhizomes of this plant, is used in textile dyeing, medicine, and food preservation. A pigment with a structure similar to diferuloylmethane is what gives it its color. Curcumin is soluble in imethylsulfoxide, ethanol, oils, and acetone but insoluble in water [4, 5].

The body weight, weight gain, Liver, Gizzard, and Proventriculus performance index, and relative growth rate of broiler chickens were all significantly ($P < 0.05$) increased when turmeric was administered at a dose of 7 g/kg feeds [6]. The consumption of the ration, the initial body weight of laying eggs, and the age of sexual maturity were all considerably impacted by the addition of turmeric flour to the ration. [7] Their research showed that increasing the amount of turmeric powder in diet has a positive impact on both the health and productivity of Sentul chickens. Given that the FCR greatly increased, it can be said that the inclusion of 3 g/kg of turmeric powder in the diet produced the greatest outcomes.

One of the criteria that must be kept in place for super native chickens to develop in accordance with their genetic potential is the normal physiological state of their internal organs. The growth of lymphoid organs like the thymus, spleen, and bursa Fabricius in the poultry defense system will be supported by the involvement of the digestive organs in the best absorption of nutrients. With the addition of turmeric flour, it is anticipated that super native chickens' immune systems will improve, with an increase in the relative weight of lymphoid organs serving as an indicator. This will improve livestock performance and ensure that breeders get the most out of raising super native chickens. This promotes investigation into how the performance and relative weight of lymphoid organs are affected when super native chickens consume water with turmeric flour (*Curcuma domestica*).

2 Materials and Methods

2.1 Place and Date

This research was conducted in May-June 2022. Super native chicken rearing was carried out in the native chicken farm of PT Surya Pangan Indonesia, Bollangi, Gowa Regency, South Sulawesi. The research lasted for 30 days.

2.2 Cage and Animal

A total of 100 mixed-sex super native chickens from the DKS Platinum Genetik Super Lereng Gunung Kawi Berline Farm, with an average initial body weight of 23016.37 g, served as the research subject. They ranged in age from 29 to 56 days. Twenty split bamboo experiment cages, each measuring 60 × 60 × 80 cm (length x width x height), were furnished with a feeding area, a watering hole, and husk litter that was about 10 cm deep. Each experimental cage unit had a 5-W lamp that was used as lighting during the maintenance period. Additional lighting was available throughout the trial from 5:00 PM to 6:00 AM. Profectan® disinfectant, turmeric flour, Promune-C® supplement feed as a positive control, hanging and analytical balance 0.1 g scale, cleaning tools (broomstick, bucket, shovel), and writing implements are some of the other items utilized.

2.3 Diet

Feed and drinking water were provided ad libitum with the composition of the 8201-Star commercial feed which is a crumble shape. The nutrition content presented in Table 1.

2.4 Procedure

Preparation of Turmeric Flour. A knife is used to clean and peel turmeric, which is employed in the content or flesh. The turmeric filling is divided into small pieces, dried in the room for 48 h, and then processed into flour with a mixer. According to the research treatment, turmeric is added to drinking water in a specific amount [8].

Sampling of Lymphoid Organs. The jugular vein was removed from the research chickens 56 days after they were killed. The lymphoid organs are removed during abdominal surgery. The weights of the bursa Fabricius and spleen were measured. One sample was taken from each replication of the experiment to collect data on the weight of the lymphoid organs using an analytical scale with a 0.1-g resolution.

Experiment Design and Data Analysis. This study employed an experimental methodology and a completely randomized design (CRD) with five treatments, four replications, and five super native chicks in each replication. P0 (drinking water sans turmeric flour), P1 (drinking water + Promune-C® 0.1 gr/l), P2 (drinking water + turmeric flour 1 gr/l), P3 (drinking water + turmeric flour 3 gr/l), and P4 (drinking water + turmeric flour 5 g/L) were the treatments (P) administered. Table 1 lists the nutritional composition of the beginning feed 8201-Star made by PT. Malindo Feedmil Tbk.

Table 1. Nutrient content of commercial rations 8201-Star

Nutritional content	
Moisture	Max. 13%
Ash	Max. 8%
Crude protein	Min. 19%
Crude Fat	Min. 3%
Crude Fiber	Max. 7%
Calcium	0.8 - 1.2%
Phosphorus with Phytase Enzyme 500 FTU/kg	Min. 0.45%
Urea	ND
Aflatoxin	Max. 50 ppb
Lysine	Min. 0.90%
Methionine	Min. 0.40%
Methionine + Cystine	Min. 0.70%
Threonine	Min. 0.65%
Tryptophan	Min. 0.18%
Enzyme	+

2.5 Research Variable

Body Weight Gain. Body weight gain is the difference between final body weight and initial body weight. The formula used is:

$$Body\ Weight\ Gain\ = \frac{Final\ Weight(g) - Initial\ Weight(g)}{Research\ period} \tag{1}$$

