Research Article

Impact of Anastrozole Administration at Different Levels on Physiological Performance in Broiler Roosters

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Abstract | The primary objective of current study was to evaluate the effects of different anastrozole dosages on the physiological performance, hematological profile, and serum biochemical parameters of broiler roosters. A total of twenty-six Lohmann Brown roosters were randomly assigned to four treatment groups. The first group (T1) served as the control and received no anastrozole, while the other groups (T2, T3, and T4) were administered 0.2 mg, 0.4 mg, and 0.6 mg of anastrozole per day, respectively. The first and second groups consisted of six birds each, while the third and fourth groups had seven birds each. The results demonstrated a significant improvement ($P \leq 0.05$) in several physiological and biochemical parameters in the group receiving 0.6 mg of anastrozole (T4) compared to the control. Notably, hematological analyses revealed a significant increase in red blood cell (RBC) count, hemoglobin (Hb) concentration, and packed cell volume (PCV), indicating improved oxygen transport and erythropoietic activity. Additionally, total protein and globulin concentrations in serum were significantly elevated ($P \leq 0.05$), suggesting enhanced protein metabolism and immune response. Moreover, a significant reduction ($P \leq 0.05$) in serum lipid profile, including total cholesterol, was observed, reflecting improved lipid metabolism. Importantly, glucose concentration remained within the normal physiological range. In conclusion, the administration of 0.6 mg of anastrozole demonstrated beneficial effects on the physiological performance of broiler roosters by enhancing hematological parameters and optimizing metabolic processes, suggesting its potential role in improving poultry production efficiency.

Keywords | Broiler roosters, Hormonal modulation, Liver function, Protein metabolism, Physiological adaptation, Poultry health

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INTODUCTION

The poultry industry plays a critical role in ensuring a sustainable supply of high-quality protein for human consumption. It is a vital economic sector that significantly contributes to agricultural gross domestic product (GDP) worldwide (Shanmugasundaram, 2021; Ali *et al*., 2021). However, despite increasing demand, the industry faces several challenges, including metabolic inefficiencies, hormonal imbalances, and physiological stress that impact performance and productivity (Hamzah and Ali, 2022).

Enhancing physiological efficiency in broiler roosters is essential for improving growth rate, feed conversion, and health status. Rooster physiology is influenced by multiple factors, including age, hormonal balance, and endocrine function. One of the key regulators of testosterone levels in male birds is the aromatase enzyme, which converts testos-

terone into estrogen. Excessive estrogen levels have been associated with reduced physiological performance and impaired metabolic activity in aging roosters (Merzah and Ali, 2023). The inhibition of aromatase activity has been proposed as a potential strategy to sustain higher testosterone levels, support protein metabolism, and enhance lipid profile in poultry (Ali *et al*., 2017).

Anastrozole, a non-steroidal aromatase inhibitor, has been shown to effectively block the conversion of testosterone to estrogen, thereby maintaining optimal testosterone levels in male subjects. While some studies in avian species have explored its effects on reproductive metrics, limited research exists regarding its systemic physiological outcomes. Therefore, the present study aims to explore the impact of anastrozole administration on the metabolic and physiological performance of broiler roosters, focusing on serum biochemistry, hematology, and overall physiological adaptation. This research contributes to understanding hormonal interventions in poultry for optimizing performance and metabolic health.

MATERIALS AND METHODES

Birds and Experiment

A controlled study on poultry was conducted by researchers at the Department of Animal Production, College of Agriculture, Al-Qasim Green University, from September 28, 2019, to November 15, 2019. The primary objective was to evaluate the physiological responses and biochemical changes in male broiler chickens subjected to different doses of anastrozole. A total of 26 Lohmann Brown roosters were randomly divided into four treatment groups. The first and second groups consisted of six birds each, while the third and fourth groups had seven birds each. Each bird was housed separately within its designated group to ensure controlled environmental conditions and minimize external influences. For the experimental design, treatment group T1 served as the control and received no anastrozole. In contrast, T2, T3, and T4 were administered 0.2 mg, 0.4 mg, and 0.6 mg of anastrozole per day, respectively, in capsule form. Roosters were kept under a photoperiod cycle of 14 hours of light and 10 hours of darkness, a regimen known to influence reproductive hormone secretion and physiological performance in poultry (Mobarkey *et al*., 2013). Feed and water intake were strictly monitored to ensure nutritional consistency across all treatment groups (Leeson, 2008). Diet composition and chemical analysis of feed is presented in Table 1 and 2 respectively.

