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Effect of Turmeric Root Powder on Productive Performance and Serum Lipid Profile of Broiler Chickens Housed at a High Stocking Density Pens

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ABSTRACT

The study aimed to evaluate the effect of turmeric powder supplementation on the production parameters and lipid profile of broilers housed at a high stocking density pens. The study used 205 Lohmann broiler chicks. From day 14, the chicks were randomly allocated to CNTRL (chickens raised at a density of 9 chicks/m^2 receiving basal feed), HSDB (density of 16 chicks/m^2 and fed basal feed), and HSDT (density of 16 chicks/m^2 and fed feed containing 1% turmeric powder). Body weight and feed intake were recorded weekly, while blood sampling was conducted at day 37. Stocking broilers at a high density pens resulted in compromised ($P<0.05$) growth performance and increased ($P<0.05$) serum total cholesterol, total triglyceride, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) levels of broilers. Dietary supplementation of turmeric powder improved ($P<0.05$) serum cholesterol and lipid profile, but failed to ameliorate the unfavourable effect of stocking density-induced stress on growth performance of broilers. In conclusion, dietary turmeric powder supplementation (1% of diet) was beneficial in improving the lipid and cholesterol profiles of broilers raised under high density condition.

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Introduction

Keeping broiler chicks in high density cages is a necessity to reduce cage investment costs. Breeders frequently house broilers at densities greater than a recommended density of 31 kg per square meter for cost-cutting reasons. Aside from investment cost efficiency, raising broilers in high density cages might have a detrimental influence on their physiological condition and health (Agusetyaningsih et al., 2021).

Stress caused by excessive stocking density has been shown to raise blood cholesterol levels in broilers (Qaid et al., 2016). The stress state is also reflected in broiler plasma triglyceride and very-low-density lipoprotein (VLDL) concentrations (Gholami et al., 2020). Rather than extending the cage space, farmers frequently use feed additives (a source of antioxidants) to mitigate the detrimental impact of stress caused by high cage density on broilers. There is other study on this subject (Önel and Aksu, 2019). Ismail et al. (2014) and Selvam et al. (2015) used vitamin E as an antioxidant supplement to reduce the stress caused by high stocking density in broilers. The use of antioxidant-rich herbal items, such as *Cassia abbreviata* stem bark extract, has also been studied to mitigate the negative effects of high stocking density on chickens (Jobe et al., 2019)

Turmeric (*Curcuma longa* L.) has long been utilized in Indonesia not only as a spice but also for phytobiotic purposes in broiler production. Guil-Guerrero et al. (2017) showed that turmeric contains bioactive secondary metabolites known as curcuminoids and has been utilized successfully as a chicken feed additive. More specifically, Sugiharto (2020) said that the curcumin component in turmeric powder may act as antioxidants, reducing the harmful effects of stress on broiler chicks. The latter investigator also revealed that dietary administration of turmeric powder was capable of improving the lipid and cholesterol profiles of broilers under heat stress conditions.

To date, the research on utilizing turmeric to reduce the side effects of high stocking density-induced stress is relatively limited. Hence, the current study sought to evaluate the effect of turmeric powder supplementation on the production parameters and lipid profile of broilers housed at high stocking density pens.

Materials and Methods

Turmeric root powder was purchased from a local market in Semarang, Indonesia's Central Java Province. The Animal Ethics Committee of the Faculty of Animal and Agricultural Sciences, Universitas Diponegoro (No.57-05/A3/KEP/FPP) authorized the *in vivo* experiment.

The study employed 205 14-day-old Lohmann broiler chicks (average body weight of 370 ± 8.77 g; mean ± standard deviation). From day one to day 14, the chicks were raised according to conventional breeding methods using commercial pre-starter feed comprising 23% crude protein, 5% crude fiber, 5% crude fat, and 7% ash.

Beginning on day 14, the chicks were randomly allocated to one of three experimental groups, each with five replications. The groups were CNTRL (chickens raised at a density of

9 chicks/m^2 and fed basal feed), HSDB (chickens raised at a density of 16 chicks/m^2 and fed basal feed), and HSDT (chickens raised at a density of 16 chicks/m^2 and fed feed containing 1% turmeric powder).

For the course of the study, the chicks were raised in an open-sided broiler chicken house using rice husk as bedding material. Each pen received a manual feeder and a drinker. A continuous lighting regimen was employed for the length of the study. The basal feed was prepared in line with the Indonesian National Broiler Feed Standards (2006) (Table 1). Turmeric powder was added to feeds ("on top") from day 14 to harvest (day 37). On day four and day 18, the chicks were administered Newcastle disease vaccination by eye drops and drinking water, respectively. On day 12, a vaccine against infectious bursal illness was also given by drinking water.

The chicks' body weight, feed intake, and feed efficiency were all monitored weekly from day 14 to day 37. On the 37th day, two male chicks representing the average body weight of each cage (10 birds per treatment group) were taken and blood samples were collected. The blood was allowed to stand at room temperature for 2 hours before being centrifuged at 5,000 rpm for 10 minutes to produce serum. According to the manufacturer's instructions, the serum triglyceride and cholesterol profile of broilers were determined using enzymatic colorimetric tests (DiaSys Diagnostic System GmbH, Holzheim, Germany).