Feed Consumption. Feed consumption can be calculated from the amount of feed consumed by chickens during the rearing period.

$$Feed\ Consumption\ (g)\ = \frac{Total\ Feed\ (g) - Remaining\ Feed\ (g)}{Number\ of\ chicks} \tag{2}$$

Feed Conversions. Conversion of ratio/feed is the ratio between feed consumption and body weight gain.

$$Feed\ Conversion\ (g)\ = \frac{Total\ Feed\ Consumption(g)}{Weight\ Gain\ (g)} \times 100\% \tag{3}$$

Relative Weight of Lymphoid Organs. The calculation of the relative weight of the lymphoid organs is based on the following formula.

$$Relative\ Organ\ Weight = \frac{\text{Organ Weight (g)}}{Chicken\ Live\ Weight\ (g)} \times 100\% \tag{4}$$

Data Analysis. With 5 treatments and 4 replicants, the experimental design used in this work was a completely randomized design (CRD). Five super native chicks were used in each replication. Data were evaluated using Analysis of Variance, and since the results were statistically different, Duncan's test was applied [9].

3 Results and Discussion

3.1 Effect of Treatment on Body Weight Gain

Weight gain is calculated by dividing the difference between the final and beginning body weights by the total number of research days (g/head/day). Table 2 displays the impact of varying the amount of turmeric flour added to water on the average weight gain of super-native chickens.

According to Table 2, the P4 treatment for super native chickens resulted in the highest average weight gain of 16.11 ± 1.32 g/head/day while the P0 treatment produced the lowest average weight gain of 14.16 ± 48 g/head/day. A statistical analysis revealed that the therapy significantly affected the super-native chickens' weight gain ($P < 0.05$). According to Duncan's test, there was no significant difference between the P0 treatment and the turmeric treatments at 1 g/L, 3 g/L, and 5 g/L with 0.1 g of feed supplement. This demonstrates how turmeric flour treatment at concentrations ranging from 1 g/L to 5 g/L impacts the weight increase of super native chickens.

The weight of the super native chicken rose by 4.94% when feed supplement 0.1 g/L was added to the drinking water (P1) compared to P0. The super native chicken's body weight gain rose by 5.32% when 1 g/L turmeric flour was added to drinking water (P2) compared to P1. In comparison to P2, the chickens' body weight increased by 0.38% after consuming water containing 3 g/L of turmeric (P3). A 2.55% increase in body weight over P3 and the addition of 5 g/L turmeric flour to the drinking water are both factors in P4.

This increase in chicken weight shows that turmeric flour can increase the metabolic rate so that the absorption of nutrients from feed becomes more efficient and results

Table 2. Weight gain of super native chickens (g/head/day).

Replications	Treatments				
	P0	P1	P2	P3	P4
R1	14.80	14.73	15.06	15.66	16.60
R2	14.26	15.53	16.60	15.46	16.06
R3	13.93	16.06	15.53	15.53	17.46
R4	13.66	13.13	15.40	16.20	14.33
Amount	56.66	59.46	62.60	62.86	64.46
Average	14.16 ± 0.48b	14.86 ± 1.27^{ab}	15.65 ± 0.66^{a}	15.71 ± 0.33^{a}	16.11 ± 1.32^{a}

Description: a,b superscripts on the same average row show significant differences ($P < 0.05$).

Table 3. Average consumption of super native chicken feed (g/head/day).

Replication	Treatments				
	P0	P1	P2	P3	P4
R1	58.20	57.93	57.40	58.33	57.40
R2	51.53	58.73	57.93	58.07	58.47
R3	58	59.87	58.13	59.67	58.60
R4	54.20	51.93	56.33	58.73	51.87
Amount	221.93	228.47	229.80	234.80	226.33
Average	55.48 ± 3.2	57.11 ± 3.54	57.45 ± 0.80	58.70 ± 0.70	56.58 ± 3.19

in greater body weight in chickens that are treated with turmeric flour. According to [10], turmeric helps the enzymatic metabolic process in the chicken body because it contains curcuminoid compounds and essential oils. Curcumin can increase the secretion of digestive enzymes such as lipase in the pancreas, amylase, trypsin and chymotrypsin so that it can increase feed digestibility and improve chicken performance [11].

The beneficial effect may be attributable to the fact that turmeric powder supplementation lengthened villi and lowered intestinal pH. Intestinal bacteria were reduced by turmeric, the number of Lactobacillus was selectively raised [12], and digestive enzyme secretion was increased, increasing nutrient absorption and, ultimately, growth performance. Additionally, turmeric increased bile synthesis, which facilitates better fat digestion [13].