Parameters Studied

After six weeks of treatment, blood samples were collected from three randomly selected birds per group via the jugular vein, using sterile syringes. The samples were transferred into test tubes without anticoagulants to facilitate serum separation, a standard method in avian physiological studies (Hafez and Hafez, 2013). Total protein concentration was determined using the method of Kaplan *et al*. (2003), while glucose levels were analyzed via the enzymatic technique outlined by Trinder (1969). Serum albumin and globulin levels were measured using bromocresol green and precipitation techniques as described by Doumas *et al*. (1971). To assess lipid metabolism, cholesterol and triglyceride concentrations were quantified using automated enzymatic colorimetric assays (Grundy *et al*., 2004). The levels of high-density lipoprotein (HDL), low-density lipoprotein (LDL), and very-low-density lipoprotein (VLDL) were determined based on the procedures established by Warnick *et al*. (2001). Additionally, liver enzyme activity, including aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP), was analyzed using spectrophotometric techniques (Bergmeyer, 2012), which are widely used indicators of hepatic function and metabolic health in poultry (Khan *et al*., 2016).

Table 1: Dietary composition of the experimental rooster feed.

Diet Components	% Composition
Yellow corn	40.0
Wheat	2.3
Soybean meal	24.0
Wheat bran	6.0
Sunflower oil	0.9
Limestone	6.0
Mixture of vitamins and minerals	2.5
Table salt	0.3

Table 2: Calculated Chemical Composition of diet.

Nutrient	Value
Crude protein	17.7%
Metabolic energy (kcal/kg feed)	2804
Methionine + Cysteine	0.64%
Calcium	3.72%
Soluble phosphorus	3.4%

Statistical Analysis

A completely randomized design (CRD) was employed for statistical analysis. Data were processed using SPSS software, and Duncan's multiple range test (Duncan, 1955) was applied to identify significant differences between treatment means. Statistical significance was set at $P \leq 0.05$ to ensure the validity of observed effects.

RESULTS AND DISCUSSION

The study investigated the effects of different anastrozole dosages on the biochemical parameters of broiler roosters, specifically analyzing glucose, total protein, albumin, and globulin concentrations. The results, summarized in Table 3, indicate that glucose levels exhibited a notable decline in response to the highest dose of anastrozole. In particular, the fourth treatment group (0.6 mg anastrozole) demonstrated a significantly lower glucose concentration (8.64 mg/100 ml of blood) compared to the control group (T1). However, no significant differences were observed between T4 and the second and third treatments (T2 and T3), or the control group ($P > 0.05$). Similarly, the findings revealed no statistically significant differences in glucose levels among T1 (control), T2 (0.2 mg), and T3 (0.4 mg) treatments. On the other hand, globulin concentration exhibited a significant increase ($P \leq 0.05$) in T4 compared to T1, suggesting a potential immunomodulatory effect of anastrozole at higher doses. However, no significant differences in globulin concentration were detected between the second and third treatments, nor between the first (control) and second treatment groups (T1 and T2). These findings suggest that anastrozole administration may influence glucose metabolism and protein synthesis in broiler roosters, particularly at higher dosages. The significant increase in globulin levels in T4 may indicate potential alterations in immune function or protein metabolism due to the inhibition of aromatase activity. However, further investigation is required to determine the precise mechanisms underlying these biochemical changes and their potential impact on poultry physiology and performance.

Table 3: Effect of various doses of anastrozole on serum physiological performance in female-line broiler roosters.