The analysis of variance (ANOVA, SPSS 16.0 version) was performed to statistically evaluate the experiment data. Following the discovery of a significant impact ($P<0.05$) of treatment, the Duncan multi-range test was conducted.

Table 1. Ingredients and chemical constituents of feed (days 14-37)

Items	**(%, unless otherwise noted)**
Yellow maize	58.7
Palm oil	2.90
SBM	34.7
DL-methionine	0.19
Bentonite	0.75
Limestone	0.75
MCP	1.20
Mineral mix	0.34
Chlorine chloride	0.07
Salt	0.40
Chemical compositions:	
ME (kcal/kg)	3000
Crude protein	20.0
Crude fiber	5.52

SBM: soybean meal, MCP: Monocalcium phosphate, ME: Metabolizable energy

Results and Discussion

It was shown in the present study that stocking broilers at high-density pens resulted in reduced ($P<0.05$) average daily gain and feed efficiency, without affecting ($P>0.05$) the average daily feed intake (Table 2). This finding is in line with that of Simitzis et al (2012), who showed that high stock density compromises the growth rate of broilers. The lower growth performance appears to be caused by physiological and oxidative stress, as the stress condition may redirect energy away from growth and toward maintenance Simitzis et al., (2012). In most cases, high stocking density is attributed to lower feed intake as a result of fierce competition for feed. The stocking density condition had no significant effect on average daily feed intake in this study. In agreement, Agusetyaningsih et al. (2021) found no effect of stocking density on broiler feed consumption. It was possible that the total live body weight of less than 31 kg/m^2 in each pen might still allow broilers to reach the feeder without intense competition.

Supplementation with curcumin has been reported to reduce oxidative stress and improve the growth performance of broilers raised at high stocking density pens (Pimson et al., 2018). In contrast to the previous work, dietary supplementation with turmeric powder was not able to alleviate the unfavorable impact of density-induced stress on broiler growth performance in this investigation. The exact cause of such disparate results is unknown, although differences in the kind of supplements utilized during the trial (curcumin derived from turmeric powder vs. turmeric powder) as well as differences in study conditions (temperature, humidity, hygiene, etc.) could be responsible.

Table 2. Performance of broilers (days 14-37)

Items	CNTRL	HSDB	HSDT	SEM	P value
Total Live BW, kg/m^2	16.434^{b}	24.784^{a}	24.979^{a}	1.083	<0.01
Average daily gain, g/day	63.0^{a}	51.7^{b}	51.6^{b}	1.53	<0.01
Average daily feed intake, g/day	115	114	115	0.68	0.90
Feed efficiency, %	55.0^{a}	45.2^{b}	44.9^{b}	1.39	<0.01

^{a,b}Means in the same row with superscript letters differ substantially ($P<0.05$).
CNTRL: chickens raised at a density of 9 chicks/m^2 and fed basal feed, HSDB: chickens raised at a density of 16 chicks/m^2 and fed basal feed, HSDT: chickens raised at a density of 16 chicks/m^2 and fed feed containing 1% turmeric powder, BW: body weight, SEM: standard error of the means

Table 3. Serum cholesterol profile of broilers

Items	CONT	HSDB	HSDT	SEM	P value
Total cholesterol (mg/dL)	89.1^{c}	127^{a}	107^{b}	3.92	<0.01
Total triglyceride (mg/dL)	54.3^{b}	92.5^{a}	62.8^{b}	5.19	<0.01
HDL (mg/dL)	66.0^{b}	82.4^{a}	67.2^{b}	2.85	0.03
LDL (mg/dL)	85.1^{c}	121.6^{a}	103.6^{b}	3.71	<0.01

^{a,b,c} Means in the same row with superscript letters differ substantially ($P<0.05$). HDL: high-density lipoprotein, LDL: low-density lipoprotein, SEM: standard error of the means

An earlier study found that blood cholesterol profiles of broilers were affected by overcrowding stress (Qaid et al., 2016). In line with this, our current research found that stocking broiler chicks in high-density pens resulted in higher total cholesterol, total triglyceride, HDL, and LDL levels (Table 3).

According to EL-Gogary et al. (2020) the altered serum cholesterol profile and triglyceride level of high-stocked broilers appeared to be caused by an increase in corticosterone levels. Greater corticosterone, as a pro-lipogenic hormone, may be linked to increased *de novo* lipogenesis, which leads to higher cholesterol and lipid levels of broilers. When compared to broilers maintained in high stocking density pens receiving no supplement, dietary supplementation with turmeric powder was able to reduce total cholesterol, total triglyceride, HDL, and LDL levels. The antioxidative effects of turmeric powder were most likely able to counterbalance the elevated corticosterone levels caused by overcrowding stress (Sugiharto, 2020). As a result, broiler fatness could be reduced.

Conclusions

Stocking broilers at a high density pens resulted in compromised growth performance and increased serum total cholesterol, total triglyceride, HDL, and LDL levels of broilers. Dietary supplementation of turmeric powder (1% of diet) improved serum cholesterol and lipid profile, but failed to ameliorate the unfavourable effect of stocking density-induced stress on growth performance of broilers.

Statement of Conflict of Interest

Authors had no conflict of interest

Author's Contributions

SS designed the experiment and drafted the manuscript, ARP conducted the experiment and did the lab analysis, TY, EW, HIW, TAS revised the manuscript.

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