3.2 Effect of Treatment on Body Weight Gain

Feed consumption (grams/head/day) is calculated as the amount of feed provided minus any leftover feed and divided by the total research time. Table 3 shows the impact of varying the amount of turmeric flour added to water on the average consumption of super-native chicken feed.

The addition of turmeric to drinking water improves feed consumption, as seen in Table 3. At comparison to untreated drinking water, the addition of turmeric flour in doses of 1 g/L, 3 g/L, and 5 g/L as well as the feed supplement at 0.1 g seems to boost feed consumption. Table 3 shows that compared to the treatment without turmeric, feed consumption in the treatment with turmeric and feed supplements (P1, P2, P3, P4) tends to be higher (P0). The P3 station had the highest feed consumption (58.70 ± 0.70 g/head/day), which was followed by the P2 station (57.45 ± 80 g/head/day), P1 station (57.11 ± 3.54 g/head/day), P4 station (56.58 ± 3.19 g/head/day), and P0 station (55.48 ± 3.21 g/head/day). In accordance with statistical analysis, the therapy had no appreciable impact on the consumption of super-native chicken feed ($P > 0.05$). The digestive system can quickly empty thanks to the essential oil in turmeric. The digestive system's capacity will expand due to the chickens' increased appetite caused by the quick emptying of their stomachs.

Table 4. Average conversion of super native chicken feed (g/head/day).

Replication	Treatments				
	P0	P1	P2	P3	P4
R1	3.93	3.93	3.80	3.72	3.45
R2	3.61	3.78	3.48	3.75	3.63
R3	4.16	3.72	3.74	3.84	3.35
R4	3.96	3.95	3.65	3.62	3.61
Amount	15.67	15.39	14.70	14.94	14.07
Average	3.92 ± 0.22a	3.85 ± 0.1ab	3.67 ± 0.14bc	3.74 ± 0.08abc	3.52 ± 0.13c

Description: a, b, c superscripts on the same average line show significant differences ($P < 0.05$).

The consumption of super native chicken feed increased by 3.55% when 1 g/L turmeric flour was added to drinking water (P2) compared to T0, although the difference was not statistically significant. Consumption of chicken feed increased in P3 by 2.18% compared to P2, however the difference was not statistically significant. Although P4 consumed less feed than P3 by 3.75%, this difference was not significant.

The addition of turmeric flour through drinking water is quickly absorbed by the digestive tract so that it will improve the function of the digestive organs. [14] stated that the function of turmeric to improve the work of the digestive organs of poultry is to stimulate the gallbladder wall to secrete bile and stimulate the release of pancreatic juice which contains amylase, lipase, and protease enzymes which are useful for improving the digestion of feed ingredients such as carbohydrates, fats, and proteins.

3.3 Effect of Treatment on Feed Conversion

The ratio of feed consumption to body weight increase, often known as feed conversion or feed conversion ratio (FCR), is also known as feed efficiency (the ratio of body weight per unit of feed consumption). The value must be low for the best feed conversion. Table 4 displays the conversion of super-native chicken feed.

According to Table 4, P4 (3.52 ± 0.13 g/head/day) had the highest feed conversion, followed by P2 (3.67 ± 0.14 g/head/day), P3 (3.74 ± 0.08 g/head/day), P1 (3.85 ± 0.1 g/head/day), and P0 (3.92 ± 0.22 g/head/day). Due to the addition of turmeric flour to drinking water, statistical analysis revealed that the treatment had a substantial impact on feed conversion ($P < 0.05$), causing super-native chickens to gain weight. The conversion of super native chicken feed was decreased by 6.37% when 1 g/L turmeric powder was added to drinking water (P2) compared to P0. The addition of turmeric at a concentration of 3 g/l in drinking water (P3) did, however, result in a 1.9% improvement in feed conversion when compared to P2, but this effect is unreal. The feed conversion reduced from P4 to P3 by 5.88%, although the difference was not significant. The drop in feed conversion from P4 to P0, which is a decrease of 10.2%, reveals a very significant difference.

Table 5. The relative weight of lymphoid organs of 56 days old super native chicken.

Variable	Treatment				
	P0	P1	P2	P3	P4
Lymphoid Organs					
Bursa Fabricius (%)	0.06 ± 0.01b	0.10 ± 0.02a	0.09 ± 0.01a	0.12 ± 0.02a	0.12 ± 0.01a
Spleen (%)	0.22 ± 0.04^{b}	0.29 ± 0.06^{ab}	0.38 ± 0.09^{a}	0.39 ± 0.07^{a}	0.33 ± 0.08^{a}

Description: a, b superscripts on the same average line show that there is a significant difference ($P < 0.05$)

[15] Described an improvement in FCR with TP supplementation at rates of 0.5, 1.0, and 1.5%, which is consistent with the present findings. The current findings concur with those of [13] and [16], which demonstrated that TP supplementation at a rate of 0.5% enhanced FCR. Better FCR was discovered by [17] with 1.0% supplementation.