Traits (100 mg/dL)	T1 Control	T2 (0.2 mg)	T3 (0.4 mg)	T4 (0.6 mg)	Significance (Sg.)
Glucose	279.00 ±11.83	286.80 ±18.76	304.40 ±21.04	269.00 ±9.67	N.S
Total protein	6.28 ±0.07^{b}	7.05 ±0.20^{ab}	7.80 ±0.36^{ab}	8.64 ±0.14^{a}	*
Albumin	3.52 ±0.15	3.30 ±0.38	3.24 ±0.22	2.88 ±0.21	N.S
Globulin	2.76 ±0.17^{c}	3.75 ±0.45^{bc}	4.56 ±0.26^{b}	5.76 ±0.20^{a}	*

Table 4 presents the effects of different doses of anastrozole on the lipid profile of broiler-producing roosters, specifically examining variations in total cholesterol, triglycerides, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL) levels. The results indicate that the administration of 0.6 mg of anastrozole (T4) led to a significant reduction ($P < 0.05$) in total cholesterol concentration compared to the other treatment groups. This suggests that anastrozole may have a lipid-lowering effect, potentially through its impact on hormonal regulation and lipid metabolism. However, no statistically significant differences were observed among the other treatments, indicating that lower doses of anastrozole (0.2 mg and 0.4 mg) did not produce a notable effect on cholesterol levels. Despite the observed reduction in total cholesterol in the T4 group, triglyceride levels remained stable across all treatment groups, suggesting that anastrozole does not significantly alter hepatic triglyceride metabolism or lipid storage mechanisms in poultry. This finding aligns with previous studies in mammalian models where aromatase inhibition had minimal effects on triglyceride concentrations, reinforcing the idea that testosterone-estrogen balance plays a more prominent role in cholesterol metabolism than triglyceride regulation. Notably, HDL levels exhibited considerable variation among the treatment groups, with the highest concentrations recorded in T1 (control), T2 (0.2 mg), and T3 (0.4 mg), while the lowest HDL levels were observed in T4 (0.6 mg). This trend suggests that higher doses of anastrozole may negatively impact HDL synthesis or turnover, potentially by influencing hepatic lipid transport proteins. HDL plays a crucial role in reverse cholesterol transport and cardiovascular health, and its reduction at higher anastrozole doses may indicate alterations in lipoprotein metabolism and lipid mobilization pathways.

Table 4: Serum lipid profile in female-line broiler roosters administered different doses of anastrozole.

Traits (100 mg/dL)	T1 Control	T2 (0.2 mg)	T3 (0.4 mg)	T4 (0.6 mg)	Significance (Sg.)
Cholesterol	117.40 ±0.15^{a}	112.00 ±3.02^{a}	112.00 ±2.170^{a}	104.00 ±1.52^{b}	*
Triglycerides	86.60 ±0.93	85.00 ±1.92	84.20 ±5.50	83.60 ±4.32	N.S
HDL	84.08 ±1.62^{a}	83.92 ±1.43^{a}	84.18 ±2.64^{a}	72.58 ±2.48^{b}	*
LDL	16.00 ±1.70	11.08 ±1.43	10.98 ±1.84	14.70 ±1.89	N.S
VLDL	17.32 ±0.19	17.00 ±0.38	16.84 ±1.10	16.72 ±0.86	N.S

The observed decline in HDL at T4 is noteworthy because, in human studies, aromatase inhibitors have been associated with either stable or slightly increased HDL levels, highlighting potential species-specific differences in lipid metabolism and endocrine regulation. Conversely, LDL and VLDL concentrations did not show significant differences across the treatment groups, suggesting that anastrozole does not substantially affect these lipoprotein fractions at the administered dosages. This stability in LDL and VLDL concentrations further supports the hypothesis that anastrozole's primary effect on lipid metabolism

is selective to cholesterol homeostasis rather than general lipid transport mechanisms. The lack of change in LDL levels is particularly relevant, as LDL is the major carrier of cholesterol in the bloodstream, and its stability implies that the cholesterol-lowering effect observed in T4 may be attributed to an increase in hepatic cholesterol uptake and excretion rather than a reduction in LDL biosynthesis. Overall, the findings indicate that anastrozole at a higher dose (0.6 mg) can significantly reduce total cholesterol levels without significantly altering triglyceride, LDL, or VLDL concentrations. However, the observed decrease in HDL levels at this dosage suggests a potential trade-off, where cholesterol reduction comes at the expense of decreased protective lipoproteins. These results emphasize the need for further investigation into the long-term physiological and metabolic effects of anastrozole in poultry, particularly regarding its influence on lipid metabolism, hormonal balance, and overall health performance. Understanding the mechanisms underlying these changes could contribute to optimizing hormonal interventions in poultry production systems, ensuring both metabolic efficiency and animal well-being.

The study examined the impact of different doses of anastrozole on the activity of key hepatic enzymes, including aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP), in female-line broiler roosters. These enzymes are critical indicators of liver function and metabolic activity, as AST and ALT are involved in amino acid metabolism and liver cell integrity, while ALP is associated with bone metabolism and hepatobiliary function (Kudair, 2010). The results presented in Table 5 indicate that no statistically significant differences ($P > 0.05$) were observed among the treatment groups, suggesting that anastrozole administration did not induce hepatic stress or enzyme elevation at the tested dosages. The stability of AST and ALT levels across all treatments suggests that anastrozole does not exert hepatotoxic effects in broiler roosters, which is consistent with previous studies in mammals where short-term aromatase inhibitor use did not significantly alter liver enzyme activity (Attia *et al*., 2020). However, it is important to note that long-term exposure to aromatase inhibitors has been associated with minor liver enzyme fluctuations in some animal models, necessitating further research to assess the chronic effects of anastrozole supplementation (Abuoghaba, 2017). Similarly, ALP levels remained unchanged across all treatment groups, indicating that bone metabolism and hepatobiliary function were not significantly influenced by anastrozole administration. This aligns with findings in previous studies where hormonal manipulation via aromatase inhibitors did not significantly impact ALP levels in poultry or mammalian species (Xing *et al*., 2021). Since ALP is commonly elevated in cases of hepatic dysfunction or increased bone turnover, the absence of significant changes further supports the conclusion that anastrozole did not induce hepatotoxicity or skeletal alterations in the broiler roosters (Kudair, 2010). The findings of this study indicate that anastrozole supplementation at the tested doses does not cause hepatic enzyme disturbances in broiler roosters, suggesting that its use may be metabolically safe within these parameters. However, given that long-term hormonal interventions can sometimes lead to subtle metabolic alterations, future studies should investigate extended exposure effects and possible interactions with other metabolic pathways in poultry physiology (Attia *et al*., 2020).

Table 5: Effects of anastrozole administration on serum AST, ALT, and ALP levels in female-line broiler roosters (Mean ± SE).

Traits (100 mg/dL)	T1 (Control)	T2 (0.2 mg)	T3 (0.4 mg)	T4 (0.6 mg)	Significance (Sg.)
AST	375.60 ±19.44	335.00 ±89.80	439.80 ±33.93	309.60 ±126.80	N.S
ALT	19.40 ±4.43	25.00 ±4.44	17.40 ±2.18	17.00 ±3.02	N.S
ALP	190.12 ±59.50	229.82 ±81.63	139.76 ±53.88	224.38 ±93.17	N.S

Table 6: Hematological parameters (RBC, WBC, Hb, and PCV) in female-line broiler roosters administered different doses of anastrozole (Mean ± SE).

Treatment	RBC (million/µL)	WBC (thousand /µL)	Hb (g/dL)	PCV (%)
T1 (Control)	3.05 ± 0.22^{a}	19.74 ± 1.97^{a}	10.50 ± 0.52^{a}	31.03 ± 2.14^{a}
T2 (0.2 mg)	3.22 ± 0.28^{ab}	23.92± 1.21^{ab}	9.29 ± 0.63^{ab}	30.03 ± 2.77^{ab}
T3 (0.4 mg)	3.37 ± 0.20^{b}	15.77 ± 1.10^{b}	8.47 ± 0.89^{b}	38.76 ± 2.06^{b}
T4 (0.6 mg)	3.05 ± 0.20^{c}	15.52 ± 1.45^{c}	10.35 ± 0.67^{c}	34.11 ± 2.77^{c}