Feed conversion can be impacted by adding turmeric flour to drinking water at doses of 1 g/L, 3 g/L, and 5 g/L as well as 0.1 g/L as a feed supplement. This is a result of the 8201-star feed's entire nutritional composition and the state of a healthy digestive system. As a result, the super native chickens can get the most out of the meal that is ingested. The feed conversion value will be less or lower the faster the body weight increases while consuming less feed. This demonstrates how feeding turmeric flour to drinking water can improve the performance of super-native chickens in terms of production.

3.4 Effect of Treatment on Relative Weight of Lymphoid Organs

The ratio of the weight of the lymphoid organs to the live weight of super native chickens is known as the relative weight of the lymphoid organs. Table 5 displays the impact of varying the amount of turmeric flour added to water on the relative weight of the lymphoid organs in super-native chickens.

Table 5 demonstrates that the medication significantly affected the relative weights of the spleen and bursa Fabricius ($P < 0.05$). The proportion of relative weights of the Fabricius bursa in treatment P0 demonstrated a significant difference ($P < 0.05$) from treatments P1, P2, P3, and P4, according to Duncan's further test results. Treatment P0's percentage of the relative weight of the spleen differed ($P < 0.05$) from treatments P2, P3, and P4, but not from P1 in a way that was statistically significant.

The Fabricius bursa's relative weight in this study is between 0.06–0.12%. The treatment P0 (negative control) had the lowest mean value, while treatments P3 (drinking water + 3 g turmeric flour) and P4 (drinking water + 5 g turmeric flour) had the highest mean values. The study's findings demonstrated a significant difference between treatment P0 (negative control) and treatments P1 (positive control; drinking water + feed supplement 0.1 g/L), P2 (drinking water + 1 g/L turmeric flour), P3 (water drink + 3 g/l turmeric flour), and P4 (drinking water + 5 g/L turmeric flour). The bursa Fabricius had the largest relative weight when turmeric flour was used at concentrations of 3 and 5 g/L, but there was no discernible difference when drinking water was combined with 0.1 and

1 g/L of feed supplement (P1) and (P2). This shows that drinking water combined with turmeric flour can improve the function of the immune organs in super native chickens based on a larger relative weight indicator of the bursa of Fabricius. [18] It has been shown that birds with comparatively large bursa Fabricius exhibit a higher level of disease resistance. On the other hand, according to [19], a low immune system in chickens may result from a decrease in the weight of the bursa Fabricius.

In this study, the relative weight of the spleen ranged from 0.22% to 0.39%. The treatment P0 (drinking water without treatment) had the lowest mean value and the treatment P3 (drinking water plus turmeric flour 3 g/L) had the highest mean value. The study's findings demonstrated that treatment P0 (the negative control) significantly differed from treatments P2 (drinking water + 1 g/L turmeric flour), P3, and P4 (drinking water + 3 g/L turmeric flour), but not from treatment P0 (drinking water + 0.1 g/l feed supplement) (P1). However, there are no appreciable differences when drinking water is combined with feed supplement 0.1 g/L (P1), turmeric flour 1 g/L (P2), or turmeric flour 5 g/L. The usage of turmeric flour 3 g/L has the biggest relative weight of the spleen (P4).

The results showed that the relative weight of the spleen may be increased in super-native chickens by feeding them feed additives and turmeric flour. The spleen, a secondary defense organ that produces lymphocyte cells, is crucial in fighting off illness pathogens that have managed to enter the bloodstream and prevents their invasion or spread before it spreads further [20]. The percentage of bursa Fabricius weight and the percentage of spleen weight are significantly affected by feeding phytobiotic turmeric extract, garlic extract, and the combination of turmeric and garlic extracts, claims [21]. A large spleen weight suggests an improved immune system, according to [22].

Additionally, the bioactive components in turmeric will stimulate the chicken immune systems and lessen the inflammation brought on by the virus. By contributing in the regeneration of the lymphocytes in the lymphoid organs when turmeric is employed as a phytobiotic, it offers a cellular repair mechanism [23, 24]. Studies have shown that adding turmeric rhizome powder to broiler chicken feed can enhance the levels of immunoglobulins such IgM, IgA, and IgG while drastically lowering the monocytes ratio [25].

4 Conclusions

The results of this study demonstrated that feeding super native chickens turmeric flour boosted their body weight gain, feed consumption, and feed conversion. The treatment using turmeric flour at a concentration of 5 g/L produced the best results in super native chicken. The treatment that included turmeric powder at a concentration of 3 g/L of drinking water showed the highest relative weight of the lymphoid organs (Fabricius bursa and spleen). Giving super native fowl turmeric flour (Curcuma domestica) in their water is advantageous for improving the functionality and relative weight of their lymphoid organs as a natural feed addition.

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