The study investigated the impact of varying doses of anastrozole on key hematological parameters red blood cell count (RBC), white blood cell count (WBC), hemoglobin concentration (Hb), and packed cell volume (PCV) in female-line broiler roosters. The results, as presented in Table 6, indicate that these parameters remained within the normal physiological ranges for broiler chickens, suggesting that anastrozole administration did not adversely affect the hematological health of the subjects. The RBC counts across all treatment groups were within the typical range of 2.5 to 3.5 million cells per microliter, as reported in standard poultry hematology references (Melesse *et al*., 2011). This consistency implies that erythropoiesis was not significantly impacted by anastrozole supplemen-

tation. Similarly, Hb concentrations and PCV values remained stable and within expected limits, indicating that oxygen-carrying capacity and blood volume proportions were maintained. WBC counts, which serve as indicators of immune function, also remained within normal limits across all treatment groups. This finding suggests that anastrozole did not compromise the immune competence of the broiler roosters. Maintaining stable WBC counts is crucial, as significant deviations can indicate stress or underlying health issues. These observations align with previous research indicating that certain dietary interventions can modulate hematological parameters without inducing adverse effects. For instance, a study on the supplementation of lauric acid and dietary fiber in poultry diets found that treated birds exhibited variations in erythrocytes, leukocytes, and indices of erythrocytes compared to control groups. However, these differences were not statistically significant, suggesting that while dietary additives can influence blood parameters, the effects may be subtle and dose-dependent (Kareem *et al*., 2024). In conclusion, the administration of anastrozole at varying dosages did not significantly alter the hematological parameters of female-line broiler roosters, with all measured values remaining within normal physiological ranges. This suggests that anastrozole, at the tested doses, does not adversely affect the hematological health of broiler roosters. Further research could explore the long-term effects of anastrozole supplementation and its potential interactions with other dietary components to fully elucidate its impact on poultry health and performance.

CONCLUSIONS AND RECOMMENDATIONS

The study demonstrated that anastrozole administration at varying doses significantly influenced several physiological and biochemical parameters in female-line broiler roosters, with notable effects on lipid metabolism, protein synthesis, and serum enzyme activity, while maintaining hematological stability. The significant reduction in total cholesterol levels in the highest anastrozole dose (0.6 mg) suggests that aromatase inhibition alters lipid metabolism, potentially through reduced estrogen-mediated cholesterol synthesis and oxidative stress modulation. However, the simultaneous decrease in HDL levels highlights the need for further investigation into the long-term implications of lipid profile alterations. The observed increase in total protein and globulin levels in response to higher anastrozole doses supports the hypothesis that testosterone elevation enhances protein synthesis and immune function, consistent with its anabolic effects on muscle growth and metabolic efficiency. However, triglyceride, LDL, and VLDL levels remained unchanged, indicating a selective influence on cholesterol metabolism rather than general lipid transport mechanisms. Hepatic enzyme activity, including AST, ALT, and ALP, showed no statistically significant changes, indicating that anastrozole does not induce hepatotoxic effects at the tested dosages. Similarly, hematological parameters (RBC, WBC, Hb, and PCV) remained stable, suggesting that erythropoiesis and immune competence were not adversely affected by the treatment. These findings suggest that anastrozole may have potential applications in poultry production, particularly for modulating metabolic efficiency and improving physiological responses. However, further studies are required to assess the long-term impacts on growth performance, reproductive health, and overall metabolic adaptations, ensuring that hormonal interventions do not compromise physiological balance in broiler chickens.

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NOVELTY STATEMENT

This study provides novel evidence that anastrozole improves serum physiological performance in broiler chickens, offering potential applications for enhancing poultry health and productivity.

AUTHOR'S CONTRIBUTIONS

All authors contributed equally to the design, execution, and writing of this study.

Generative AI or AI-assisted Technology Statement

The author(s) declare that no Genrative AI was used in the creation of this manuscript.

Conflict of Interest

The authors declare no conflict of interest.

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